

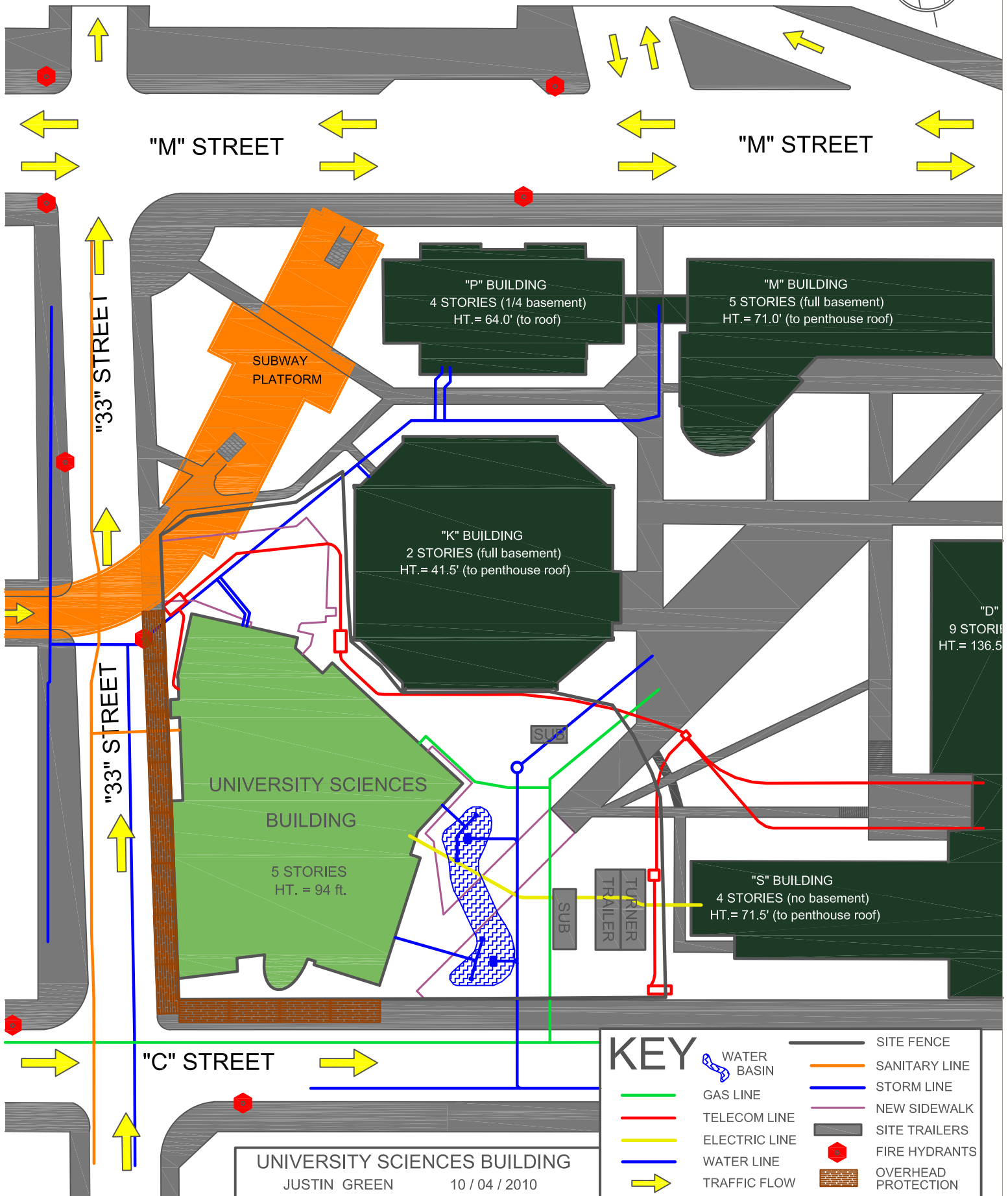
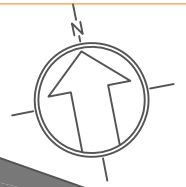


University Sciences Building

Northeastern U.S.

APPENDIX A - Existing Conditions and Utilities

EXISTING SITE LAYOUT



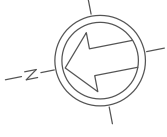
UNIVERSITY SCIENCES BUILDING
JUSTIN GREEN 10 / 04 / 2010



University Sciences Building

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APPENDIX B - Superstructure Logistics Plan



SUPERSTRUCTURE SITE LOGISTICS PLAN

KEY	
	PORTABLE TOILET
	EXT. MOCK-UP
	SITE TRAILERS
	FIRE HYDRANTS
	TRAFFIC FLOW
	SITE FENCE
	NEW SIDEWALK
	OVERHEAD PROTECTION
	SITE TRASH
	TOWER CRANE
	STORAGE CONTAINER





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APPENDIX C - Detailed Project Schedule



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APPENDIX D - General Conditions Estimate

GENERAL CONDITIONS

ESTIMATE

All figures were obtained from RS Means Building Construction
Data 2011

Project Duration = 22 Months

Bulk Construction = 20 Months

SUPERVISION AND PERSONNEL

Description	Quantity	Unit	Unit Rate	Cost
Vice President	95	WEEK	\$ 2,500	\$ 237,500
Project Executive	95	WEEK	\$ 2,200	\$ 209,000
Project Superintendent	95	WEEK	\$ 1,925	\$ 182,875
Assistant Superintendent	95	WEEK	\$ 1,800	\$ 171,000
Field Engineer	95	WEEK	\$ 1,265	\$ 120,175
Project Manager	95	WEEK	\$ 2,075	\$ 197,125
Project Engineer	95	WEEK	\$ 1,800	\$ 171,000
Office Engineer	95	WEEK	\$ 1,265	\$ 120,175
Project Administrator	22	MONTH	\$ 800	\$ 17,600
Safety Coordinator	95	WEEK	\$ 175	\$ 16,625
Project Scheduler	95	WEEK	\$ 225	\$ 21,375
Estimating Expenses	1	LS	\$ 45,000	\$ 45,000
TOTAL				\$ 1,509,450

CONSTRUCTION FACILITIES AND EQUIPMENT

Description	Quantity	Unit	Unit Rate	Cost
Field Office Trailer Set-up	1	LS	\$ 2,000	\$ 2,000
Field Office Trailer Rental	22	MONTH	\$ 425	\$ 9,350
Field Office Trailer Removal	1	LS	\$ 2,500	\$ 2,500
Construction Site Fence	20	MONTH	\$ 600	\$ 12,000
Sidewalk Overhead Protection	1	LS	\$ 1,250	\$ 1,250
Storage Trailer	15	MONTH	\$ 140	\$ 2,100
Gang Box	20	MONTH	\$ 55	\$ 1,100
Tools/Equipment	20	MONTH	\$ 650	\$ 13,000
Fire Extinguishers	20	MONTH	\$ 275	\$ 5,500
Copier/Fax/Printer	22	MONTH	\$ 400	\$ 8,800
Computer/LAN Equipment	22	MONTH	\$ 2,400	\$ 52,800
Mobile Phones	22	MONTH	\$ 325	\$ 7,150
Personal Protective Equipment	20	MONTH	\$ 250	\$ 5,000
Signage	1	LS	\$ 2,600	\$ 2,600
Dumpsters	20	MONTH	\$ 1,800	\$ 36,000
TOTAL				\$ 161,150

TEMPORARY UTILITIES

Description	Quantity	Unit	Unit Rate	Cost
Field IT/Network Set-up	1	LS	\$ 4,250	\$ 4,250
Temporary Power Installation	1	LS	\$ 15,000	\$ 15,000
Temporary Power Consumption	20	MONTH	\$ 750	\$ 15,000
Temporary Water/Sanitary Supply	1	LS	\$ 1,500	\$ 1,500
Temporary Toilets	22	MONTH	\$ 550	\$ 12,100
Potable Water	22	MONTH	\$ 175	\$ 3,850
TOTAL				\$ 51,700

MISCELLANEOUS COSTS

Description	Quantity	Unit	Unit Rate	Cost
Progress Photographs	20	MONTH	\$ 350	\$ 7,000
Document Reproduction	1	LS	\$ 25,000	\$ 25,000
Travel Expenses (Staff Vehicles)	20	MONTH	\$ 3,500	\$ 70,000
Delivery/Shipping Expenses	20	MONTH	\$ 300	\$ 6,000
Clean-up Expenses	20	MONTH	\$ 2,000	\$ 40,000
Misc. Field Expenses	20	MONTH	\$ 1,000	\$ 20,000
Office Supplies	20	MONTH	\$ 86	\$ 1,720
QC and Commissioning (0.5%)	1	LS	\$ 250,000	\$ 250,000
Permits (0.75%)	1	LS	\$ 375,000	\$ 375,000
Insurance (0.3%)	1	LS	\$ 150,000	\$ 150,000
Bonds (0.6%)	1	LS	\$ 300,000	\$ 300,000
TOTAL				\$ 1,244,720

GENERAL CONDITIONS SUMMARY

Description	Cost/Month	Cost
Supervision and Personnel	\$ 68,611	\$ 1,509,450
Construction Facilities and Equipment	\$ 7,325	\$ 161,150
Temporary Utilities	\$ 2,350	\$ 51,700
Miscellaneous Costs	\$ 56,578	\$ 1,244,720
TOTAL		\$ 2,967,020



University Sciences Building

Northeastern U.S.

APPENDIX E - Detailed Structural Systems Estimate

DETAILED STRUCTURAL SYSTEMS ESTIMATE SUMMARY

TYPE	DESCRIPTION	QUANTITY	UNIT	MATERIAL UNIT RATE	MATERIAL COST	LABOR UNIT RATE	LABOR COST	EQUIPMENT UNIT RATE	EQUIPMENT COST	TOTAL COST
Structural Steel										
Steel Column (28)	W8x40 - 22'6"	630.000	LF	59.50	\$ 37,485.00	4.82	\$ 3,036.60	2.95	\$ 1,858.50	\$ 42,380.10
Steel Column (17)	W8x48 - 22'6"	382.500	LF	59.50	\$ 22,758.75	4.82	\$ 1,843.65	2.95	\$ 1,128.38	\$ 25,730.78
Steel Column (7)	W8x48 - 29'9"	208.250	LF	59.50	\$ 12,390.88	4.82	\$ 1,003.77	2.95	\$ 614.34	\$ 14,008.98
Steel Column (1)	W8x67 - 29'9"	29.750	LF	59.50	\$ 1,770.13	4.82	\$ 143.40	2.95	\$ 87.76	\$ 2,001.28
Steel Column (1)	W12x65 - 22'6"	22.500	LF	59.50	\$ 1,338.75	4.82	\$ 108.45	2.95	\$ 66.38	\$ 1,513.58
Steel Beam (8)	Auditorium - W10x26 - 15'0"		LF							
Steel Beam (8)	Auditorium - W12x26 - 40'0"	120.000	LF	32.00	\$ 3,840.00	4.42	\$ 530.40	2.70	\$ 324.00	\$ 4,694.40
Steel Beam (2)	Auditorium - W24x103 - 44'0"	320.000	LF	32.00	\$ 10,240.00	3.01	\$ 963.20	1.84	\$ 588.80	\$ 11,792.00
Steel Beam (7)	5th FL - W18x35 - 21'0"	88.000	LF	129.00	\$ 11,352.00	3.65	\$ 321.20	1.65	\$ 145.20	\$ 11,818.40
Steel Beam (3)	5th FL - W18x40 - 21'0"	147.000	LF	43.50	\$ 6,394.50	3.99	\$ 586.53	1.80	\$ 264.60	\$ 7,245.63
Steel Beam (7)	5th FL - W21x44 - 36'6"	63.000	LF	49.50	\$ 3,118.50	3.99	\$ 251.37	1.80	\$ 113.40	\$ 3,483.27
Steel Beam (1)	5th FL - W21x48 - 21'0"	255.500	LF	54.50	\$ 13,924.75	3.60	\$ 919.80	1.63	\$ 416.47	\$ 15,261.02
Steel Beam (1)	5th FL - W21x50 - 36'6"	21.000	LF	62.00	\$ 1,302.00	3.60	\$ 75.60	1.63	\$ 34.23	\$ 1,411.83
Steel Beam (1)	5th FL - W21x62 - 36'6"	36.500	LF	62.00	\$ 2,263.00	3.60	\$ 131.40	1.63	\$ 59.50	\$ 2,453.90
Steel Beam (1)	5th FL - W21x68 - 36'6"	36.500	LF	76.50	\$ 2,792.25	3.70	\$ 135.05	1.67	\$ 60.96	\$ 2,988.26
Steel Beam	Atrium - W8x10 - 32'	322	LF	12.40	\$ 3,992.80	4.42	\$ 1,423.24	2.70	\$ 869.40	\$ 6,285.44
Steel Beam	Atrium - W8x15 - 9'	9	LF	18.55	\$ 166.95	4.42	\$ 39.78	2.70	\$ 24.30	\$ 231.03
Steel Beam	Atrium - W8x35 - 59'	59	LF	43.50	\$ 2,566.50	4.82	\$ 284.38	2.95	\$ 174.05	\$ 3,024.93
Steel Beam	Atrium - W10x12 - 21'	12	LF	14.85	\$ 178.20	4.42	\$ 53.04	2.70	\$ 32.40	\$ 263.64
Steel Beam	Atrium - W12x14 - 47'	47	LF	19.80	\$ 930.60	3.01	\$ 141.47	1.84	\$ 86.48	\$ 1,158.55
Steel Beam	Atrium - W12x152 - 11'	11	LF	108.00	\$ 1,188.00	4.14	\$ 45.54	2.53	\$ 27.83	\$ 1,261.37
Steel Beam	Atrium - W14x22 - 117'	117	LF	32.00	\$ 3,744.00	2.68	\$ 313.56	1.64	\$ 191.88	\$ 4,249.44
Steel Beam	Atrium - W18x35 - 47'	47	LF	43.50	\$ 2,044.50	3.99	\$ 187.53	1.80	\$ 84.60	\$ 2,316.63
Steel Beam	Atrium - W18x40 - 31'	31	LF	49.50	\$ 1,534.50	3.99	\$ 123.69	1.80	\$ 55.80	\$ 1,713.99
Steel Beam	Atrium - W18x65 - 40'	40	LF	80.50	\$ 3,220.00	4.26	\$ 170.40	1.92	\$ 76.80	\$ 3,467.20
Steel Beam	Atrium - W21x44 - 23'	23	LF	54.50	\$ 1,253.50	3.60	\$ 82.80	1.63	\$ 37.49	\$ 1,373.79
Steel Beam	Atrium - W21x48 - 17'	17	LF	62.00	\$ 1,054.00	3.60	\$ 61.20	1.63	\$ 27.71	\$ 1,142.91
Steel Beam	Atrium - W21x93 - 43'	43	LF	115.00	\$ 4,945.00	3.83	\$ 164.69	1.73	\$ 74.39	\$ 5,184.08
Steel Beam	Atrium - W21x101 - 110'	110	LF	125.00	\$ 13,750.00	3.83	\$ 421.30	1.73	\$ 190.30	\$ 14,361.60
Steel Beam	Atrium - W21x111 - 20'	20	LF	151.00	\$ 3,020.00	3.83	\$ 76.60	1.73	\$ 34.60	\$ 3,131.20
Steel Beam	Atrium - W21x166 - 150'	150	LF	151.00	\$ 22,650.00	3.83	\$ 574.50	1.73	\$ 259.50	\$ 23,484.00
Steel Beam	Pent - W8x10 - 253'	253	LF	12.40	\$ 3,137.20	4.42	\$ 1,118.26	2.70	\$ 683.10	\$ 4,938.56
Steel Beam	Pent - W8x15 - 84'	84	LF	18.55	\$ 1,558.20	4.42	\$ 371.28	2.70	\$ 226.80	\$ 2,156.28
Steel Beam	Pent - W8x24 - 165'	165	LF	29.50	\$ 4,867.50	4.82	\$ 795.30	2.95	\$ 486.75	\$ 6,149.55
Steel Beam	Pent - W10x12 - 12'	12	LF	14.85	\$ 178.20	4.42	\$ 53.04	2.70	\$ 32.40	\$ 263.64
Steel Beam	Pent - W10x15 - 96'	96	LF	18.55	\$ 1,780.80	4.42	\$ 424.32	2.70	\$ 259.20	\$ 2,464.32
Steel Beam	Pent - W12x14 - 68'	68	LF	19.80	\$ 1,346.40	3.01	\$ 204.68	1.84	\$ 125.12	\$ 1,676.20
Steel Beam	Pent - W12x16 - 24'	24	LF	19.80	\$ 475.20	3.01	\$ 72.24	1.84	\$ 44.16	\$ 591.60
Steel Beam	Pent - W14x22 - 252'	252	LF	32.00	\$ 8,064.00	2.68	\$ 675.36	1.64	\$ 413.28	\$ 9,152.64
Steel Beam	Pent - W14x30 - 38'	38	LF	37.00	\$ 1,406.00	2.95	\$ 112.10	1.80	\$ 68.40	\$ 1,586.50
Steel Beam	Pent - W14x38 - 14'	14	LF	42.00	\$ 588.00	3.27	\$ 45.78	2.00	\$ 28.00	\$ 661.78
Steel Beam	Pent - W16x26 - 115'	115	LF	32.00	\$ 3,680.00	2.65	\$ 304.75	1.62	\$ 186.30	\$ 4,171.05
Steel Beam	Pent - W16x31 - 293'	293	LF	38.50	\$ 11,280.50	2.95	\$ 864.35	1.80	\$ 527.40	\$ 12,672.25
Steel Beam	Pent - W18x35 - 226'	226	LF	43.50	\$ 9,831.00	3.99	\$ 901.74	1.80	\$ 406.80	\$ 11,139.54
Steel Beam	Pent - W18x40 - 195'	195	LF	49.50	\$ 9,652.50	3.99	\$ 778.05	1.80	\$ 351.00	\$ 10,781.55
Steel Beam	Pent - W18x46 - 148'	148	LF	57.00	\$ 8,436.00	3.99	\$ 590.52	1.80	\$ 266.40	\$ 9,292.92

