Appendix B

Curtain Wall Takeoff

South Elevation		
Type of Glass	**Location**	**Area of Glass (ft^2)**
Spandrel/Opaque	E-S Lines	2720
Spandrel/Opaque	B.5-C.5 Lines	154
Spandrel/Opaque	A-B Lines	182
Ceramic Frit	G-R Lines	854
Sub-Total Area of Spandrel/Opaque:		**3056**
Sub-Total Area of Ceramic Frit:		**854**

East Elevation		
Type of Glass	**Location**	**Area of Glass (ft^2)**
Spandrel/Opaque	8-9 Lines	200
Ceramic Frit	8-9 Lines	70
Sub-Total Area of Spandrel/Opaque:		**200**
Sub-Total Area of Ceramic Frit:		**70**

West Elevation		
Type of Glass	**Location**	**Area of Glass (ft^2)**
Spandrel/Opaque	8-8.5 Lines	640
Sub-Total Area of Spandrel/Opaque:		**640**

North Elevation		
Type of Glass	**Location**	**Area of Glass (ft^2)**
Spandrel/Opaque	BB-B Lines	352
Sub-Total Area of Spandrel/Opaque:		**352**

Total Area of Spandrel/Opaque:	**4248**
Total Area of Ceramic Frit:	**924**

Double Pane Glass Design Values

Double Pane Ceramic Frit Glazing (Insulating Radiant Low-E VRE1-46 Glass)

Month	Season	U-Value (BTU/ft^{2}xhxºF)	Area of Glass (ft^2)	Inside Temperature (ºF)	Outside Temperature (ºF)	Δ Temperature (ºF)
January	Winter	0.3	924	68	25	43
February	Winter	0.3	924	68	28	40
March	Winter	0.3	924	68	36	32
April	Winter	0.3	924	68	48	20
May	Winter	0.3	924	68	59	9
June	Winter	0.3	924	68	67	1
June	Summer	0.27	924	72	67	5
July	Summer	0.27	924	72	71	1
August	Summer	0.27	924	72	70	2
September	Summer	0.27	924	72	62	10
October	Summer	0.27	924	72	51	21
November	Summer	0.27	924	72	41	31
December	Summer	0.27	924	72	31	41
December	Winter	0.3	924	68	31	37

Double Pane Spandrel/Opaque (Insulating Radiant Low-E VRBI Glass)

Month	Season	U-Value (BTU/ft^{2}xhxºF)	Area of Glass (ft^2)	Inside Temperature (ºF)	Outside Temperature (ºF)	Δ Temperature (ºF)
January	Winter	0.25	4248	68	25	43
February	Winter	0.25	4248	68	28	40
March	Winter	0.25	4248	68	36	32
April	Winter	0.25	4248	68	48	20
May	Winter	0.25	4248	68	59	9
June	Winter	0.25	4248	68	67	1
June	Summer	0.22	4248	72	67	5
July	Summer	0.22	4248	72	71	1
August	Summer	0.22	4248	72	70	2
September	Summer	0.22	4248	72	62	10
October	Summer	0.22	4248	72	51	21
November	Summer	0.22	4248	72	41	31
December	Summer	0.22	4248	72	31	41
December	Winter	0.25	4248	68	31	37

Note: -Seasons are Based on the First Day of Summer, June 21, and First Day of Winter, December 21.
-Inside Temperatures are Assumed Design Temperatures That Will Provide Thermal Comfort.
-Outside Temperatures were Obtained from the National Weather Service's Averages for 1995-2005 for State College, PA.

Triple Pane Glass Design Values

Triple Pane Ceramic Frit Glazing (Insulating Radiant Low-E VRE1-46 Glass)						
Month	**Season**	**U-Value (BTU/ft²xhxºF)**	**Area of Glass (ft²)**	**Inside Temperature (ºF)**	**Outside Temperature (ºF)**	**Δ Temperature (ºF)**
January	Winter	0.22	924	68	25	43
February	Winter	0.22	924	68	28	40
March	Winter	0.22	924	68	36	32
April	Winter	0.22	924	68	48	20
May	Winter	0.22	924	68	59	9
June	Winter	0.22	924	68	67	1
June	Summer	0.21	924	72	67	5
July	Summer	0.21	924	72	71	1
August	Summer	0.21	924	72	70	2
September	Summer	0.21	924	72	62	10
October	Summer	0.21	924	72	51	21
November	Summer	0.21	924	72	41	31
December	Summer	0.21	924	72	31	41
December	Winter	0.22	924	68	31	37

Triple Pane Spandrel/Opaque (Insulating Radiant Low-E VRE1-46 Glass)						
Month	**Season**	**U-Value (BTU/ft²xhxºF)**	**Area of Glass (ft²)**	**Inside Temperature (ºF)**	**Outside Temperature (ºF)**	**Δ Temperature (ºF)**
January	Winter	0.17	4248	68	25	43
February	Winter	0.17	4248	68	28	40
March	Winter	0.17	4248	68	36	32
April	Winter	0.17	4248	68	48	20
May	Winter	0.17	4248	68	59	9
June	Winter	0.17	4248	68	67	1
June	Summer	0.14	4248	72	67	5
July	Summer	0.14	4248	72	71	1
August	Summer	0.14	4248	72	70	2
September	Summer	0.14	4248	72	62	10
October	Summer	0.14	4248	72	51	21
November	Summer	0.14	4248	72	41	31
December	Summer	0.14	4248	72	31	41
December	Winter	0.17	4248	68	31	37

Note: -Seasons are Based on the First Day of Summer, June 21, and First Day of Winter, December 21. -Inside Temperatures are Assumed to Provide Thermal Comfort. -Outside Temperatures were Obtained from the National Weather Service's Averages for 1995-2005

Double Pane Glass Energy Losses Per Month

Double Pane Ceramic Frit Glazing (Insulating Radiant Low-E VRE1-46 Glass)						
Month	**U-Value (BTU/ft²xhxºF)**	**Area of Glass (ft²)**	**Δ Temperature (ºF)**	**Energy Loss/Hour (BTU/hr)**	**Hours/ Month**	**Total Energy Loss/Month (BTU/Month)**
January	0.3	924	43	11,919.60	744	8,868,182.40
February	0.3	924	40	11,088.00	672	7,451,136.00
March	0.3	924	32	8,870.40	744	6,599,577.60
April	0.3	924	20	5,544.00	720	3,991,680.00
May	0.3	924	9	2,494.80	744	1,856,131.20
June	0.3	924	1	277.20	480	133,056.00
June	0.27	924	5	1,247.40	264	329,313.60
July	0.27	924	1	249.48	744	185,613.12
August	0.27	924	2	498.96	744	371,226.24
September	0.27	924	10	2,494.80	720	1,796,256.00
October	0.27	924	21	5,239.08	744	3,897,875.52
November	0.27	924	31	7,733.88	720	5,568,393.60
December	0.27	924	41	10,228.68	480	4,909,766.40
December	0.3	924	37	10,256.40	264	2,707,689.60

Double Pane Spandrel Glazing (Insulating Radiant Low-E VRBI Glass)						
Month	**U-Value (BTU/ft²xhxºF)**	**Area of Glass (ft²)**	**Δ Temperature (ºF)**	**Energy Loss/Hour (BTU/hr)**	**Hours/ Month**	**Total Energy Loss/Month (BTU/Month)**
January	0.25	4248	43	45,666.00	744	33,975,504.00
February	0.25	4248	40	42,480.00	672	28,546,560.00
March	0.25	4248	32	33,984.00	744	25,284,096.00
April	0.25	4248	20	21,240.00	720	15,292,800.00
May	0.25	4248	9	9,558.00	744	7,111,152.00
June	0.25	4248	1	1,062.00	480	509,760.00
June	0.22	4248	5	4,672.80	264	1,233,619.20
July	0.22	4248	1	934.56	744	695,312.64
August	0.22	4248	2	1,869.12	744	1,390,625.28
September	0.22	4248	10	9,345.60	720	6,728,832.00
October	0.22	4248	21	19,625.76	744	14,601,565.44
November	0.22	4248	31	28,971.36	720	20,859,379.20
December	0.22	4248	41	38,316.96	480	18,392,140.80
December	0.25	4248	37	39,294.00	264	10,373,616.00

Notes: - The Formula Used was: Total Energy Loss = Area x U-Value x ΔT.