	Pent - W18x50 - 21'	21	LF	\$ 62.00	\$ 1,302.00	4.20 \$	88.20	1.90 \$	39.90 \$	1,430.10
Steel Beam	Pent - W18x55 - 42'	42	LF	\$ 68.00	\$ 2,856.00	4.20 \$	176.40	1.90 \$	79.80 \$	3,112.20
Steel Beam	Pent - W21x44 - 17'	17	LF	\$ 54.50	\$ 926.50	3.60 \$	61.20	1.63 \$	27.71 \$	1,015.41
Steel Beam	Pent - W24x84 - 19'	19	LF	\$ 103.00	\$ 1,957.00	3.83 \$	72.77	1.73 \$	32.87 \$	2,062.64
Steel Beam	Pent Roof - W10x30 - 120'	120	LF	\$ 41.00	\$ 4,920.00	4.82 \$	578.40	2.95 \$	354.00 \$	5,852.40
Steel Beam	Pent Roof - W10x33 - 54'	54	LF	\$ 41.00	\$ 2,214.00	4.82 \$	260.28	2.95 \$	159.30 \$	2,633.58
* Doesn't include Steel at Skylights										
Totals:				\$ 280,732	\$ 22,898	\$ 12,870	\$ 316,500			

TYPE	DESCRIPTION	QUANTITY	UNIT	MATERIAL UNIT RATE	MATERIAL COST	LABOR UNIT RATE	LABOR COST	EQUIPMENT UNIT RATE	EQUIPMENT COST	TOTAL COST
Precast Fillgree Slabs										
Precast	2nd FL - 2.25" typ. Fillgree Slab	21230.75	SF	7.25	\$ 153,922.94	1.30	\$ 27,599.98	0.42	\$ 8,916.92	\$ 190,439.83
Precast	3rd FL - 2.25" typ. Fillgree Slab	21230.75	SF	7.25	\$ 153,922.94	1.30	\$ 27,599.98	0.42	\$ 8,916.92	\$ 190,439.83
Precast	4th FL - 2.25" typ. Fillgree Slab	21230.75	SF	7.25	\$ 153,922.94	1.30	\$ 27,599.98	0.42	\$ 8,916.92	\$ 190,439.83
Precast	5th FL - 2.25" typ. Fillgree Slab	17926.25	SF	7.25	\$ 129,965.31	1.30	\$ 23,304.13	0.42	\$ 7,529.03	\$ 160,798.46
Precast	Pent. - 2.25" typ. Fillgree Slab	11369.75	SF	7.25	\$ 82,430.69	1.30	\$ 14,780.68	0.42	\$ 4,775.30	\$ 101,986.66
Totals:				\$	674,165	\$	120,885	\$	39,055	\$ 834,105

TYPE	DESCRIPTION	QUANTITY	UNIT	MATERIAL UNIT RATE	MATERIAL COST	LABOR UNIT RATE	LABOR COST	EQUIPMENT UNIT RATE	EQUIPMENT COST	TOTAL COST
Cast-In-Place Concrete										
Caisson (20)	36" (3'-0") diameter caisson	70.7	CY	111.00	\$ 7,842.15	12.25	\$ 865.46	0.33	\$ 23.31	\$ 8,730.93
Caisson (21)	42" (3'-6") diameter caisson	101.0	CY	111.00	\$ 11,207.74	12.25	\$ 1,236.89	0.33	\$ 33.32	\$ 12,477.95
Caisson (22)	48" (4'-0") diameter caisson	138.2	CY	111.00	\$ 15,335.76	12.25	\$ 1,692.46	0.33	\$ 45.59	\$ 17,073.81
Caisson (15)	54" (4'-6") diameter caisson	119.2	CY	111.00	\$ 13,233.63	12.25	\$ 1,460.47	0.33	\$ 39.34	\$ 14,733.44
Caisson (5)	60" (5'-0") diameter caisson	49.1	CY	111.00	\$ 5,445.94	12.25	\$ 601.02	0.33	\$ 16.19	\$ 6,063.14
Pile Cap (13)	42"x 42"x 40" pile cap	19.7	CY	111.00	\$ 2,182.29	19.10	\$ 375.51	0.52	\$ 10.22	\$ 2,568.03
Pile Cap (17)	48"x 48"x 40" pile cap	33.6	CY	111.00	\$ 3,727.37	19.10	\$ 641.38	0.52	\$ 17.46	\$ 4,386.21
Pile Cap (19)	54"x 54"x 40" pile cap	47.5	CY	111.00	\$ 5,272.45	19.10	\$ 907.24	0.52	\$ 24.70	\$ 6,204.39
Pile Cap (3)	56"x 56"x 40" pile cap	8.1	CY	111.00	\$ 895.43	19.10	\$ 154.08	0.52	\$ 4.19	\$ 1,053.70
Pile Cap (15)	58"x 58"x 40" pile cap	43.3	CY	111.00	\$ 4,801.30	19.10	\$ 826.17	0.52	\$ 22.49	\$ 5,649.96
Pile Cap (5)	60"x 60"x 40" pile cap	15.4	CY	111.00	\$ 1,712.95	19.10	\$ 294.75	0.52	\$ 8.02	\$ 2,015.72
Pile Cap (2)	66"x 66"x 40" pile cap	7.5	CY	111.00	\$ 829.07	19.10	\$ 142.66	0.52	\$ 3.88	\$ 975.61
Pile Cap (9)	82"x 42" x 40" pile cap	26.6	CY	111.00	\$ 2,949.68	19.10	\$ 507.56	0.52	\$ 13.82	\$ 3,471.05
Grade Beam	Grade Beams (~ 1,450 LF)	214.8	CY	111.00	\$ 23,838.48	11.45	\$ 2,459.01	0.31	\$ 66.58	\$ 26,364.07
Foundation Wall (379 LF)	Concrete Wall - 11'8" x 1'0" section	163.8	CY	106.00	\$ 17,359.14	29.50	\$ 4,831.08	14.20	\$ 2,325.47	\$ 24,515.69
Column (5)	Base to Ground - 10"x 24"	3.6	CY	111.00	\$ 399.69	67.00	\$ 241.26	32.00	\$ 115.23	\$ 756.18
Column (2)	Base to Ground - 16"x 34"	3.3	CY	111.00	\$ 362.39	48.50	\$ 158.34	48.50	\$ 158.34	\$ 679.07
Column (6)	Base to Ground - 16"x 36"	10.4	CY	111.00	\$ 1,151.11	38.00	\$ 394.08	18.50	\$ 191.85	\$ 1,737.04
Column (2)	Base to Ground - 24"x 24"	2.1	CY	111.00	\$ 238.44	39.00	\$ 83.78	19.50	\$ 41.89	\$ 364.11
Column (1)	Base to Ground - 24" diameter	1.4	CY	111.00	\$ 150.60	38.00	\$ 51.56	18.25	\$ 24.76	\$ 226.92
Column (1)	Base to Ground - 28" diameter	1.8	CY	111.00	\$ 204.99	27.00	\$ 49.86	12.75	\$ 23.55	\$ 278.40
Column (4)	Base to 2nd - 28"x 40"	30.9	CY	111.00	\$ 3,432.01	27.00	\$ 834.81	12.75	\$ 394.22	\$ 4,661.04
Column (15)	1st to 2nd - 24" diameter	26.5	CY	111.00	\$ 2,936.77	38.00	\$ 1,005.38	18.25	\$ 482.85	\$ 4,425.00
Column (3)	1st to 2nd - 28" diameter	7.2	CY	111.00	\$ 799.46	27.00	\$ 194.46	12.75	\$ 91.83	\$ 1,085.75

Column (2)	1st to 5th - 16"x 36"		16.9	CY	111.00	\$	1,880.15	38.00	\$	643.65	18.50	\$	313.36	\$	2,837.16
Column (1)	1st to 5th - 24" diameter		6.6	CY	111.00	\$	737.96	38.00	\$	252.63	18.25	\$	121.33	\$	1,111.92
Column (8)	1st to Penthouse - 16"x 34"		80.3	CY	111.00	\$	8,914.72	48.50	\$	3,895.17	48.50	\$	3,895.17	\$	16,705.05
Column (10)	1st to Penthouse - 16"x 36"		106.3	CY	111.00	\$	11,798.89	38.00	\$	4,039.26	18.50	\$	1,966.48	\$	17,804.63
Column (5)	1st to Penthouse - 24" diameter		41.7	CY	111.00	\$	4,631.06	38.00	\$	1,585.41	18.25	\$	761.41	\$	6,977.89
Column (1)	2nd to 3rd - 30"x 36"		3.9	CY	111.00	\$	431.67	27.00	\$	105.00	12.75	\$	49.58	\$	586.25
Column (9)	2nd to 5th - 16"x 34"		52.9	CY	111.00	\$	5,870.67	48.50	\$	2,565.11	48.50	\$	2,565.11	\$	11,000.89
Column (10)	2nd to 5th - 16"x 36"		62.2	CY	111.00	\$	6,906.67	38.00	\$	2,364.44	18.50	\$	1,151.11	\$	10,422.22
Column (1)	2nd to Penthouse - 16"x 36"		8.4	CY	111.00	\$	930.48	39.00	\$	326.93	19.50	\$	163.46	\$	1,420.87
Column (1)	3rd to Penthouse - 16"x 34"		6.0	CY	111.00	\$	661.36	48.50	\$	288.97	48.50	\$	288.97	\$	1,239.30
Shear Wall (97 LF)	From 1st to 5th - 57' 2" High		5545.2	CY	106.00	\$	587,787.70	29.50	\$	163,582.43	14.20	\$	78,741.37	\$	830,111.50
Shear Wall (87 LF)	From 1st to Pent. Roof - 94' 3"		8199.8	CY	106.00	\$	869,173.50	29.50	\$	241,892.63	14.20	\$	116,436.45	\$	1,227,502.58
Shear Wall (66 LF)	From Base to Pent. - 83' 5"		5505.5	CY	106.00	\$	583,583.02	29.50	\$	162,412.26	14.20	\$	78,178.10	\$	824,173.38
Shear Wall (139 LF)	From Base to Pent. Roof - 105' 11"		14722.4	CY	106.00	\$	1,560,576.66	29.50	\$	434,311.43	14.20	\$	209,058.38	\$	2,203,946.47
Beam (770 LF)	2nd FL Slab (Cross Sect. = 2.25 SF)		64.2	CY	106.00	\$	6,801.67	41.00	\$	2,630.83	19.65	\$	1,260.88	\$	10,693.38
Beam (770 LF)	3rd FL Slab (Cross Sect. = 2.25 SF)		64.2	CY	106.00	\$	6,801.67	41.00	\$	2,630.83	19.65	\$	1,260.88	\$	10,693.38
Beam (770 LF)	4th FL Slab (Cross Sect. = 2.25 SF)		64.2	CY	106.00	\$	6,801.67	41.00	\$	2,630.83	19.65	\$	1,260.88	\$	10,693.38
Beam (785 LF)	5th FL Slab (Cross Sect. = 4.92 SF)		143.0	CY	106.00	\$	15,162.71	41.00	\$	5,864.82	19.65	\$	2,810.82	\$	23,838.36
Beam (585 LF)	Pent FL Slab (Cross Sect. = 5.58 SF)		120.9	CY	106.00	\$	12,815.40	41.00	\$	4,956.90	19.65	\$	2,375.69	\$	20,147.99
Slab (5634 SF)	Base Floor Slab		86.9	CY	106.00	\$	9,216.11	15.60	\$	1,356.33	0.42	\$	36.52	\$	10,608.96
Slab (20899 SF)	1st Floor Slab		322.5	CY	106.00	\$	34,186.64	15.60	\$	5,031.24	0.42	\$	135.46	\$	39,353.33
Slab (4413.25 SF)	1st Floor Atrium		81.7	CY	106.00	\$	8,663.05	24.50	\$	2,002.31	11.60	\$	948.03	\$	11,613.39
Slab (21231 SF)	2nd Floor Slab		276.4	CY	106.00	\$	29,301.33	24.50	\$	6,772.48	11.60	\$	3,206.56	\$	39,280.36
Slab (21231 SF)	3rd Floor Slab		276.4	CY	106.00	\$	29,301.33	24.50	\$	6,772.48	11.60	\$	3,206.56	\$	39,280.36
Slab (21231 SF)	4th Floor Slab		276.4	CY	106.00	\$	29,301.33	24.50	\$	6,772.48	11.60	\$	3,206.56	\$	39,280.36
Slab (17926 SF)	5th Floor Slab		233.4	CY	106.00	\$	24,740.03	24.50	\$	5,718.21	11.60	\$	2,707.40	\$	33,165.65
Slab (11369 SF)	Pent Floor Slab		148.0	CY	106.00	\$	15,690.58	24.50	\$	3,626.60	11.60	\$	1,717.08	\$	21,034.26
Totals:										\$	3,998,977	\$	1,095,041	\$	5,616,020
Reinforcing Steel															
Caisson (20)	36" (3'-0") diameter cassion		0.3742	Tons	810.00	\$	303.07	430.00	\$	160.89	0.00	\$	-	\$	463.95
Caisson (21)	42" (3'-6") diameter cassion		0.3824	Tons	810.00	\$	309.78	430.00	\$	164.45	0.00	\$	-	\$	474.24
Caisson (22)	48" (4'-0") diameter cassion		0.4989	Tons	810.00	\$	404.09	430.00	\$	214.52	0.00	\$	-	\$	618.61
Caisson (15)	54" (4'-6") diameter cassion		0.5072	Tons	810.00	\$	410.81	430.00	\$	218.08	0.00	\$	-	\$	628.89
Caisson (5)	60" (5'-0") diameter cassion		0.6236	Tons	810.00	\$	505.11	430.00	\$	268.15	0.00	\$	-	\$	773.26
Pile Cap (13)	42"x 42"x 40" pile cap rebar		0.7831	Tons	810.00	\$	634.35	430.00	\$	336.75	0.00	\$	-	\$	971.10
Pile Cap (17)	48"x 48"x 40" pile cap rebar		1.1704	Tons	810.00	\$	948.04	430.00	\$	503.28	0.00	\$	-	\$	1,451.32
Pile Cap (19)	54"x 54"x 40" pile cap rebar		1.4716	Tons	810.00	\$	1,192.02	430.00	\$	632.80	0.00	\$	-	\$	1,824.82
Pile Cap (3)	56"x 56"x 40" pile cap rebar		0.2410	Tons	810.00	\$	195.18	430.00	\$	103.62	0.00	\$	-	\$	298.80
Pile Cap (15)	58"x 58"x 40" pile cap rebar		1.2479	Tons	810.00	\$	1,010.77	430.00	\$	536.58	0.00	\$	-	\$	1,547.36
Pile Cap (5)	60"x 60"x 40" pile cap rebar		0.4303	Tons	810.00	\$	348.54	430.00	\$	185.03	0.00	\$	-	\$	533.57
Pile Cap (2)	66"x 66"x 40" pile cap rebar		0.1893	Tons	810.00	\$	153.36	430.00	\$	81.41	0.00	\$	-	\$	234.77
Pile Cap (9)	82"x 42"x 40" pile cap rebar		0.8004	Tons	810.00	\$	648.29	430.00	\$	344.15	0.00	\$	-	\$	992.44
Grade Beam	Grade Beams - Epoxy Coated		16.4252	Tons	900.00	\$	14,782.70	970.00	\$	15,932.47	0.00	\$	-	\$	30,715.17
Grade Beam	Additional cost for Epoxy Coating		16.4252	Tons	350.00	\$	5,748.83	0.00	\$	-	0.00	\$	-	\$	5,748.83

Foundation Wall (379 LF)	Vertical (Inside Face) Rebar	7.0431	Tons	855.00	\$	6,021.85	385.00	\$	2,711.59	0.00	\$	-	\$	8,733.44
Foundation Wall (379 LF)	Vertical (Outside Face) Rebar	1.5285	Tons	855.00	\$	1,306.87	515.00	\$	787.18	0.00	\$	-	\$	2,094.05
Foundation Wall (379 LF)	Horizontal Rebar	3.0570	Tons	855.00	\$	2,613.74	515.00	\$	1,574.36	0.00	\$	-	\$	4,188.09
Column	Column - 10"x 24"	0.4217	Tons	900.00	\$	379.50	700.00	\$	295.17	0.00	\$	-	\$	674.66
Column	Column - 16"x 34"	21.8577	Tons	900.00	\$	19,671.94	700.00	\$	15,300.39	0.00	\$	-	\$	34,972.33
Column	Column - 16"x 36"	26.0720	Tons	900.00	\$	23,464.78	700.00	\$	18,250.38	0.00	\$	-	\$	41,715.16
Column	Column - 24"x 24"	0.3872	Tons	900.00	\$	348.49	700.00	\$	271.05	0.00	\$	-	\$	619.53
Column	Column - 28"x 40"	3.2711	Tons	900.00	\$	2,943.97	700.00	\$	2,289.75	0.00	\$	-	\$	5,233.72
Column	Column - 30"x 36"	0.3131	Tons	900.00	\$	281.79	700.00	\$	219.17	0.00	\$	-	\$	500.95
Column	Column - 24" diameter	8.3706	Tons	900.00	\$	7,533.50	700.00	\$	5,859.39	0.00	\$	-	\$	13,392.89
Column	Column - 28" diameter	0.7509	Tons	900.00	\$	675.78	700.00	\$	525.61	0.00	\$	-	\$	1,201.39
Shear Wall (97 LF)	1st to 5th - 57' 2" High	7.7115	Tons	855.00	\$	6,593.31	515.00	\$	3,971.41	0.00	\$	-	\$	10,564.73
Shear Wall (87 LF)	1st to Pent. Roof - 94' 3"	11.4031	Tons	855.00	\$	9,749.67	515.00	\$	5,872.61	0.00	\$	-	\$	15,622.27
Shear Wall (66 LF)	Base to Pent. - 83' 5"	7.6563	Tons	855.00	\$	6,546.15	515.00	\$	3,943.00	0.00	\$	-	\$	10,489.15
Shear Wall (139 LF)	Base to Pent. Roof - 105' 11"	20.4740	Tons	855.00	\$	17,505.25	515.00	\$	10,544.10	0.00	\$	-	\$	28,049.35
Beam - Rebar	Concrete Beam - Horiz	1.9191	Tons	900.00	\$	1,727.19	970.00	\$	1,861.53	0.00	\$	-	\$	3,588.72
Beam - Rebar	Concrete Beam - Long (top)	43.792	Tons	900.00	\$	39,412.80	575.00	\$	25,180.40	0.00	\$	-	\$	64,593.20
Beam - Rebar	Concrete Beam - Long (bot)	13.8184	Tons	900.00	\$	12,436.56	970.00	\$	13,403.85	0.00	\$	-	\$	25,840.41
Slab - Rebar	Concrete Slabs - SOG's	16.1665	Tons	855.00	\$	13,822.36	675.00	\$	10,912.39	0.00	\$	-	\$	24,734.75
Slab - WWF (31,000 SF)	6x6 W4.0 x W4.0 WWF - SOG only	310	CSF	29.50	\$	9,145.00	28.50	\$	8,835.00	0.00	\$	-	\$	17,980.00
Slab - WWF (93,000 SF)	6x6 W2.0 x W2.0 WWF - Elev. Slabs	930	CSF	18.90	\$	17,577.00	25.00	\$	23,250.00	0.00	\$	-	\$	40,827.00
Totals:										\$	227,352	\$	175,540	\$ 402,893

TYPE	DESCRIPTION	QUANTITY	UNIT	MATERIAL UNIT RATE	MATERIAL COST	LABOR UNIT RATE	LABOR COST	EQUIPMENT UNIT RATE	EQUIPMENT COST	TOTAL COST
Concrete Formwork										
Pile Cap (13)	42"x 42"x 40" pile cap rebar	606.7	SF	0.76	\$ 461.07	3.42	\$ 2,074.80	0.00	\$ -	\$ 2,535.87
Pile Cap (17)	48"x 48"x 40" pile cap rebar	906.7	SF	0.76	\$ 689.07	3.42	\$ 3,100.80	0.00	\$ -	\$ 3,789.87
Pile Cap (19)	54"x 54"x 40" pile cap rebar	1140.0	SF	0.76	\$ 866.40	3.42	\$ 3,898.80	0.00	\$ -	\$ 4,765.20
Pile Cap (3)	56"x 56"x 40" pile cap rebar	186.7	SF	0.76	\$ 141.87	3.42	\$ 638.40	0.00	\$ -	\$ 780.27
Pile Cap (15)	58"x 58"x 40" pile cap rebar	966.7	SF	0.76	\$ 734.67	3.42	\$ 3,306.00	0.00	\$ -	\$ 4,040.67
Pile Cap (5)	60"x 60"x 40" pile cap rebar	333.3	SF	0.76	\$ 333.33	3.42	\$ 1,140.00	0.00	\$ -	\$ 1,393.33
Pile Cap (2)	66"x 66"x 40" pile cap rebar	146.7	SF	0.76	\$ 111.47	3.42	\$ 501.60	0.00	\$ -	\$ 613.07
Pile Cap (9)	82"x 42"x 40" pile cap rebar	620.0	SF	0.76	\$ 471.20	3.42	\$ 2,120.40	0.00	\$ -	\$ 2,591.60
Grade Beam (1,450 LF)	Grade Beam	8700.0	SF	1.30	\$ 11,310.00	3.47	\$ 30,189.00	0.00	\$ -	\$ 41,499.00
Foundation Wall (379 LF)	Concrete Wall - 11'8" x 1'0" section	8843.3	SF	0.63	\$ 5,571.30	5.10	\$ 45,101.01	0.00	\$ -	\$ 50,672.31
Column	Column - 10"x 24"	330.4	SF	0.71	\$ 234.56	5.80	\$ 1,916.13	0.00	\$ -	\$ 2,150.69
Column	Column - 16"x 34"	8482.5	SF	0.71	\$ 6,022.58	5.55	\$ 47,077.88	0.00	\$ -	\$ 53,100.45
Column	Column - 16"x 36"	11946.1	SF	0.71	\$ 8,481.75	5.55	\$ 66,301.04	0.00	\$ -	\$ 74,782.79
Column	Column - 24"x 24"	232.0	SF	0.79	\$ 183.28	5.50	\$ 1,276.00	0.00	\$ -	\$ 1,459.28
Column	Column - 28"x 40"	1216.1	SF	1.01	\$ 1,228.23	5.70	\$ 6,931.58	0.00	\$ -	\$ 8,159.81
Column	Column - 30"x 36"	154.0	SF	1.01	\$ 155.54	5.70	\$ 877.80	0.00	\$ -	\$ 1,033.34
Column	Column - 24" diameter	655.1	LF	8.40	\$ 5,502.84	10.05	\$ 6,583.76	0.00	\$ -	\$ 12,086.60

ASSUMPTIONS / FINDINGS

Estimated π to be 3.14.

CAISSONS

Caissons have a minimum length of 13'6", and that's what I used for length.

GRADE BEAMS

Determined average width and depths of grade beams to be 16" x 36" based on the range of values found in the beam schedule.

Determined average stirrup spacing w/in grade beams to be 15" and an average length of 8.667 LF based on the range of values found in the beam schedule.

Determined average horizontal spacing of rebar in grade beams to be 6" totaling 7 bars on each face of the grade beam based on the range of values found in the beam schedule.

Determined average size of horizontal rebar to be #6 size rebar (most were either #5 or #7) based on the range of values found in the beam schedule.

FOUNDATION WALLS

Typical vertical (Inside Face) reinforcing is #8@10".

Typical vertical (Outside Face) reinforcing is #5@18".

Typical horizontal reinforcing is #5@18".

CONCRETE COLUMNS

Typical horizontal reinforcement is #4 rebar @ 12" spacing (found in the caisson and column schedule).

Typical average vertical reinforcement is #8 rebar (very few cases have # 10 rebar, so assumed #8 for all cases).

SHEAR WALLS

All shear walls are 12" thick according to the framing plans given.

CONCRETE BEAMS

Typical concrete beams are 96" x 18" (includes slab thickness) on Floors 2-4.

Typical concrete beams are 96" x 26" (includes slab thickness) on the 5th Floor.

Typical concrete beams are 96" x 28" (includes slab thickness) on the Penthouse Floor.

Determined the cross-sectional area of the typical 96" x 18" voided concrete beam with precast to contain 2.25 SF of concrete (this excludes concrete considered in slab quantity).

Determined the cross-sectional area of the typical 96" x 26" voided concrete beam with precast to contain 4.92 SF of concrete (this excludes concrete considered in slab quantity).

Determined the cross-sectional area of the typical 96" x 28" voided concrete beam with precast to contain 5.58 SF of concrete (this excludes concrete considered in slab quantity).

PRECAST SLABS

SF of Filigree Slab is roughly the same as the total SF of slab area for each floor.

Precast slabs include rebar in their material cost.

SLABS

The majority of slabs (excluding SOG's) are 8" and 10" voided slabs with a 12" thickened edge at the perimeter of the building (36" from the edge of slab).

Assumed a 9" voided slab everywhere to simplify calculations and to account for the extra concrete at thickened slab locations.

SOG thickness for the Auditorium, Offices, and Classrooms is 5" thick.

SOG thickness for the Atrium is 6" thick.

Determined the ratio of CY of concrete to SF of slab surface area to be 0.01302 CY/SF for a typical 9" Voided Slab

Basement Area = 5,633.5 SF

1st Floor Area = 25,312.25 SF (Includes Atrium Area)

2nd Floor Area = 21,230.75 SF

3rd Floor Area = 21,230.75 SF

4th Floor Area = 21,230.75 SF

5th Floor Area = 17,926.25 SF

Penthouse Floor Area = 11,369.75 SF

Atrium Floor Area = 4,413.25 SF

CONCRETE FORMWORK

Assumed multiple uses of various types of formwork.

STEEL REINFORCING

6x6 - W2.0 x W2.0 WWF throughout all elevated slabs (totaling 93,000 SF).

6x6 - W4.0 x W4.0 WWF throughout all Slab On Grade concrete (totaling 31,000 SF).

SOG's have a typical reinforcing of #5 rebar spaced @12" o.c. (one way).

Concrete beams have typical longitudinal rebar with 7#9 bar on top and 5#6 bar on the bottom.

Concrete beams have typical horizontal rebar of #5@12" spanning an average of 16'0".

REINFORCING STEEL CALCULATIONS:

							Size	Wt. in Lbs./Ft.
							#4	0.67
							#5	1.04
							#6	1.50
							#8	2.67
							#9	3.40
							#10	4.30

36" Caisson	Vertical Reinforcement Stirrups	18 #8 x 13.5' = #5 @ 16" =	243.0 95.4	LF	0.3244 0.0498	Tons Tons	
42" Caisson	Vertical Reinforcement Stirrups	18 #8 x 13.5' = #5 @ 16" =	243.0 111.3	LF	0.3244 0.0580	Tons Tons	
48" Caisson	Vertical Reinforcement Stirrups	24 #8 x 13.5' = #5 @ 16" =	324.0 127.2	LF	0.4325 0.0663	Tons Tons	
54" Caisson	Vertical Reinforcement Stirrups	24 #8 x 13.5' = #5 @ 16" =	324.0 143.1	LF	0.4325 0.0746	Tons Tons	
60" Caisson	Vertical Reinforcement Stirrups	30 #8 x 13.5' = #5 @ 16" =	405.0 159.0	LF	0.5407 0.0829	Tons Tons	
42"x 42"x 40" pile cap (13)	NS-EW Reinforcement	2 x 4 #10 =	364.0	LF	0.7831	Tons	
48"x 48"x 40" pile cap (17)	NS-EW Reinforcement	2 x 4 #10 =	544.0	LF	1.1704	Tons	
54"x 54"x 40" pile cap (19)	NS-EW Reinforcement	2 x 4 #10 =	684.0	LF	1.4716	Tons	
56"x 56"x 40" pile cap (3)	NS-EW Reinforcement	2 x 4 #10 =	112.0	LF	0.2410	Tons	
58"x 58"x 40" pile cap (15)	NS-EW Reinforcement	2 x 4 #10 =	580.0	LF	1.2479	Tons	
60"x 60"x 40" pile cap (5)	NS-EW Reinforcement	2 x 4 #10 =	200.0	LF	0.4303	Tons	
66"x 66"x 40" pile cap (2)	NS-EW Reinforcement	2 x 4 #10 =	88.0	LF	0.1893	Tons	
82"x 42"x 40" pile cap (9)	NS-EW Reinforcement	2 x 4 #10 =	372.0	LF	0.8004	Tons	
Grade Beams (1,450 LF)	Stirrups	#4 @ 1.25' =	10053.4	LF	3.3578	Tons	
	Horizontal Reinforcement	#6 @ 0.5' =	17400.0	LF	13.0674	Tons	
						* Epoxy Coated * Epoxy Coated	
Foundation Wall (379 LF)	Vertical (Inside Face) Rebar	#8@10" =	5275.7	LF	7.0431	Tons	
Foundation Wall (379 LF)	Vertical (Outside Face) Rebar	#5@18" =	2930.9	LF	1.5285	Tons	
Foundation Wall (379 LF)	Horizontal Rebar	#5@18" =	5861.9	LF	3.0570	Tons	
Column - 10"x 24"	58.3 LF	Vertical Reinforcement Stirrups	4 - #8 #4 @ 12"	233.2 330.4	LF	0.3113 0.1103	Tons Tons
Column - 16"x 34"	1017.9 LF	Vertical Reinforcement Stirrups	14 - #8 #4 @ 12"	14250.6 8482.5	LF	19.0246 2.8332	Tons Tons
Column - 16"x 36"	1378.4 LF	Vertical Reinforcement Stirrups	12 - #8 #4 @ 12"	16540.8 11946.1	LF	22.0820 3.9900	Tons Tons
Column - 24"x 24"	29.0 LF	Vertical Reinforcement Stirrups	8 - #8 #4 @ 12"	232.0 232.0	LF	0.3097 0.0775	Tons Tons
Column - 28"x 40"	107.3 LF	Vertical Reinforcement Stirrups	20 - #8 #4 @ 12"	2146.0 1216.1	LF	2.8649 0.4062	Tons Tons
Column - 30"x 36"	14.0 LF	Vertical Reinforcement Stirrups	14 - #8 #4 @ 12"	196.0 154.0	LF	0.2617 0.0514	Tons Tons
Column - 24" diameter	655.1 LF	Vertical Reinforcement Stirrups	8 - #8 #4 @ 12"	5240.8 4114.0	LF	6.9965 1.3741	Tons Tons
Column - 28" diameter	57.2 LF	Vertical Reinforcement Stirrups	8 - #8 #4 @ 12"	457.6 419.1	LF	0.6109 0.1400	Tons Tons
Shear Wall (97 LF)	1st to 5th - 57' 2" High	Vertical / Horizontal Reinforcement	2 x #5 @ 18"	14787.1	LF	7.7115	Tons
Shear Wall (87 LF)	1st to Pent. Roof - 94' 3"	Vertical / Horizontal Reinforcement	2 x #5 @ 18"	21866.0	LF	11.4031	Tons
Shear Wall (66 LF)	Base to Pent. - 83' 5"	Vertical / Horizontal Reinforcement	2 x #5 @ 18"	14681.3	LF	7.6563	Tons
Shear Wall (139 LF)	Base to Pent. Roof - 105' 11"	Vertical / Horizontal Reinforcement	2 x #5 @ 18"	39259.8	LF	20.4740	Tons
Concrete Slabs - SOG's	31,000 SF	#5@12"	31000.0	LF	16.1665	Tons	
Concrete Beam - Horiz	3680 LF	#5@12"	3680.0	LF	1.9191	Tons	
Concrete Beam - Long	3680 LF	T - 7#9	25760.0	LF	43.7920	Tons	
Concrete Beam - Long	3680 LF	B - 5#6	18400.0	LF	13.8184	Tons	



University Sciences Building

Northeastern U.S.

APPENDIX F - BIM Execution Plan

BIM PROJECT EXECUTION PLAN

VERSION 2.0

FOR

UNIVERSITY SCIENCES BUILDING

DEVELOPED BY

JUSTIN GREEN

This template is a tool that is provided to assist in the development of a BIM project execution plan as required per contract. The template plan was created from the buildingSMART alliance™ (bSa) Project “BIM Project Execution Planning” as developed by The Computer Integrated Construction (CIC) Research Group of The Pennsylvania State University. The bSa project is sponsored by The Charles Pankow Foundation (<http://www.pankowfoundation.org>), Construction Industry Institute (CII) (<http://www.construction-institute.org>), Penn State Office of Physical Plant (OPP) (<http://www.opp.psu.edu>), and The Partnership for Achieving Construction Excellence (PACE) (<http://www.engr.psu.edu/pace>). The BIM Project Execution Planning Guide can be downloaded at <http://www.engr.psu.edu/BIM/PxP>.

This coversheet can be replaced by a company specific coversheet that includes at a minimum document title, project title, project location, author company, and project number.

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SECTION A: BIM PROJECT EXECUTION PLAN OVERVIEW

To successfully implement Building Information Modeling (BIM) on a project, the project team has developed this detailed BIM Project Execution Plan. The BIM Project Execution Plan defines uses for BIM on the project (e.g. design authoring, cost estimating, and design coordination), along with a detailed design of the process for executing BIM throughout the project lifecycle.

Thesis Description – Taken from the AE Senior Thesis website at <http://www.engr.psu.edu/ae/thesis/about.htm>

“The course sequence of AE 481W and AE 482 comprise what is more commonly known as AE Senior Thesis. This year long capstone design project is one of the major highlights of the five year professional degree BAE program. It is required of all undergraduate students in the Department of Architectural Engineering at Penn State.”

“Senior Thesis consists of obtaining an outside sponsor who provides the student with an actual building that will be used as the model for a variety of technical and management tasks throughout the year. Based on the building or project model, students will investigate the project, perform technical analysis, develop project criteria and eventually prepare a written proposal for more advanced design work. This is followed up by a semester of intense effort to complete the goals of the proposal. A formal written final report is required as is a verbal presentation to a faculty jury.”