Triple Pane Glass Energy Losses Per Month

Triple Pane Ceramic Frit Glazing (Insulating Radiant Low-E VRE1-46 Glass)						
Month	**U-Value (BTU/ft²xhxºF)**	**Area of Glass (ft²)**	**Δ Temperature (ºF)**	**Energy Loss/Hour (BTU/hr)**	**Hours/ Month**	**Total Energy Loss/Month (BTU/Month)**
January	0.22	924	43	8,741.04	744	6,503,333.76
February	0.22	924	40	8,131.20	672	5,464,166.40
March	0.22	924	32	6,504.96	744	4,839,690.24
April	0.22	924	20	4,065.60	720	2,927,232.00
May	0.22	924	9	1,829.52	744	1,361,162.88
June	0.22	924	1	203.28	480	97,574.40
June	0.21	924	5	970.20	264	256,132.80
July	0.21	924	1	194.04	744	144,365.76
August	0.21	924	2	388.08	744	288,731.52
September	0.21	924	10	1,940.40	720	1,397,088.00
October	0.21	924	21	4,074.84	744	3,031,680.96
November	0.21	924	31	6,015.24	720	4,330,972.80
December	0.21	924	41	7,955.64	480	3,818,707.20
December	0.22	924	37	7,521.36	264	1,985,639.04

Triple Pane Spandrel Glazing (Insulating Radiant Low-E VRBI Glass)						
Month	**U-Value (BTU/ft²xhxºF)**	**Area of Glass (ft²)**	**Δ Temperature (ºF)**	**Energy Loss/Hour (BTU/hr)**	**Hours/ Month**	**Total Energy Loss/Month (BTU/Month)**
January	0.17	4248	43	31,052.88	744	23,103,342.72
February	0.17	4248	40	28,886.40	672	19,411,660.80
March	0.17	4248	32	23,109.12	744	17,193,185.28
April	0.17	4248	20	14,443.20	720	10,399,104.00
May	0.17	4248	9	6,499.44	744	4,835,583.36
June	0.17	4248	1	722.16	480	346,636.80
June	0.14	4248	5	2,973.60	264	785,030.40
July	0.14	4248	1	594.72	744	442,471.68
August	0.14	4248	2	1,189.44	744	884,943.36
September	0.14	4248	10	5,947.20	720	4,281,984.00
October	0.14	4248	21	12,489.12	744	9,291,905.28
November	0.14	4248	31	18,436.32	720	13,274,150.40
December	0.14	4248	41	24,383.52	480	11,704,089.60
December	0.17	4248	37	26,719.92	264	7,054,058.88

Notes: - The Formula Used was: Total Energy Loss = Area x U-Value x ΔT.

Triple Pane Glass Energy Costs Per Month

Triple Pane Glazing-Heating Load					
Month	**Total Energy Loss/Month (BTU/Month)**	**Cost of Electricity Per BTU**	**Cost of Natural Gas Per BTU**	**Cost of Coal Per BTU**	**Total Cost Per Month**
January	25,165,675.01	0.000007	$0.00001	$0.000043	$940.94
February	21,144,453.12	0.000007	$0.00001	$0.000043	$790.59
March	18,727,944.19	0.000007	$0.00001	$0.000043	$700.24
April	11,327,385.60	0.000007	$0.00001	$0.000043	$423.53
May	5,267,234.30	0.000007	$0.00001	$0.000043	$196.94
June	377,579.52	0.000007	$0.00001	$0.000043	$14.12
June	0.00	0.000007	$0.00001	$0.000043	$0.00
July	0.00	0.000007	$0.00001	$0.000043	$0.00
August	0.00	0.000007	$0.00001	$0.000043	$0.00
September	0.00	0.000007	$0.00001	$0.000043	$0.00
October	0.00	0.000007	$0.00001	$0.000043	$0.00
November	0.00	0.000007	$0.00001	$0.000043	$0.00
December	0.00	0.000007	$0.00001	$0.000043	$0.00
December	7,683,743.23	0.000007	$0.00001	$0.000043	$287.30

Notes: - Heating Load is Fueled by 17% Natural Gas and 83% Coal. -
Energy Prices are the Prices Paid by The Pennsylvania State University.

Triple Pane Glazing-Cooling Load					
Month	**Total Energy Loss/Month (BTU/Month)**	**Cost of Electricity Per BTU**	**Cost of Natural Gas Per BTU**	**Cost of Coal Per BTU**	**Total Cost Per Month**
January	0.00	0.000007	$0.00001	$0.000043	$0.00
February	0.00	0.000007	$0.00001	$0.000043	$0.00
March	0.00	0.000007	$0.00001	$0.000043	$0.00
April	0.00	0.000007	$0.00001	$0.000043	$0.00
May	0.00	0.000007	$0.00001	$0.000043	$0.00
June	0.00	0.000007	$0.00001	$0.000043	$0.00
June	832,930.56	0.000007	$0.00001	$0.000043	$5.83
July	469,469.95	0.000007	$0.00001	$0.000043	$3.29
August	938,939.90	0.000007	$0.00001	$0.000043	$6.57
September	4,543,257.60	0.000007	$0.00001	$0.000043	$31.80
October	9,858,868.99	0.000007	$0.00001	$0.000043	$69.01
November	14,084,098.56	0.000007	$0.00001	$0.000043	$98.59
December	12,418,237.44	0.000007	$0.00001	$0.000043	$86.93
December	0.00	0.000007	$0.00001	$0.000043	$0.00

Notes: - Cooling Load is Fueled by Electricity. -Energy
Prices are the Prices Paid by The Pennsylvania State University.