“A number of students, selected by the AE faculty from the first presentations, will represent their class and compete for numerous awards by presenting a second time. This second presentation will be to an invited jury of about 50 visiting practitioners from all over the country.”

“It is important to note that students are required to include work in their primary discipline area of AE as well as to demonstrate breadth capabilities in several other architectural engineering areas.”

SECTION B: PROJECT INFORMATION

This section defines basic project reference information and determined project milestones.

1. **PROJECT OWNER:** PUBLISHING RESTRICTIONS
2. **PROJECT NAME:** UNIVERSITY SCIENCES BUILDING
3. **PROJECT LOCATION AND ADDRESS:** MAJOR CITY IN THE NORTHEASTERN U.S.
4. **CONTRACT TYPE / DELIVERY METHOD:** LUMP SUM / DESIGN-BID-BUILD WITH CM @ Risk
5. **BRIEF PROJECT DESCRIPTION:** MIXED USE FACILITY THAT WILL HOUSE BOTH STUDENTS AND FACULTY OF THE UNIVERSITY. WITHIN THE BUILDING ARE 39 RESEARCH AND TEACHING LABORATORIES FOR BIO-MEDICAL ENGINEERING, BIOLOGY, CHEMISTRY, AND FOSSIL PREPARATION. THE FACILITY WILL ALSO HOUSE 8 CLASSROOMS AND A SMALL AUDITORIUM SEATING 240 STUDENTS FOR EDUCATIONAL LECTURES AND PRESENTATIONS. EACH LEVEL OF THIS BUILDING CONTAINS A SECTION OF ADMINISTRATIVE AND FACULTY OFFICE SPACE. FIVE STORY BUILDING WITH A BASEMENT BELOW AND MECHANICAL PENTHOUSE ABOVE. TOTAL COST IS APPROXIMATELY \$70 MILLION.
6. **PROJECT SCHEDULE / PHASES / MILESTONES:**
Include BIM milestones, pre-design activities, major design reviews, stakeholder reviews, and any other major events which occur during the project lifecycle.

PROJECT PHASE / MILESTONE	ESTIMATED START DATE	ESTIMATED COMPLETION DATE	PROJECT STAKEHOLDERS INVOLVED
PRECONSTRUCTION	03/20/08	09/09/09	Architect, Owner, City Officials/Planners
CONSTRUCTION	08/25/09	07/01/11	Owner, Turner, all other subs and project vendors.

SECTION D: PROJECT GOALS / BIM USES

1. MAJOR BIM USES / GOALS / OBJECTIVES:

State Major BIM Goals and Objectives – Descriptions taken from http://www.engr.psu.edu/ae/cic/bimex/bim_uses.aspx

BIM Use	DESCRIPTION	PRIORITY (HIGH/ MED/ LOW)
Building Maintenance Scheduling	Building structure and equipment maintenance over the lifetime of a facility. This should improve building performance, reduce energy repairs, and limit overall maintenance costs.	MED
Building System Analysis	Measuring how a building's performance compares to the specified design. This analysis includes ventilated façade studies, lighting analysis, solar analysis, internal & external CFD airflow, and energy used by MEP systems.	VERY HIGH
Asset Management	An organized management system that will efficiently aid in the operation and maintenance of a building's assets. These assets must be maintained, upgraded, and operated at a level which will satisfy both the owner and the users at the lowest cost. This process assists in financial decision-making for both short-term and long-term planning. Asset management uses the data in a building model to determine the cost implications of changing or upgrading building assets.	LOW
Space Management and Tracking	Effectively allocating, managing, and tracking assigned workspaces and resources. A BIM model will help allow the facility manager to analyze the existing use of the building spaces and manage any changes, use of space, and future changes throughout the building's lifetime.	LOW
Disaster Planning	When emergency responders have access to critical building information in the form of a model. This is intended to improve the efficiency of the response and to minimize safety risks. The model would be able to clearly display where the emergency was located within the building and the possible routes to the area.	LOW
Record Modeling	A 3D model that contains an accurate depiction of the physical conditions and environment of a facility. This model can contain information on architectural features, MEP elements, building equipment, serial codes, warranties, maintenance history, and other building assets.	MED
Site Utilization Planning	Using a 4D model to graphically represent both permanent and temporary facilities on site. This requires linking the construction activity schedule into the 3D model. Labor resources, materials, and equipment location can also be tied into this model.	HIGH
Construction System Design	The design and analysis of a complex building system (ex. form work, glazing, tie-backs, etc.) by utilizing a 3D system design software.	VERY LOW
Digital Fabrication	Using machine technology to prefabricate objects directly from a 3D model. The model is broken down into its various sections and then fed into an assembly system for production.	VERY HIGH
3D Control and Planning	Utilizing a model to layout the building assemblies through lift drawings. Lift drawings are 2D/3D component drawings used by foremen during construction.	HIGH
3D Coordination	The use of a 3D model and Clash Detection software to determine and eliminate field conflicts before material installation begins.	VERY HIGH
Field / Materials Tracking	Using a BIM model to track and monitor the installation of multiple building components.	LOW
Design Authoring	A process using 3D software to develop a BIM model based on criteria that are important to the translation of a building's design. Design authoring tools are the first step towards BIM and connecting a 3D model with a database of properties, quantities, means & methods, costs, and schedules.	MED

Engineering Analysis	The use of modeling software to determine the most effective engineering methods based on the given design specifications. These analysis tools and performance simulations can significantly improve the design and energy consumption of any building.	HIGH
Design Reviews	A process in which a 3D model can be used to either showcase a design to project stakeholders, or to analyze alternatives to design/constructability issues. These reviews are intended to provide positive feedback from the owners and end users.	MED
Programming	The use of a spatial program to efficiently and accurately assess design performance in regard to spatial requirements. A developed BIM model allows the project team to analyze building spaces and understand the complexity of space standards and regulations.	MED
Site Analysis	A process used to evaluate properties in a given area to determine the most optimal site location for a future project.	VERY LOW
Phase Planning (4D Modeling)	Utilizing a 4D model to effectively plan the phased occupancy in a renovation, retrofit, addition, or to show the construction sequence and space requirements on a building site. 4D modeling can be used as visualization and communication tool to better understand project milestones and construction plans.	LOW
Cost Estimation	A BIM model can help produce an accurate quantity take-off and cost estimate early in the design process and provide cost effects of additions and modification with potential to save time and money while avoiding budget overruns.	MED
Existing Conditions Modeling	A process where the project team constructs a 3D model of the existing conditions for a site, the facilities on a site, or a specific area within a facility.	LOW

2. BIM Uses:

Highlight and place an X next to the additional BIM Uses to be developed by the use of the BIM model as selected by the project team using the BIM Goal & Use Analysis Worksheet. See BIM Project Execution Planning Guide at www.engr.psu.edu/BIM/BIM_Uses for Use descriptions. Include additional BIM Uses as applicable in empty cells.

X	PLAN	X	DESIGN	X	CONSTRUCT	X	OPERATE
X	PROGRAMMING	X	DESIGN AUTHORIZING	X	SITE UTILIZATION PLANNING	X	BUILDING MAINTENANCE SCHEDULING
	SITE ANALYSIS	X	DESIGN REVIEWS		CONSTRUCTION SYSTEM DESIGN	X	BUILDING SYSTEM ANALYSIS
		X	3D COORDINATION	X	3D COORDINATION		ASSET MANAGEMENT
		X	STRUCTURAL ANALYSIS	X	DIGITAL FABRICATION		SPACE MANAGEMENT / TRACKING
		X	LIGHTING ANALYSIS	X	3D CONTROL AND PLANNING		DISASTER PLANNING
		X	ENERGY ANALYSIS	X	RECORD MODELING	X	RECORD MODELING
		X	MECHANICAL ANALYSIS				
		X	OTHER ENG. ANALYSIS				
			SUSTAINABILITY (LEED) EVALUATION				
			CODE VALIDATION				
	PHASE PLANNING (4D MODELING)		PHASE PLANNING (4D MODELING)		PHASE PLANNING (4D MODELING)		PHASE PLANNING (4D MODELING)
X	COST ESTIMATION	X	COST ESTIMATION	X	COST ESTIMATION		COST ESTIMATION
	EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING



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APPENDIX G - Kyocera Product Data Sheets

Kyocera KD Modules

Kyocera KD Modules utilize a larger, more powerful, high efficiency 156mm x 156mm solar cell and produce higher output per module.



LOCKING PLUG-IN CONNECTORS
HEAVY DUTY ANODIZED ALUMINUM FRAME
LARGER, MORE POWERFUL 156MM SOLAR CELLS

Kyocera Empowers Your Future

Kyocera began research and development of solar energy back in 1975. Since then, we have been leading the solar industry with the development of the most efficient and cost effective systems available. With over 35 years of experience in solar, Kyocera is a natural industry leader. Our modules are ideal for a wide range of applications from off-grid industrial to on-grid commercial and residential, providing superior field performance among the competition. Kyocera stands behind its products and has a proven reputation within the solar industry for quality and reliability.

KD MODULES / F SERIES SPECIFICATIONS



	KD240GX-LFB	KD235GX-LFB	KD230GX-LFB	KD215GX-LFBS	KD210GX-LFBS	KD205GX-LFBS	KD185GX-LFBS	KD135GX-LFBS
Maximum Power	240W	235W	230W	215W	210W	205W	185W	135W
Number of Cells	60	60	60	54	54	54	48	36
Tolerance	+5%/-3%	+5%/-3%	+5%/-3%	+5%/-3%	+5%/-3%	+5%/-3%	+5%/-5%	+5%/-5%
Maximum System Voltage	600V	600V	600V	600V	600V	600V	600V	600V
Maximum Power Voltage	29.8V	29.8V	29.8V	26.6V	26.6V	26.6V	23.6V	17.7V
Maximum Power Current	8.06A	7.89A	7.72A	8.09A	7.90A	7.71A	7.84A	7.63A
Open Circuit Voltage	36.9V	36.9V	36.9V	33.2V	33.2V	33.2V	29.5V	22.1V
Short Circuit Current	8.59A	8.55A	8.36A	8.78A	8.58A	8.36A	8.58A	8.37A
Series Fuse Rating	15A	15A	15A	15A	15A	15A	15A	15A
Length	65.4"	65.4"	65.4"	59.1"	59.1"	59.1"	52.7"	59.1"
Width	39.0"	39.0"	39.0"	39.0"	39.0"	39.0"	39.0"	26.3"
Depth	1.8"	1.8"	1.8"	1.8"	1.8"	1.8"	1.8"	1.8"
Weight	46.3 lbs	46.3 lbs	46.3 lbs	39.7 lbs	39.7 lbs	39.7 lbs	35.3 lbs	27.5 lbs
Termination Method	Locking Plug-in Connectors	Locking Plug-in Connectors	Locking Plug-in Connectors	Locking Plug-in Connectors	Locking Plug-in Connectors	Locking Plug-in Connectors	Locking Plug-in Connectors	Locking Plug-in Connectors

Warranty

- Kyocera standard 20 year power output warranty and 5 year workmanship warranty applies in USA.
- Extended warranties available per project requirements.
- Kyocera standard 20 year power output warranty and 2 year workmanship warranty applies outside of USA.
- Refer to Kyocera warranty policy for details.

NEC 2008 Compliant
UL 1703 Listed, Class C
IEC 61215

Kyocera reserves the right to modify these specifications without notice.

All specification at 25°C. cell temperature, 1.5 AM and 1000W/m².

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KYOCERA SOLAR, INC.

800-223-9580 toll-free

800-523-2329 fax

www.kyocerasolar.com

KD 200-60 Series



Cutting Edge Technology As a pioneer with 35 years in solar, Kyocera demonstrates leadership in the development of solar energy products. Kyocera's *Kaizen* Philosophy, commitment to continuous improvement, is shown by repeatedly achieving world record cell efficiencies.

Quality Built In

- UV stabilized, aesthetically pleasing black anodized frame
- Supported by major mounting structure manufacturers
- Easily accessible grounding points on all four corners for fast installation
- Proven junction box technology with PV wire to work with transformerless inverters
- Quality locking plug-in connectors to provide safe & quick connections



UL Listing
QIGU.E173074

NEC 2008 Compliant UL 1703, ISO 9001 and ISO 14001
Certified and Registered Class C

Also available:



QUALIFIED FOR "BUY AMERICAN"
Manufactured in San Diego, California

New Process Improvements

- All solar cells are fabricated with a new proprietary etching and coating process which translates into a 'smoother' appearance while maintaining the same gridline and bus-bar design.
- All modules have added crossbars on the back side of the module for greater support and stability in harsh conditions, including high wind and snow load regions.

Reliable

- Superior built-in quality
- Proven superior field performance
- Tight power tolerance

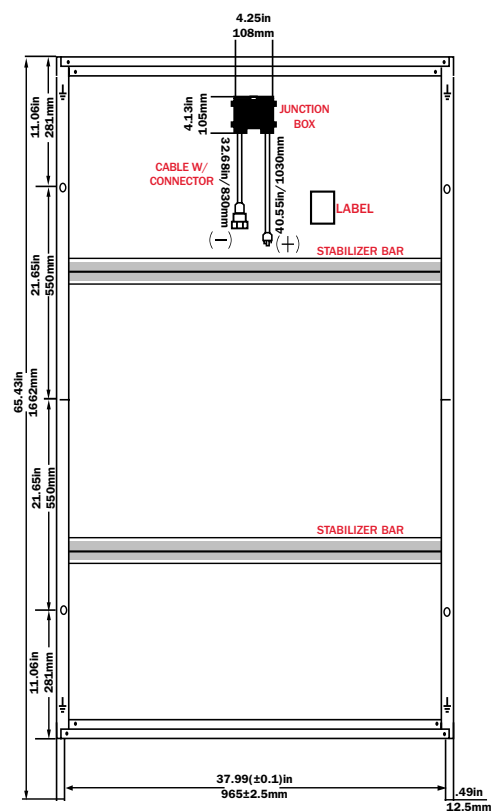
Warranty

- Kyocera standard 20 year power output warranty and 5 year workmanship warranty applies in USA
- Extended warranties available per project requirements
- Kyocera standard 20 year power output warranty and 2 year workmanship warranty applies outside of USA
- Refer to Kyocera warranty policy for details

ELECTRICAL SPECIFICATIONS

Standard Test Conditions				
	KD230GX-LFB	KD235GX-LFB	KD240GX-LFB	
P_{mp}^2	230	235	240	W
V_{mp}	29.8	29.8	29.8	V
I_{mp}	7.72	7.89	8.06	A
V_{oc}	36.9	36.9	36.9	V
I_{sc}	8.36	8.55	8.59	A
$P_{tolerance}$	+5/-3	+5/-3	+5/-3	%
Nominal Operating Cell Temperature Conditions (NOCT)				
T_{NOCT}	45.0	45.0	45.0	°C
P_{max}	165	169	172	W
V_{mp}	26.8	26.8	26.7	V
I_{mp}	6.18	6.31	6.45	A
V_{oc}	33.7	33.7	33.7	V
I_{sc}	6.77	6.92	6.95	A
Temperature Coefficients				
P_{max}	-1.04	-1.07	-1.10	W/°C
V_{oc}	-0.133	-0.133	-0.133	V/°C
I_{sc}	0.00502	0.00513	0.00515	A/°C
Operating Temp	-40~90	-40~90	-40~90	°C
System Design				
Series Fuse Rating	15 A			
Maximum DC System Voltage (UL)	600 V			

MECHANICAL SPECIFICATIONS



Weight: 46.3lbs (21.0kg)

NEC 2008 Compliant
UL 1703 Listed



Registered to ISO9001-2000

Kyocera reserves the right to modify these specifications without notice.

All specification at 25°C, cell temperature, 1.5 AM and 1000W/m².

Legend

○ MOUNTING HOLES ● DRAINAGE HOLES ↓ GROUNDING HOLES

AUTHORIZED DISTRIBUTOR



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APPENDIX H - SMA Inverter Product Data Sheets



SUNNY BOY 3000-US / 3800-US / 4000-US

SB 3000US / SB 3800-US-10 / SB 4000US



SB 3800-US NOW AVAILABLE



UL Certified

- For countries that require UL certification (UL 1741/IEEE 1547)

Efficient

- 96.8% peak efficiency
- OptiCool™ active temperature management system

Safe

- Galvanic isolation

Simple

- Patented automatic grid voltage detection*
- Integrated DC disconnect switch

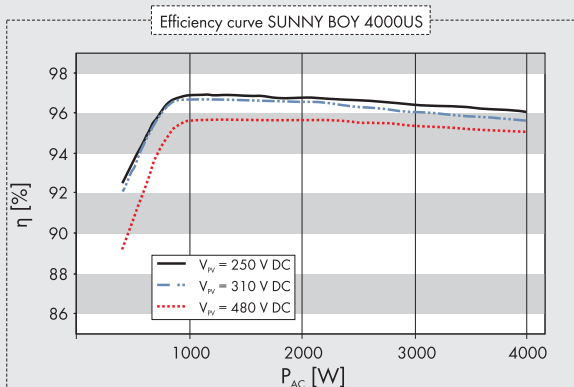
SUNNY BOY 3000-US / 3800-US / 4000-US

UL certified, reliable system managers

The Sunny Boy 3000-US, 3800-US and 4000-US inverters are specially designed for countries that require UL certification. Automatic grid voltage detection* and an integrated DC disconnect switch simplifies installation, ensuring safety as well as saving time. These models feature galvanic isolation and can be used with all types of modules—crystalline as well as thin-film. The die-cast aluminum enclosure, with the OptiCool active temperature management system, guarantees the highest yields possible and a long service life, even under extreme conditions. The Sunny Boy 3800-US is designed for projects with a current limit of 16A.

* US Patent US7352549B1

Technical data	Sunny Boy 3000-US		Sunny Boy 3800-US	Sunny Boy 4000-US	
	208 V AC	240 V AC	240 V AC	208 V AC	240 V AC
Input (DC)					
Max. recommended PV power (@ module STC)	3750 W		4750 W	4375 W	5000 W
Max. DC power (@ cos φ = 1)	3200 W		4200 W	4200 W	
Max. DC voltage	500 V		600 V	600 V	
DC nominal voltage	250 V		310 V	310 V	
MPP voltage range	175 – 400 V	200 – 400 V	250 – 480 V	220 – 480 V	250 – 480 V
Min. DC voltage / start voltage	175 / 228 V	200 / 228 V	250 / 285 V	220 / 285 V	250 / 285 V
Max. input current / per string (at DC disconnect)	17 A / 17 A 36 A @ combined terminal		18 A / 18 A 36 A @ combined terminal	18 A / 18 A 36 A @ combined terminal	
Number of MPP trackers / fused strings per MPP tracker			1 / 4 (DC disconnect)		
Output (AC)					
AC nominal power	3000 W		3800 W	3500 W	4000 W
Max. AC apparent power	3000 VA		3800 VA	3500 VA	4000 VA
Nominal AC voltage / adjustable	208 V / ●	240 V / ●	240 V / –	208 V / ●	240 V / ●
AC voltage range	183 – 229 V	211 – 264 V	211 – 264 V	183 – 229 V	211 – 264 V
AC grid frequency; range	60 Hz; 59.3 – 60.5 Hz		60 Hz; 59.3 – 60.5 Hz	60 Hz; 59.3 – 60.5 Hz	
Max. output current	15 A	13 A	16 A	17 A	
Power factor (cos φ)	1		1	1	
Phase conductors / connection phases	1 / 2		1 / 2	1 / 2	
Harmonics	< 4%		< 4%	< 4%	
Efficiency					
Max. efficiency	96.0%	96.5%	96.8%	96.5%	96.8%
CEC efficiency	95.0%	95.5%	96.0%	95.5%	96.0%
Protection devices					
DC reverse-polarity protection	●		●	●	
AC short circuit protection	●		●	●	
Galvanically isolated / all-pole sensitive monitoring unit	●/–		●/–	●/–	
Protection class / overvoltage category	I / III		I / III	I / III	
General data					
Dimensions (W / H / D) in mm (in)			450 / 350 / 235 (18 / 14 / 9)		
DC Disconnect dimensions (W / H / D) in mm (in)			187 / 297 / 190 (7 / 12 / 7.5)		
Packing dimensions (W / H / D) in mm (in)			390 / 580 / 470 (15 / 23 / 18.5)		
DC Disconnect packing dimensions (W / H / D) in mm (in)			370 / 240 / 280 (15 / 9 / 11)		
Weight / DC Disconnect weight			38 kg (84 lb) / 3.5 kg (8 lb)		
Packing weight / DC Disconnect packing weight			44 kg (97 lb) / 4 kg (9 lb)		
Operating temperature range (full power)			–25 °C ... +45 °C (–13 °F ... +113 °F)		
Noise emission (typical)	40 dB(A)		www.SMA-Solar.com		37 dB(A)
Internal consumption at night	0.1 W		0.1 W		0.1 W
Topology	LF transformer		LF transformer		LF transformer
Cooling concept	OptiCool		OptiCool		OptiCool
Electronics protection rating / connection area	NEMA 3R / NEMA 3R		NEMA 3R / NEMA 3R		NEMA 3R / NEMA 3R
Features					
Display: text line / graphic	●/–		●/–		●/–
Interfaces: RS485 / Bluetooth	○/○		○/○		○/○
Warranty: 10 / 15 / 20 years	●/○/○		●/○/○		●/○/○
Certificates and permits (more available on request)	UL1741, UL1998, IEEE 1547, FCC Part 15 (Class A & B), CSA C22.2 No. 107.1-2001				
NOTE: US inverters ship with gray lids.					
Data at nominal conditions					
● Standard features ○ Optional features – Not available					
Type designation	SB 3000US		SB 3800-US-10		SB 4000US



Accessories



RS485 interface
485USPB-NR



Bluetooth® Piggy Back
BTPBINV-NR



Combi-Switch
DC disconnect and PV
array combiner box
COMBO-SWITCH



Combiner Box
Simplify wiring for added
convenience and safety
SBCB-6-3R or SBCB-6-4

ST36 / ST42 / ST48



UL Certified

- UL certified (UL 1741/IEEE-1547)

Reliable

- 10 year standard warranty
- Sealed electronics enclosure and rugged stainless steel outdoor-rated structure
- Opticool™ temperature management system

Simple

- Prewired at factory for three-phase utility interconnection
- Integrated load-break rated lockable AC/DC disconnect switch

Flexible

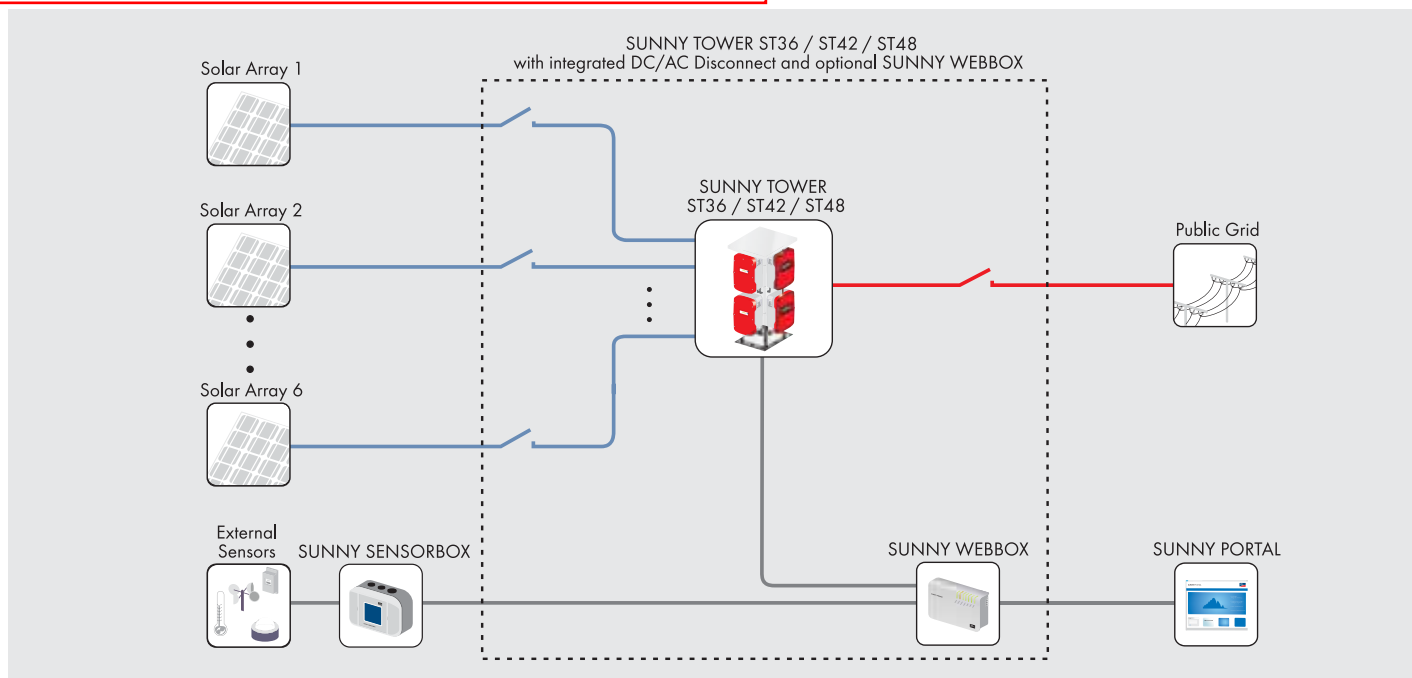
- Internet-ready with Sunny WebBox
- Integrated fused series string combiner
- Ideal for commercial applications

SUNNY TOWER-US

The UL certified, flexible solution for commercial PV systems

Designed with the installer in mind, SMA has combined ease of installation, a low cost per watt and high efficiency in the Sunny Tower-US. The UL-certified inverter system is pre-configured for a per-tower capacity of 36, 42 or 48 kW and its modular design eliminates the need for cost-prohibitive heavy machinery, as is required for large central inverters. It allows installers to apply their existing experience and tools in the residential market to attract commercial-grade projects, all while benefiting from the Sunny Boy's world-class efficiency and SMA's industry-best reliability.

Technical Data	Sunny Tower with 6 Sunny Boy 6000-US	Sunny Tower with 6 Sunny Boy 7000-US	Sunny Tower with 6 Sunny Boy 8000-US
Input (DC)			
Recommended maximum PV power (module STC)	45.0 kW	52.5 kW	60 kW
DC maximum voltage	600 V	600 V	600 V
Peak power tracking voltage	250 – 480 V	250 – 480 V	250 – 480 V
DC maximum input current	150 A	180 A	180 A
DC voltage ripple	< 5%	< 5%	< 5%
Number of fused string inputs	24 x 15 A (AC / DC disconnect)	24 x 15 A (AC / DC disconnect)	24 x 15 A (AC / DC disconnect)
PV start voltage (adjustable)	300 V	300 V	300 V
Output (AC)			
AC nominal power / maximum power	36.0 kW / 36.0 kW	42.0 kW / 42.0 kW	48.0 kW / 48.0 kW
AC maximum output current (per phase @ 208, 240, 277 V)	100 A, 87 A, 44 A	117 A, 101 A, 51 A	N/A, 116 A, 58 A
AC nominal voltage range (3-phase)	183 – 229 V @ 208 V Delta or WYE 244 - 305 V @ 277 V WYE	183 – 229 V @ 208 V Delta or WYE 244 - 305 V @ 277 V WYE	N/A 244 - 305 V @ 277 V WYE
AC Frequency: nominal / range	60 Hz / 59.3 – 60.5 Hz	60 Hz / 59.3 – 60.5 Hz	60 Hz / 59.3 – 60.5 Hz
Power factor (nominal)	0.99	0.99	0.99
Efficiency			
Peak inverter efficiency	97.0%	97.1%	96.3% @ 240 V 96.5% @ 277 V
CEC weighted efficiency	95.5% @ 208 V, 240 V 96.0% @ 277 V	95.5% @ 208 V 96.0% @ 240 V, 277 V	96.0%
General data			
Dimensions (W / H / D) in mm (in)	1100 / 1810 / 990 (43 / 71 / 39)	1100 / 1810 / 990 (43 / 71 / 39)	1100 / 1810 / 990 (43 / 71 / 39)
Weight	384 kg (846 lb)	384 kg (846 lb)	384 kg (846 lb)
Ambient temperature range	–13 to 113 °F	–13 to 113 °F	–13 to 113 °F
Internal consumption: standby / nighttime	< 42 W / 0.6 W	< 42 W / 0.6 W	< 42 W / 0.6 W
Topology	Low frequency transformer, true sinewave	Low frequency transformer, true sinewave	Low frequency transformer, true sinewave
Cooling concept	OptiCool, forced active cooling	OptiCool, forced active cooling	OptiCool, forced active cooling
Mounting location: indoor / outdoor (NEMA 3R)	●/●	●/●	●/●
LCD display	●	●	●
Lid color: aluminum / red / blue / yellow	●/○/○/○	●/○/○/○	●/○/○/○
Features			
Communication: RS485 / wireless	○/○	○/○	○/○
Warranty: 10 years	●	●	●
Compliance: IEEE-929, IEEE-1547, UL 1741, UL 1998, FCC Part 15 A & B	●	●	●
Data at nominal conditions			
● Standard features ○ Optional features			
Type designation	ST36	ST42	ST48





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APPENDIX I - Kyocera PV Calculations



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Kyocera Solar Clean Power Estimator

Benefits of your Kyocera Solar system

Cost	\$130,000
Federal / State / Local Tax Credits	\$39,000
State / Utility Rebate	\$7,426
Net Cost (Click the System Cost tab for a cost breakdown)	\$83,574
Cumulative Lifetime Savings	\$117,466 over 25 years
Investment Return	4.7%

System Cost

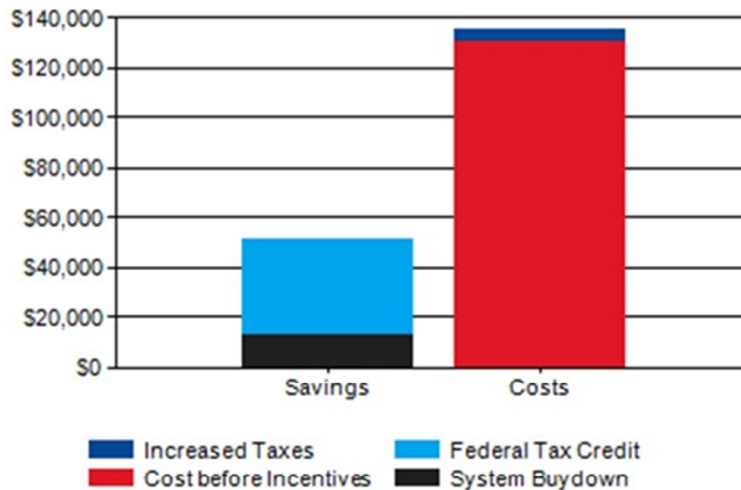
Solar Savings

Cash Flow

Cost Breakdown

Your net cost for this Kyocera Solar PV system is \$83,574

Net Cost Detail

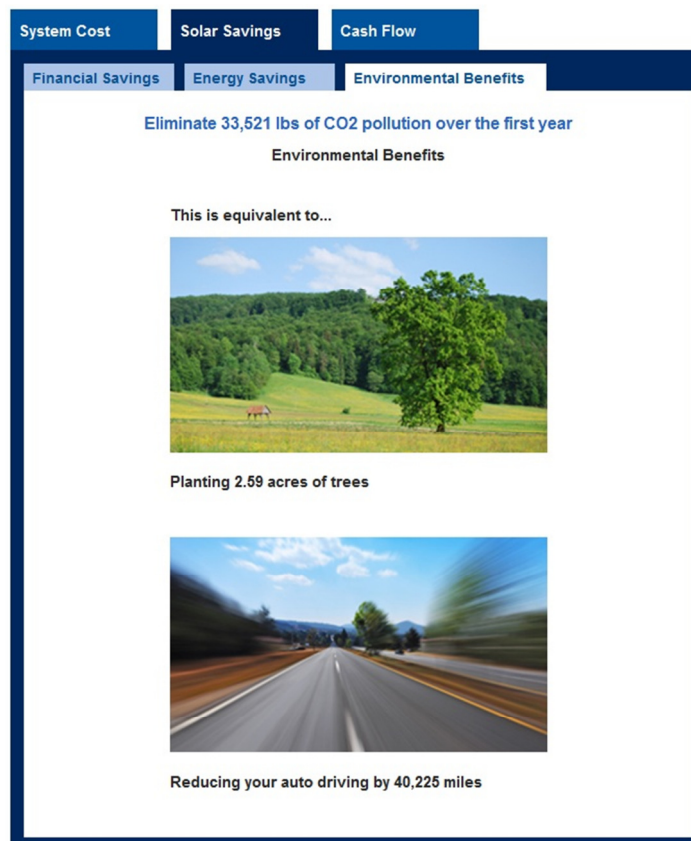
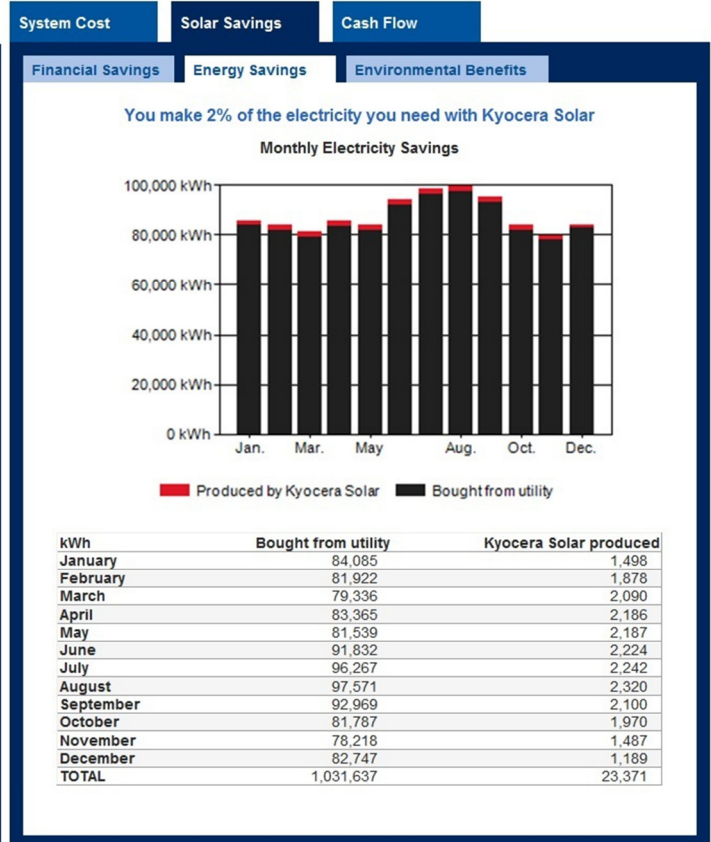
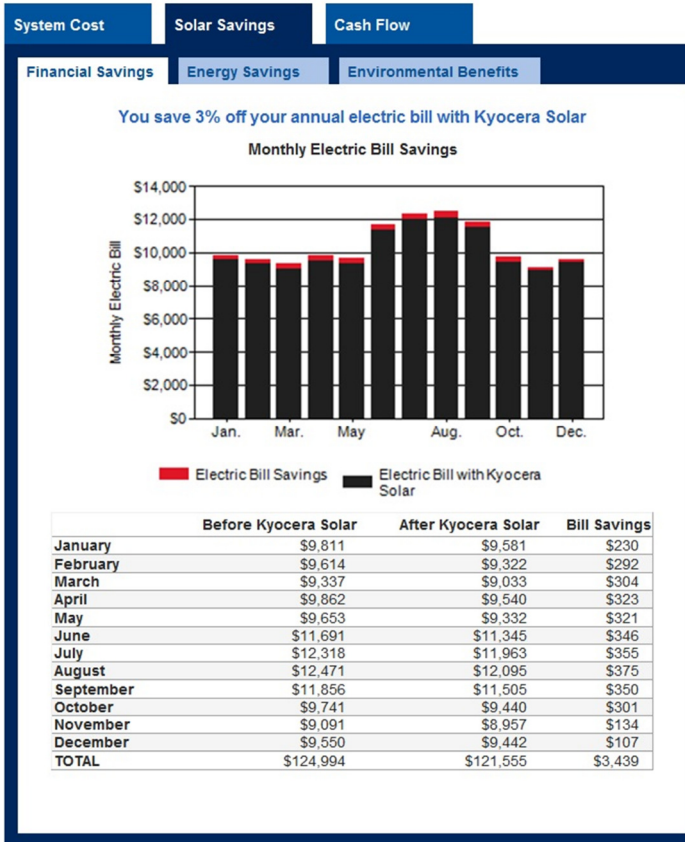