Double Pane Glass Energy Costs Per Month

Double Pane Glazing-Heating Load					
Month	**Total Energy Loss/Month (BTU/Month)**	**Cost of Electricity Per BTU**	**Cost of Natural Gas Per BTU**	**Cost of Coal Per BTU**	**Total Cost Per Month**
January	36,417,133.44	0.000007	$0.00001	$0.000043	$1,361.64
February	30,598,041.60	0.000007	$0.00001	$0.000043	$1,144.06
March	27,101,122.56	0.000007	$0.00001	$0.000043	$1,013.31
April	16,391,808.00	0.000007	$0.00001	$0.000043	$612.89
May	7,622,190.72	0.000007	$0.00001	$0.000043	$284.99
June	546,393.60	0.000007	$0.00001	$0.000043	$20.43
June	0.00	0.000007	$0.00001	$0.000043	$0.00
July	0.00	0.000007	$0.00001	$0.000043	$0.00
August	0.00	0.000007	$0.00001	$0.000043	$0.00
September	0.00	0.000007	$0.00001	$0.000043	$0.00
October	0.00	0.000007	$0.00001	$0.000043	$0.00
November	0.00	0.000007	$0.00001	$0.000043	$0.00
December	0.00	0.000007	$0.00001	$0.000043	$0.00
December	11,119,109.76	0.000007	$0.00001	$0.000043	$415.74

Notes: - Heating Load is Fueled by 17% Natural Gas and 83% Coal. -Energy Prices are the Prices Paid by The Pennsylvania State University.

Double Pane Glazing-Cooling Load					
Month	**Total Energy Loss/Month (BTU/Month)**	**Cost of Electricity Per BTU**	**Cost of Natural Gas Per BTU**	**Cost of Coal Per BTU**	**Total Cost Per Month**
January	0.00	0.000007	$0.00001	$0.000043	0.00
February	0.00	0.000007	$0.00001	$0.000043	0.00
March	0.00	0.000007	$0.00001	$0.000043	0.00
April	0.00	0.000007	$0.00001	$0.000043	0.00
May	0.00	0.000007	$0.00001	$0.000043	0.00
June	0.00	0.000007	$0.00001	$0.000043	0.00
June	1,250,346.24	0.000007	$0.00001	$0.000043	8.75
July	704,740.61	0.000007	$0.00001	$0.000043	4.93
August	1,409,481.22	0.000007	$0.00001	$0.000043	9.87
September	6,820,070.40	0.000007	$0.00001	$0.000043	47.74
October	14,799,552.77	0.000007	$0.00001	$0.000043	103.60
November	21,142,218.24	0.000007	$0.00001	$0.000043	148.00
December	18,641,525.76	0.000007	$0.00001	$0.000043	130.49
December	0.00	0.000007	$0.00001	$0.000043	0.00

Notes: - Cooling Load is Fueled by Electricity.
-Energy Prices are the Prices Paid by The Pennsylvania State University.

Initial Costs for Material of Double and Triple Pane Glass

Description	Area	Cost/Area ($/ft$^{2)}$	Cost ($)
Double Pane Spandrel/Opaque Glass	4,248.00	10.25	$43,542.00
Double Pane Ceramic Frit Glass	924.00	10.25	$9,471.00
Total:	**5,172.00**	**----**	**$53,013.00**

Description	Area	Cost/Area ($/ft$^{2)}$	Cost ($)
Triple Pane Spandrel/Opaque Glass	4,248.00	17.25	$73,278.00
Triple Pane Ceramic Frit Glass	924.00	17.25	$15,939.00
Total:	**5,172.00**	**----**	**$89,217.00**

Loading Comparison Between Triple and Double Pane Glass

Description	Weight (lb/ft^2)	Area (ft^2)	Total Weight (lb)
Actual Design-Double Pane Glass w/ Aluminum Framing (7525 Wall)	13.00	5172	67,236.00
Proposed Design-Triple Pane Glass w/ Aluminum Framing (7550 Wall)	16.30	5172	84,303.60
Total Weight Difference:	3.30	-----	17,067.60

Structural Plan View at Curtain Wall Columns