System Cost	\$130,000
Incentives	
PA Sunshine PV Rebate (Com. >10-100 kW) (Step 4)	\$5,000
PA Sunshine PV Rebate (Com. 3-10 kW) (Step 4)	\$7,500
Federal PV Tax Credit (Com.) (Jan. 2006)	\$39,000
less Total Incentives	\$51,500
Increased Taxes	
PA Sunshine PV Rebate (Com. >10-100 kW) (Step 4)	\$2,030
PA Sunshine PV Rebate (Com. 3-10 kW) (Step 4)	\$3,045
plus Total Tax Increase	\$5,074
NET COST	\$83,574



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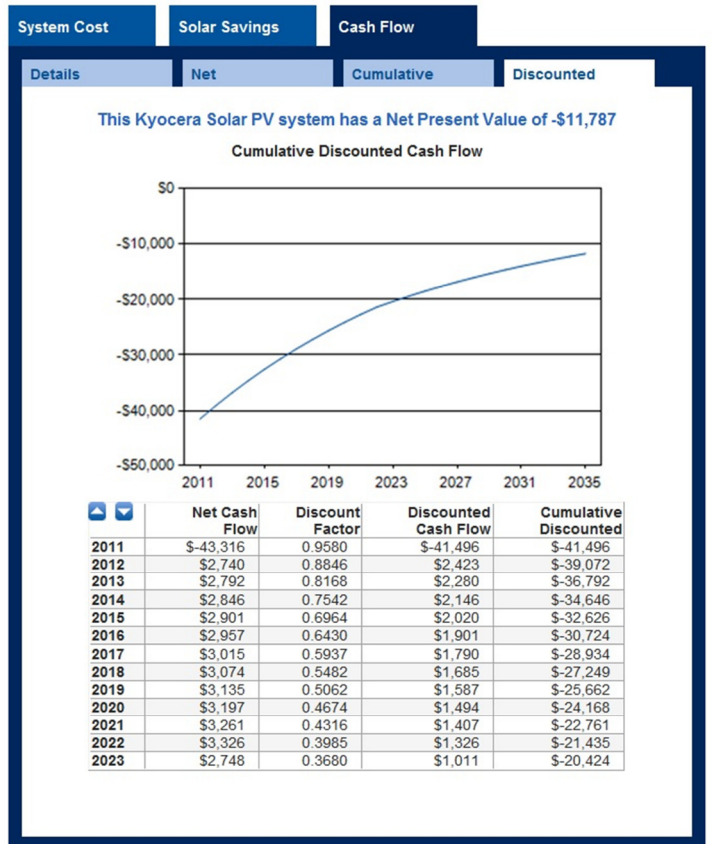
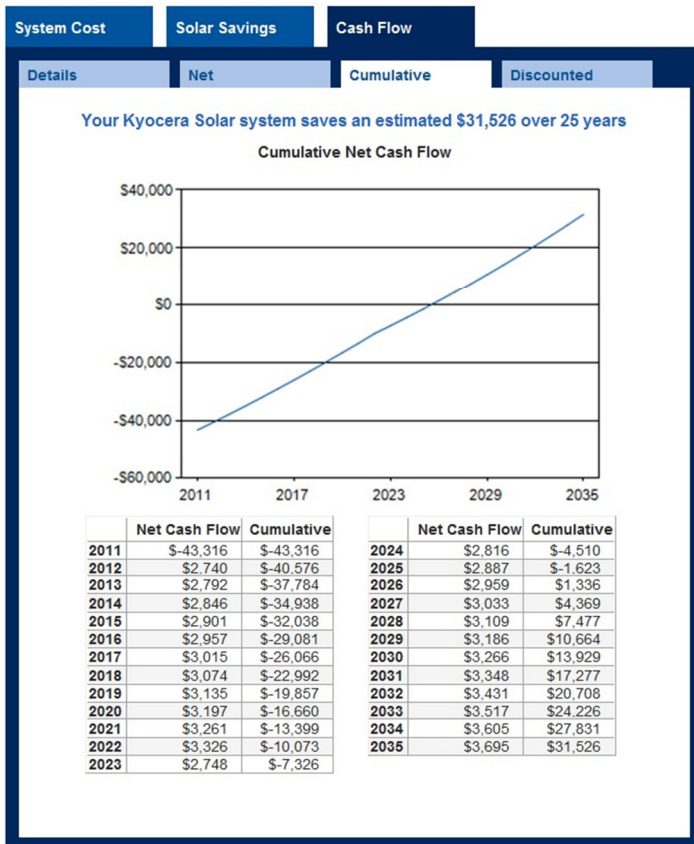
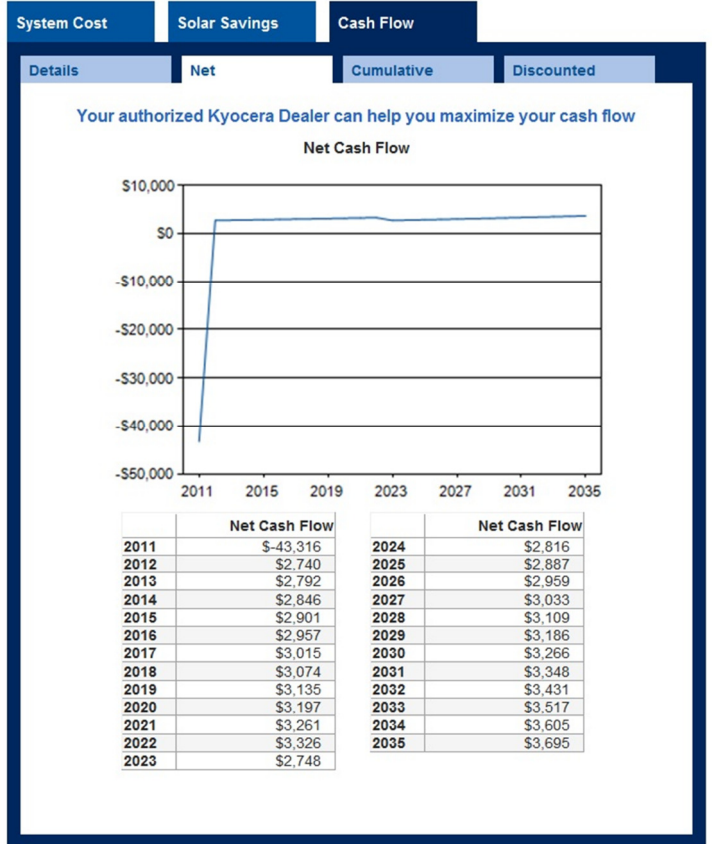
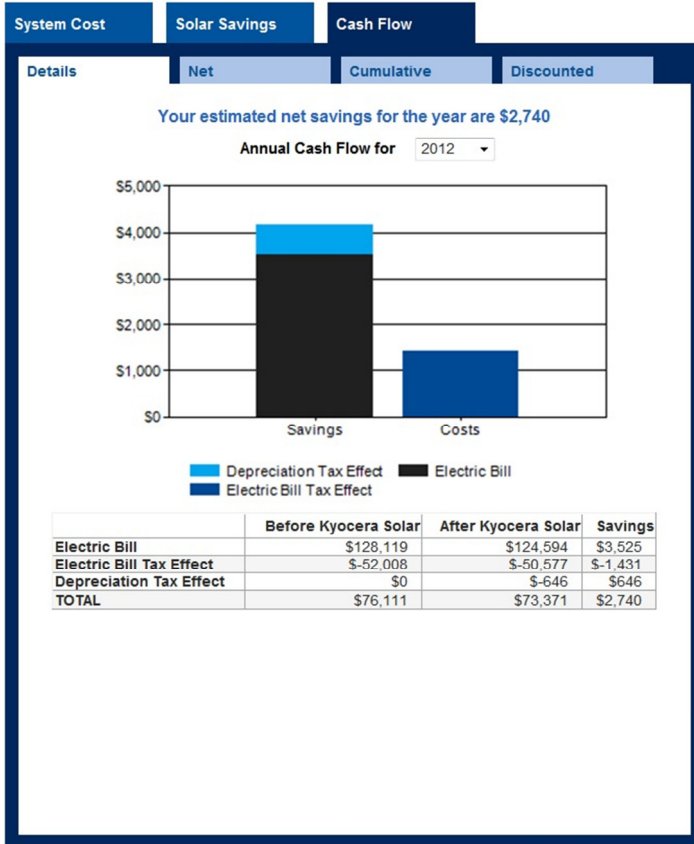
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APPENDIX J - LEED Scorecard - Version 2.2

Targeted	Pending	Decision Req	Not Pursued	LEED® Scorecard for: University Sciences Building			
43	0	0	26	Now Targeting LEED NC V2.2 GOLD			
				July 28, 2010			
				Certified: 26 to 32 points Silver: 33 to 38 points Gold: 39 to 51 points Platinum: 52 or more points			
10	0	0	4	Sustainable Sites			
▪				SSp1 Construction Activity Pollution Prevention:			
1				SSc1 Site Selection:			
1				SSc2 Development Density & Community Connectivity:			
			1	SSc3 Brownfield Redevelopment:			
1				SSc4.1 Public Transportation Access:			
1				SSc4.2 Bicycle Storage & Changing Rooms:			
			1	SSc4.3 Low Emitting & Fuel Efficient Vehicles:			
1				SSc4.4 Parking Capacity:			
1				SSc5.1 Protect or Restore Habitat:			
1				SSc5.2 Maximize Open Space:			
			1	SSc6.1 SW Design - Quantity Control:			
1				SSc6.2 SW Design - Quality Control:			
1				SSc7.1 Heat Island Effect, Non-Roof:			
1				SSc7.2 Heat Island Effect, Roof:			
			1	SSc8 Light Pollution Reduction:			
4	0	0	1	Water Efficiency			
2				WEc1 Water Efficient Landscaping:			
			1	WEc2 Wastewater:			
2				WEc3 Water Use Reduction:			
9	0	0	8	Energy & Atmosphere			
▪				EAp1 Fundamental Commissioning of Energy Systems:			
▪				EAp2 Minimum Energy Performance:			
▪				EAp3 Fundamental Refrigerant Management:			
6			4	EAc1 Optimize Energy Performance:			
			3	EAc2 On-Site Renewable Energy:			
1				EAc3 Enhanced Commissioning:			
			1	EAc4 Enhanced Refrigerant Management:			
1				EAc5 Measurement & Verification:			
1				EAc6 Green Power:			

7	0	0	6	Materials & Resources
▪				MRp1 Storage & Collection of Recyclables:
			3	MRc1 Building Reuse :
2				MRc2 Construction Waste Management:
			2	MRc3 Materials Reuse:
2				MRc4 Recycled Content Materials:
2				MRc5 Regional Materials:
			1	MRc6 Rapidly Renewable Materials:
1				MRc7 Certified Wood:
8	0	0	7	Indoor Environmental Quality
▪				EQp1 Minimum IAQ Performance:
▪				EQp2 Environmental Tobacco Smoke Control:
			1	EQc1 Outdoor Air Delivery Monitoring:
			1	EQc2 Increase Ventilation Effectiveness:
1				EQc3.1 Construction IAQ, During Construction:
1				EQc3.2 Construction IAQ, Before Occupancy:
1				EQc4.1 Low-Emitting Adhesives & Sealants:
1				EQc4.2 Low-Emitting Paints & Coatings:
1				EQc4.3 Low-Emitting Carpets:
1				EQc4.4 Low-Emitting Composite Wood and Agrifibre:
			1	EQc5 Indoor Chemical & Pollutant Source Control:
			1	EQc6.1 Controllability of Systems, Lighting:
			1	EQc6.2 Controllability of Systems, Thermal Comfort:
1				EQc7.1 Thermal Comfort, Design:
1				EQc7.2 Thermal Comfort, Verification:
			1	EQc8.1 Daylight 75% of Spaces:
			1	EQc8.2 Views for 90% of Spaces:
5	0	0	0	Innovation & Design Process
1				IDc1.1 Green Housekeeping:
1				IDc1.2 Building Exterior & Hardscape Management Plan:
1				IDc1.3 Exemplary Performance -Water Efficiency
1				IDc1.4 Innovation & Design: Hydration Station
1				IDc2 LEED® Accredited Professional:

* This scorecard is intended to serve as a benchmarking tool to assess potential LEED NC v2.2 performance. It does not confirm a LEED rating nor guarantee credit compliance. This document is the sole property of Enermodal and is only to be used for the project listed above. This document is not to be used in any other capacity without the expressed consent of Enermodal Engineering.



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APPENDIX K - Rainwater Collection Calculations



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ESTIMATED AMOUNT OF WATER USED ANNUALLY:

BATHROOM CONSUMPTION

Bathroom Fixture Type:	Quantity	Gal./Flush	Est. # of Uses/Day	School Days/Yr.	Gal./Day	Gal./Month	Gal./Yr.
Urinal U-1: Wall Hung	10	0.5	$900 \times 0.375 \times 1.3 = 439$	261	219.4	4,771	57,257
WC-1: Wall Mounted Toilet	24	1.26	$900 \times 0.625 \times 1.3 \times (24/36) = 488$	261	614.3	13,360	160,319
WC-2: Wall Mounted Barrier Free Toilet	9	1.26	$900 \times 0.625 \times 1.3 \times (9/36) = 183$	261	230.3	5,010	60,120
WC-3: Wall Hung Toilet	1	1.26	$900 \times 0.625 \times 1.3 \times (1/36) = 20$	261	25.6	557	6,680
WC-4: Wall Hung Toilet	1	1.26	$900 \times 0.625 \times 1.3 \times (1/36) = 20$	261	25.6	557	6,680
WC-5: Floor Mounted	1	1.26	$900 \times 0.625 \times 1.3 \times (1/36) = 20$	261	25.6	557	6,680
TOTALS					1,140.8	24,811	297,736

BIOWALL CONSUMPTION:

Total Surface Area =	2,000 SF = 7.3 m
Spec. Section 13 60 00 =	Water trickles down at a rate of 6 litres/m/min for each m of horizontal width of the living wall.
Flow Rate =	6 litres/m/min x 7.3m = 43.8 litres/min = 11.6 gal/min = 16,662 gal/day = 506,803 gal/month = 6,081,630 gal/year
Basin Capacity =	400 gallons (1818 litres)
Evapotranspiration Rate =	0.25% loss in water content per hour = 6.0% per day
Water Lost Per Day =	400 gallons x 0.06 = 24 gallons

Quantity	Gal./Flush	Est. # of Uses/Day	Days/Yr.	Gal./Day	Gal./Month	Gal./Yr.
1	N/A	N/A	365	24.0	730	8,760
NEW TOTAL				1,164.8	25,541	306,496

SUB. URINAL U-1 W/ A WATERLESS URINAL:

Bathroom Fixture Type:	Quantity	Gal./Flush	Est. # of Uses/Day	School Days/Yr.	Gal./Day	Gal./Month	Gal./Yr.
Sloan WES-4000 series	10	0.0	$900 \times 0.375 \times 1.3 = 439$	261	0.0	0.0	0.0
Savings (Gal.)					-219.4	-4,771	-57,257
NEW TOTAL					945.4	20,770	249,239

ASSUMPTIONS:

Auditorium holds 240 people
 8 Classrooms hold up to 240 people
 39 labs ~ 10 people/lab = 390 people
 Faculty/Office can hold 30 people
 Total = **900** people in the building at all times of the day

Est. each person probably uses the bathroom **1.3** times/day while in the building.
 Est. that urinals are only used by 3/4 of the men in the building (37.5% of building occupants assuming even mix of men and women).
 Other building occupants use the toilets (equal distribution among type).
 School Days Per Year assumes year round occupancy except for weekends.

Evapotranspiration Rate of around 0.25% per hour for the Biowall and Water Basin.



University Sciences Building

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RAINWATER COLLECTION PAYBACK PERIOD (with waterless urinals)					
Year	Initial Cost	Installation Savings	Utility Bill Savings	Urinal Maint. (9 Filters)	+/- After Maintenance
1	(\$13,258.75)	\$2,365.70	\$1,054.28	(\$517.50)	(\$10,356.27)
2	\$0.00	\$0.00	\$1,125.31	(\$517.50)	(\$9,748.46)
3	\$0.00	\$0.00	\$1,196.35	(\$517.50)	(\$9,069.61)
4	\$0.00	\$0.00	\$1,267.38	(\$517.50)	(\$8,319.73)
5	\$0.00	\$0.00	\$1,338.41	(\$517.50)	(\$7,498.82)
6	\$0.00	\$0.00	\$1,409.45	(\$517.50)	(\$6,606.87)
7	\$0.00	\$0.00	\$1,480.48	(\$517.50)	(\$5,643.89)
8	\$0.00	\$0.00	\$1,551.51	(\$517.50)	(\$4,609.88)
9	\$0.00	\$0.00	\$1,622.55	(\$517.50)	(\$3,504.83)
10	\$0.00	\$0.00	\$1,693.58	(\$517.50)	(\$2,328.76)
11	\$0.00	\$0.00	\$1,764.61	(\$517.50)	(\$1,081.64)
12	\$0.00	\$0.00	\$1,835.64	(\$517.50)	\$236.50
13	\$0.00	\$0.00	\$1,906.68	(\$517.50)	\$1,625.68
14	\$0.00	\$0.00	\$1,977.71	(\$517.50)	\$3,085.89
15	\$0.00	\$0.00	\$2,048.74	(\$517.50)	\$4,617.13
16	\$0.00	\$0.00	\$2,119.78	(\$517.50)	\$6,219.41
17	\$0.00	\$0.00	\$2,190.81	(\$517.50)	\$7,892.72
18	\$0.00	\$0.00	\$2,261.84	(\$517.50)	\$9,637.06
19	\$0.00	\$0.00	\$2,332.88	(\$517.50)	\$11,452.44
20	\$0.00	\$0.00	\$2,403.91	(\$517.50)	\$13,338.85
21	\$0.00	\$0.00	\$2,474.94	(\$517.50)	\$15,296.29
22	\$0.00	\$0.00	\$2,545.98	(\$517.50)	\$17,324.77
23	\$0.00	\$0.00	\$2,617.01	(\$517.50)	\$19,424.27
24	\$0.00	\$0.00	\$2,688.04	(\$517.50)	\$21,594.82
25	\$0.00	\$0.00	\$2,759.07	(\$517.50)	\$23,836.39
26	\$0.00	\$0.00	\$2,830.11	(\$517.50)	\$26,149.00
27	\$0.00	\$0.00	\$2,901.14	(\$517.50)	\$28,532.64
28	\$0.00	\$0.00	\$2,972.17	(\$517.50)	\$30,987.31
29	\$0.00	\$0.00	\$3,043.21	(\$517.50)	\$33,513.02
30	\$0.00	\$0.00	\$3,114.24	(\$517.50)	\$36,109.76

TOTAL INITIAL SAVINGS

Waterless Urinals = (\$2,365.70)

TOTAL INITIAL COST

Waterless Urinals Used = \$13,258.75

Total Gallons Harvested Yearly

288,926 gallons

Total Gallons Used Per Year

Waterless Urinals Used = 249,239 gallons

Total Gallons Saved Per Year

Waterless Urinals Used = 249,239 gallons

Total Make-up Quantity Required

Waterless Urinals Used = 0 gallons



University Sciences Building

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RAINWATER COLLECTION PAYBACK PERIOD (w/out waterless urinals)				
Year	Initial Cost	Utility Bill Savings	Utility Bill Costs	+/- After Maintenance
1	(\$18,097.35)	\$1,222.16	(\$74.32)	(\$16,949.51)
2	\$0.00	\$1,304.50	(\$79.33)	(\$15,724.34)
3	\$0.00	\$1,386.84	(\$84.34)	(\$14,421.83)
4	\$0.00	\$1,469.19	(\$89.34)	(\$13,041.99)
5	\$0.00	\$1,551.53	(\$94.35)	(\$11,584.81)
6	\$0.00	\$1,633.88	(\$99.36)	(\$10,050.29)
7	\$0.00	\$1,716.22	(\$104.37)	(\$8,438.43)
8	\$0.00	\$1,798.56	(\$109.37)	(\$6,749.24)
9	\$0.00	\$1,880.91	(\$114.38)	(\$4,982.71)
10	\$0.00	\$1,963.25	(\$119.39)	(\$3,138.85)
11	\$0.00	\$2,045.60	(\$124.40)	(\$1,217.65)
12	\$0.00	\$2,127.94	(\$129.40)	\$780.89
13	\$0.00	\$2,210.28	(\$134.41)	\$2,856.76
14	\$0.00	\$2,292.63	(\$139.42)	\$5,009.97
15	\$0.00	\$2,374.97	(\$144.43)	\$7,240.52
16	\$0.00	\$2,457.32	(\$149.43)	\$9,548.40
17	\$0.00	\$2,539.66	(\$154.44)	\$11,933.62
18	\$0.00	\$2,622.00	(\$159.45)	\$14,396.17
19	\$0.00	\$2,704.35	(\$164.46)	\$16,936.07
20	\$0.00	\$2,786.69	(\$169.46)	\$19,553.30
21	\$0.00	\$2,869.04	(\$174.47)	\$22,247.86
22	\$0.00	\$2,951.38	(\$179.48)	\$25,019.76
23	\$0.00	\$3,033.72	(\$184.49)	\$27,869.00
24	\$0.00	\$3,116.07	(\$189.49)	\$30,795.57
25	\$0.00	\$3,198.41	(\$194.50)	\$33,799.49
26	\$0.00	\$3,280.75	(\$199.51)	\$36,880.73
27	\$0.00	\$3,363.10	(\$204.51)	\$40,039.32
28	\$0.00	\$3,445.44	(\$209.52)	\$43,275.24
29	\$0.00	\$3,527.79	(\$214.53)	\$46,588.49
30	\$0.00	\$3,610.13	(\$219.54)	\$49,979.09

TOTAL INITIAL COST

Regular Urinals Used = \$18,097.35

Total Gallons Harvested Yearly 288,926 gallons

Total Gallons Used Per Year

Regular Urinals Used = 306,496 gallons

Total Gallons Saved Per Year

Regular Urinals Used = 288,926 gallons

Total Make-up Quantity Required

Regular Urinals Used = (17,570) gallons

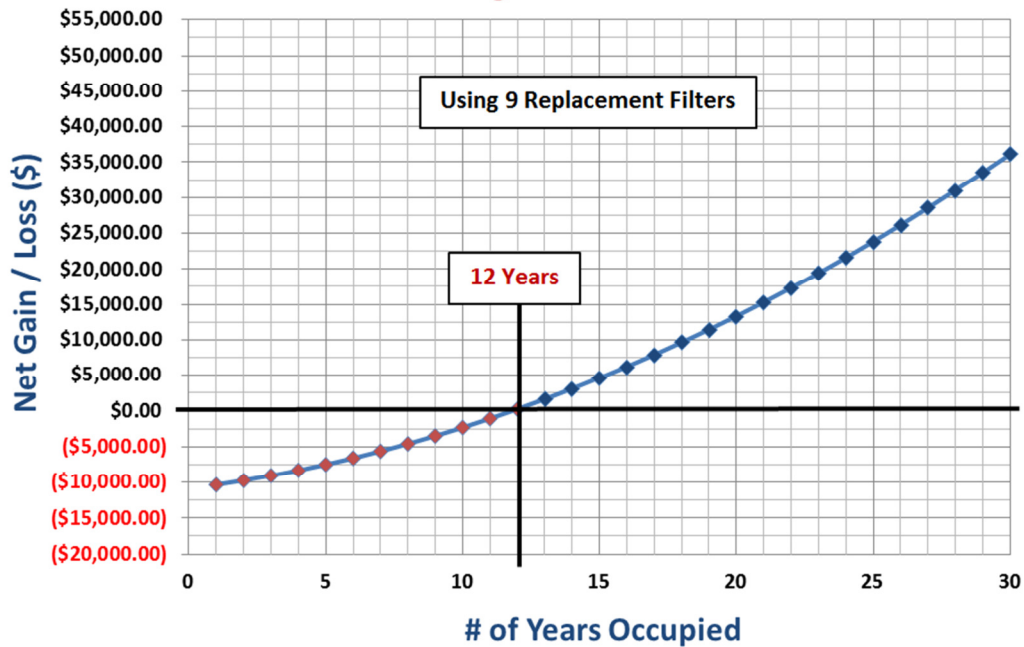


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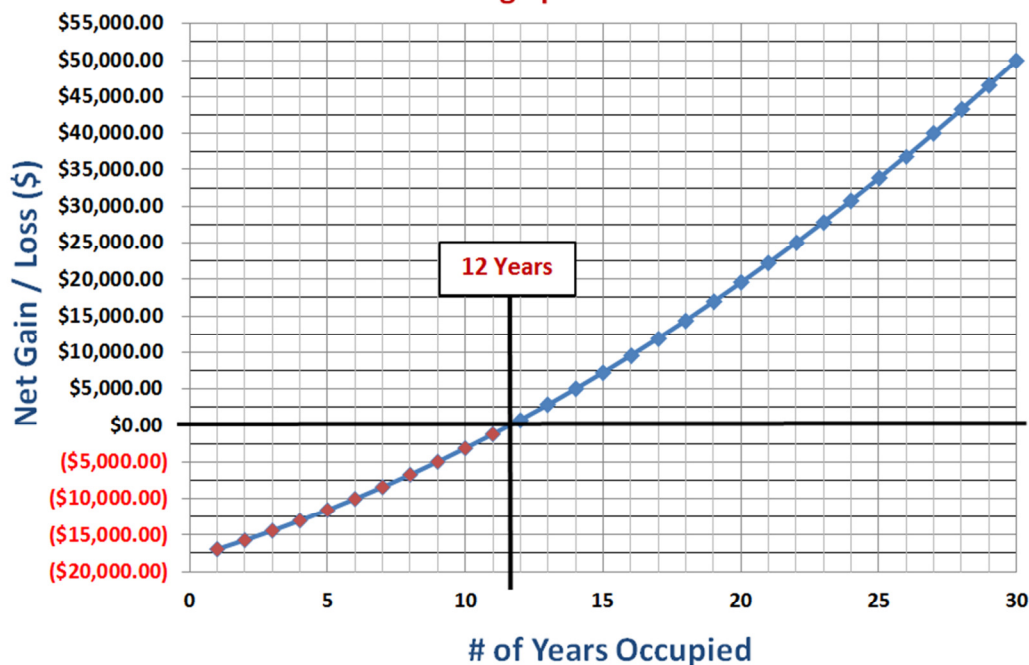
Rainwater Collection Payback Period

Using Waterless Urinals



Rainwater Collection Payback Period

Using Specified Urinals

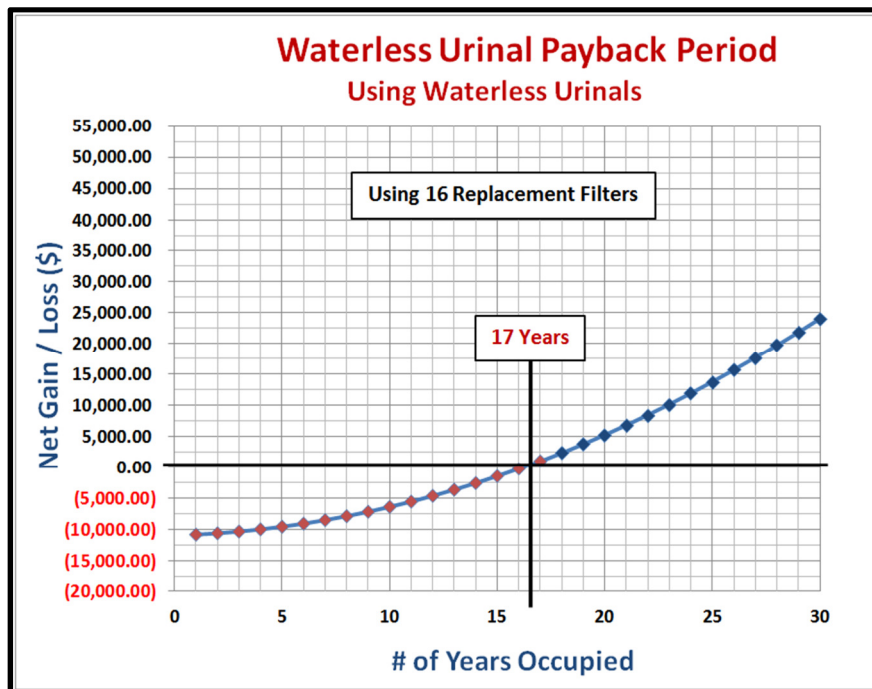




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RAINWATER COLLECTION PAYBACK PERIOD (with waterless urinals)					
Year	Initial Cost	Installation Savings	Utility Bill Savings	Urinal Maint. (16 Filters)	+/- After Maintenance
1	(\$13,258.75)	\$2,365.70	\$1,054.28	(\$920.00)	(10,758.77)
2	\$0.00	\$0.00	\$1,125.31	(\$920.00)	(10,553.46)
3	\$0.00	\$0.00	\$1,196.35	(\$920.00)	(10,277.11)
4	\$0.00	\$0.00	\$1,267.38	(\$920.00)	(9,929.73)
5	\$0.00	\$0.00	\$1,338.41	(\$920.00)	(9,511.32)
6	\$0.00	\$0.00	\$1,409.45	(\$920.00)	(9,021.87)
7	\$0.00	\$0.00	\$1,480.48	(\$920.00)	(8,461.39)
8	\$0.00	\$0.00	\$1,551.51	(\$920.00)	(7,829.88)
9	\$0.00	\$0.00	\$1,622.55	(\$920.00)	(7,127.33)
10	\$0.00	\$0.00	\$1,693.58	(\$920.00)	(6,353.76)
11	\$0.00	\$0.00	\$1,764.61	(\$920.00)	(5,509.14)
12	\$0.00	\$0.00	\$1,835.64	(\$920.00)	(4,593.50)
13	\$0.00	\$0.00	\$1,906.68	(\$920.00)	(3,606.82)
14	\$0.00	\$0.00	\$1,977.71	(\$920.00)	(2,549.11)
15	\$0.00	\$0.00	\$2,048.74	(\$920.00)	(1,420.37)
16	\$0.00	\$0.00	\$2,119.78	(\$920.00)	(220.59)
17	\$0.00	\$0.00	\$2,190.81	(\$920.00)	1,050.22
18	\$0.00	\$0.00	\$2,261.84	(\$920.00)	2,392.06
19	\$0.00	\$0.00	\$2,332.88	(\$920.00)	3,804.94
20	\$0.00	\$0.00	\$2,403.91	(\$920.00)	5,288.85
21	\$0.00	\$0.00	\$2,474.94	(\$920.00)	6,843.79
22	\$0.00	\$0.00	\$2,545.98	(\$920.00)	8,469.77
23	\$0.00	\$0.00	\$2,617.01	(\$920.00)	10,166.77
24	\$0.00	\$0.00	\$2,688.04	(\$920.00)	11,934.82
25	\$0.00	\$0.00	\$2,759.07	(\$920.00)	13,773.89
26	\$0.00	\$0.00	\$2,830.11	(\$920.00)	15,684.00
27	\$0.00	\$0.00	\$2,901.14	(\$920.00)	17,665.14
28	\$0.00	\$0.00	\$2,972.17	(\$920.00)	19,717.31
29	\$0.00	\$0.00	\$3,043.21	(\$920.00)	21,840.52
30	\$0.00	\$0.00	\$3,114.24	(\$920.00)	24,034.76





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CITY OF PHILADELPHIA WATER DEPARTMENT (PWD)

Mcf = 1000 Cubic Feet = 7480 gallons

2005-2006	Monthly Water Usage	Charge Per Mcf	Monthly Water Usage	Charge Per Gal.
	0 - 2 Mcf	20.99	0 - 14,960 Gallons	0.002806
	2.1 - 100 Mcf	16.64	14,961 - 748,000 Gallons	0.002225
	100.1 - 2000 Mcf	14.81	748,001 - 14,960,000 Gallons	0.001980
	Over 2000 Mcf	11.06	Over 14,960,001 Gallons	0.001479

2006-2007	Monthly Water Usage	Charge Per Mcf	Monthly Water Usage	Charge Per Gal.
	0 - 2 Mcf	22.99	0 - 14,960 Gallons	0.003074
	2.1 - 100 Mcf	18.22	14,961 - 748,000 Gallons	0.002436
	100.1 - 2000 Mcf	16.22	748,001 - 14,960,000 Gallons	0.002168
	Over 2000 Mcf	12.12	Over 14,960,001 Gallons	0.001620

2007-2008	Monthly Water Usage	Charge Per Mcf	Monthly Water Usage	Charge Per Gal.
	0 - 2 Mcf	25.25	0 - 14,960 Gallons	0.003376
	2.1 - 100 Mcf	20.01	14,961 - 748,000 Gallons	0.002675
	100.1 - 2000 Mcf	17.81	748,001 - 14,960,000 Gallons	0.002381
	Over 2000 Mcf	13.31	Over 14,960,001 Gallons	0.001779

Average Increase...

Monthly Water Usage	Charge / Mcf Avg. Increase / Yr.	Monthly Water Usage	Charge / Gal. Avg. Increase / Yr.
0 - 2 Mcf	2.13	0 - 14,960 Gallons	0.000285
2.1 - 100 Mcf	1.69	14,961 - 748,000 Gallons	0.000225
100.1 - 2000 Mcf	1.50	748,001 - 14,960,000 Gallons	0.000201
Over 2000 Mcf	1.13	Over 14,960,001 Gallons	0.000150

Extrapolating...

2011-2012	Monthly Water Usage	Charge Per Mcf	Monthly Water Usage	Charge Per Gal.
	0 - 2 Mcf	31.64	0 - 14,960 Gallons	0.004230
	2.1 - 100 Mcf	25.07	14,961 - 748,000 Gallons	0.003351
	100.1 - 2000 Mcf	22.31	748,001 - 14,960,000 Gallons	0.002983
	Over 2000 Mcf	16.69	Over 14,960,001 Gallons	0.002231

FACTORS TO CONSIDER:

The cost per gallon of water is constantly rising and will NOT be cheap forever.

The past few years have shown an average increase of \$0.000285 per gallon of water used.

New filters may not be needed after every 7,000 uses, this is what is recommended by the manufacturer.

Buying filters in bulk and from other manufactures can reduce the replacement costs.

Cost of buying filters should increase over time with inflation.

Waterless urinals help reduce the size of the rainwater collection tanks by a total of 4,000 gallons.

Regular Urinals also require regular maintenance.



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APPENDIX L - Waterless Urinal Calculations



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INITIAL WATERLESS URINAL SAVINGS (\$):

Used Both Product Data Sheets and RS Means Cost Works

Type (10 of each):	Initial Material Cost	Initial Labor Cost	Total Initial Cost	Initial Pipe Savings	
Urinal U-1: Wall Hung - WEUS-1005	\$504.30 ea.	\$238.00 ea.	\$7,423.00	<i>Material</i>	<i>Labor</i>
Waterless Urinal: Sloan WES-4000 series	\$342.15 ea.	\$230.00 ea.	\$5,721.50	(\$396.00)	(\$268.20)
Savings			(1,701.50)	(\$396.00)	(\$268.20)
			TOTAL INITIAL SAVINGS =		(\$2,365.70)

CALCULATIONS:

Scaled Drawings and Referenced RS Means CostWorks

Copper Piping Length Eliminated	
1st Floor	21 Feet
2nd Floor	6 Feet
3rd Floor	3 Feet
4th Floor	3 Feet
5th Floor	3 Feet
Total	36 Feet

Material Cost of 1.5" Dia. Copper Pipe
11.00 per LF

Labor Cost of 1.5" Dia. Copper Pipe
7.45 per LF

Cost Per Gallon of Water for 2011-2012
0 - 14,960 Gal. = \$0.004230

Avg. Increase in Cost Per Gallon of Water
\$0.000285 per year

Gallon of Water Saved per Year
57,257 gallons

Urinal Uses Per Year
439 uses/day * 261 days
= 114,579 uses / yr.

Urinals Need New Filter Every 7,000 Uses
= 16 per year are required = \$960.00 / yr.
Each cost ~ \$60.00 to buy
Not cost beneficial after 9 replacements per year (...over a 30 year ROI period).



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WATERLESS URINAL PAYBACK PERIOD

Year	Installation Savings	Utility Bill Savings	Maintenance (9 Filters)	+/- After Maintenance
1	\$2,365.70	\$242.20	(\$517.50)	2,090.40
2	\$0.00	\$258.52	(\$517.50)	1,831.41
3	\$0.00	\$274.83	(\$517.50)	1,588.75
4	\$0.00	\$291.15	(\$517.50)	1,362.40
5	\$0.00	\$307.47	(\$517.50)	1,152.37
6	\$0.00	\$323.79	(\$517.50)	958.66
7	\$0.00	\$340.11	(\$517.50)	781.26
8	\$0.00	\$356.42	(\$517.50)	620.19
9	\$0.00	\$372.74	(\$517.50)	475.43
10	\$0.00	\$389.06	(\$517.50)	346.99
11	\$0.00	\$405.38	(\$517.50)	234.87
12	\$0.00	\$421.70	(\$517.50)	139.07
13	\$0.00	\$438.02	(\$517.50)	59.59
14	\$0.00	\$454.33	(\$517.50)	(3.58)
15	\$0.00	\$470.65	(\$517.50)	(50.43)
16	\$0.00	\$486.97	(\$517.50)	(80.96)
17	\$0.00	\$503.29	(\$517.50)	(95.17)
18	\$0.00	\$519.61	(\$517.50)	(93.06)
19	\$0.00	\$535.93	(\$517.50)	(74.64)
20	\$0.00	\$552.24	(\$517.50)	(39.89)
21	\$0.00	\$568.56	(\$517.50)	11.17
22	\$0.00	\$584.88	(\$517.50)	78.55
23	\$0.00	\$601.20	(\$517.50)	162.25
24	\$0.00	\$617.52	(\$517.50)	262.27
25	\$0.00	\$633.83	(\$517.50)	378.60
26	\$0.00	\$650.15	(\$517.50)	511.25
27	\$0.00	\$666.47	(\$517.50)	660.23
28	\$0.00	\$682.79	(\$517.50)	825.52
29	\$0.00	\$699.11	(\$517.50)	1,007.12
30	\$0.00	\$715.43	(\$517.50)	1,205.05

FILTER REPLACEMENTS

# of Filters	Cost of Filters / Yr.
1	\$57.50
2	\$115.00
3	\$172.50
4	\$230.00
5	\$287.50
6	\$345.00
7	\$402.50
8	\$460.00
9	\$517.50
10	\$575.00
11	\$632.50
12	\$690.00
13	\$747.50
14	\$805.00
15	\$862.50
16	\$920.00

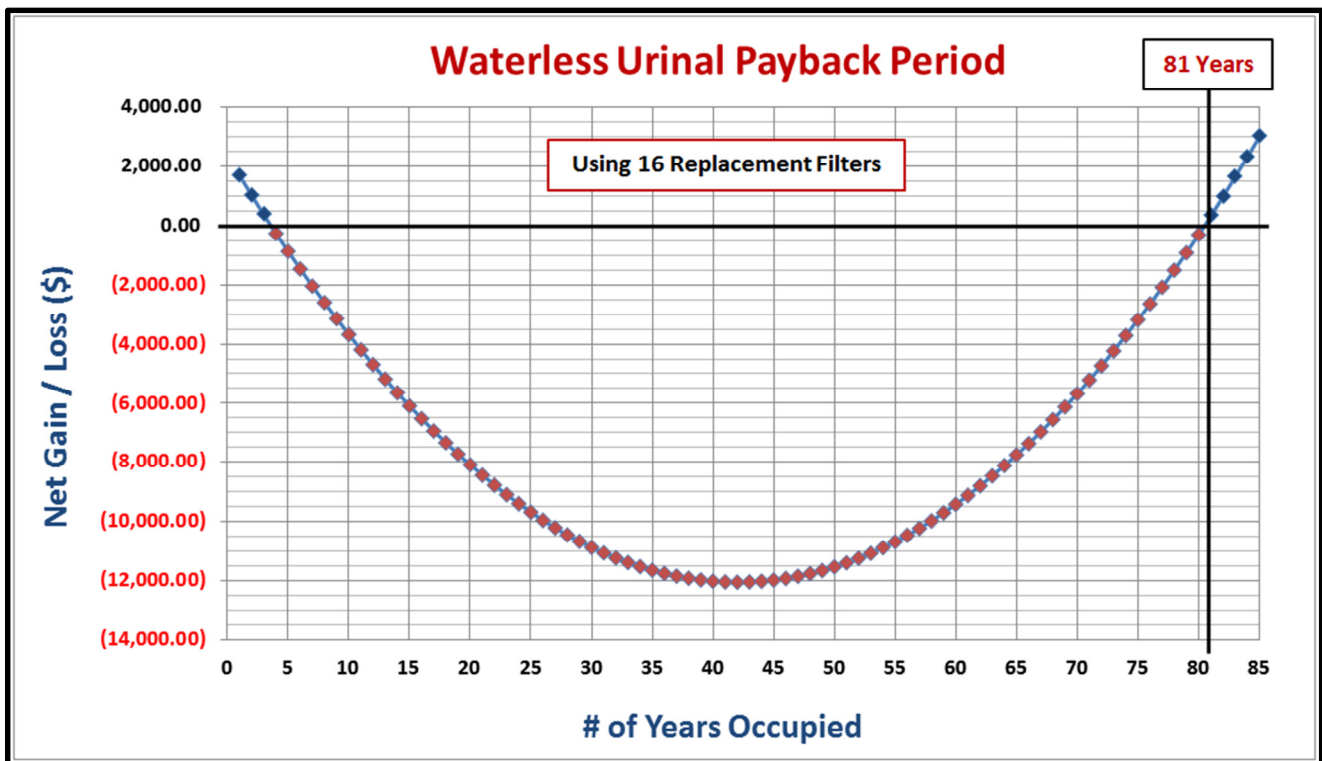
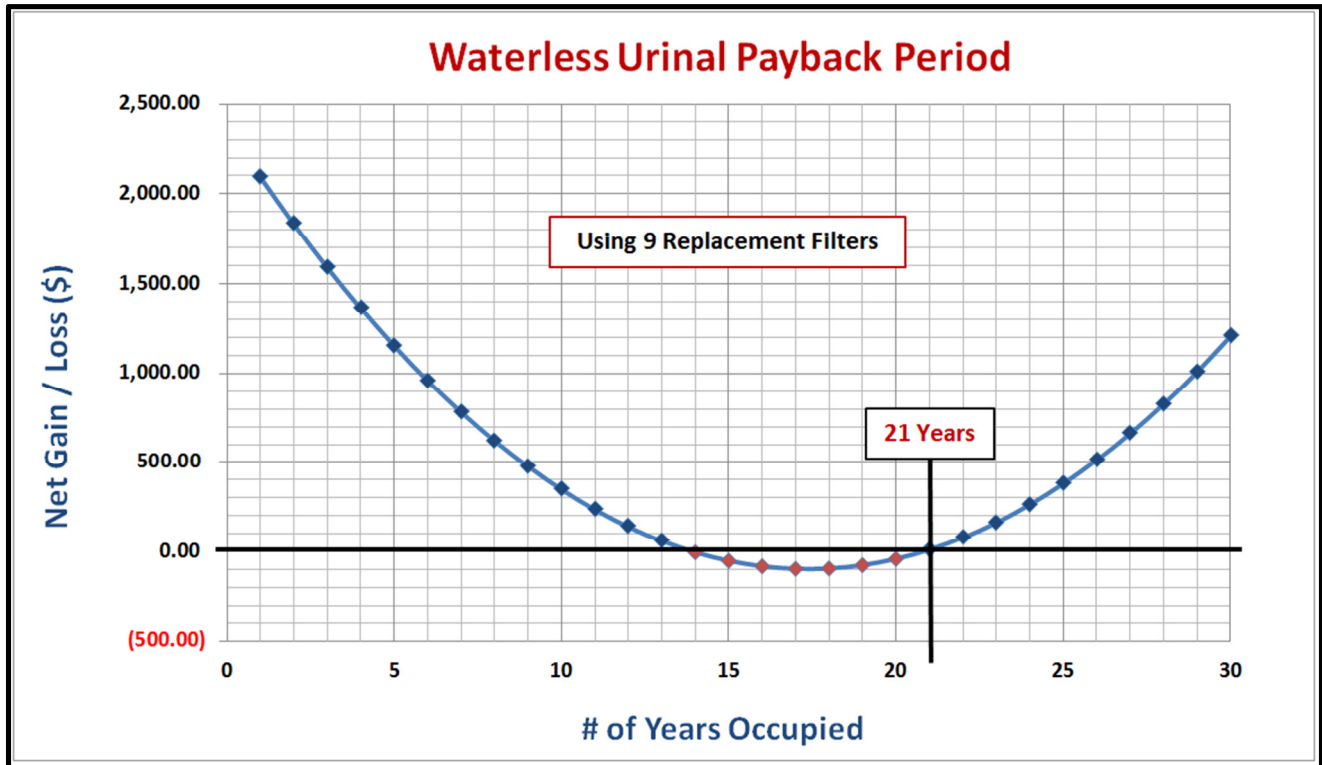
WATERLESS URINAL PAYBACK PERIOD

Year	Installation Savings	Utility Bill Savings	Maintenance (16 Filters)	+/- After Maintenance
1	\$2,365.70	\$242.20	(\$920.00)	1,687.90
2	\$0.00	\$258.52	(\$920.00)	1,026.41
3	\$0.00	\$274.83	(\$920.00)	381.25
4	\$0.00	\$291.15	(\$920.00)	(247.60)
5	\$0.00	\$307.47	(\$920.00)	(860.13)
6	\$0.00	\$323.79	(\$920.00)	(1,456.34)
7	\$0.00	\$340.11	(\$920.00)	(2,036.24)
8	\$0.00	\$356.42	(\$920.00)	(2,599.81)
9	\$0.00	\$372.74	(\$920.00)	(3,147.07)
10	\$0.00	\$389.06	(\$920.00)	(3,678.01)
11	\$0.00	\$405.38	(\$920.00)	(4,192.63)
12	\$0.00	\$421.70	(\$920.00)	(4,690.93)
13	\$0.00	\$438.02	(\$920.00)	(5,172.91)
14	\$0.00	\$454.33	(\$920.00)	(5,638.58)
15	\$0.00	\$470.65	(\$920.00)	(6,087.93)
16	\$0.00	\$486.97	(\$920.00)	(6,520.96)
17	\$0.00	\$503.29	(\$920.00)	(6,937.67)
18	\$0.00	\$519.61	(\$920.00)	(7,338.06)
19	\$0.00	\$535.93	(\$920.00)	(7,722.14)
20	\$0.00	\$552.24	(\$920.00)	(8,089.89)
40	\$0.00	\$878.61	(\$920.00)	(12,018.18)
41	\$0.00	\$894.93	(\$920.00)	(12,043.25)
42	\$0.00	\$911.25	(\$920.00)	(12,052.01)
43	\$0.00	\$927.56	(\$920.00)	(12,044.44)
44	\$0.00	\$943.88	(\$920.00)	(12,020.56)
45	\$0.00	\$960.20	(\$920.00)	(11,980.36)
46	\$0.00	\$976.52	(\$920.00)	(11,923.84)
47	\$0.00	\$992.84	(\$920.00)	(11,851.01)
48	\$0.00	\$1,009.15	(\$920.00)	(11,761.85)
49	\$0.00	\$1,025.47	(\$920.00)	(11,656.38)
50	\$0.00	\$1,041.79	(\$920.00)	(11,534.59)
70	\$0.00	\$1,368.16	(\$920.00)	(5,671.94)
71	\$0.00	\$1,384.47	(\$920.00)	(5,207.47)
72	\$0.00	\$1,400.79	(\$920.00)	(4,726.67)
73	\$0.00	\$1,417.11	(\$920.00)	(4,229.56)
74	\$0.00	\$1,433.43	(\$920.00)	(3,716.13)
75	\$0.00	\$1,449.75	(\$920.00)	(3,186.39)
76	\$0.00	\$1,466.07	(\$920.00)	(2,640.32)
77	\$0.00	\$1,482.38	(\$920.00)	(2,077.94)
78	\$0.00	\$1,498.70	(\$920.00)	(1,499.24)
79	\$0.00	\$1,515.02	(\$920.00)	(904.21)
80	\$0.00	\$1,531.34	(\$920.00)	(292.88)
81	\$0.00	\$1,547.66	(\$920.00)	334.78
82	\$0.00	\$1,563.97	(\$920.00)	978.76



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APPENDIX M - Sloan Waterless Urinal Product Data

*"Our mission is to develop
complete water and energy
conservation solutions
obtainable without
sacrificing performance.
That is not just our mission.
It is our promise."*

Charles Allen
President & CEO

SLOAN®
Waterfree

**"ADD UP
THE COSTS!"**

As water and sewage rates rise every year...
it's like pouring money down the drain.

**How can you stop
the flow?**

Sloan's new Waterfree Urinals
provide the answer for today
and tomorrow.



Style

Sloan's Waterfree Urinals provide the contemporary style to complement any restroom design.

Cut Costs

Sloan's Waterfree Urinals reflect today's water conservation efforts. They perform like a conventional urinal except... there is no water usage.

The Waterfree Urinal installs easily to a 2" drainline, eliminates water and sewage costs and can reduce maintenance expenses.

Maintenance Friendly

Sloan Waterfree Urinals can help reduce maintenance costs and workloads. Harsh chemical cleaners become unnecessary. Cleaning of the Waterfree Urinal is the same as standard urinals. Any mildly-acidic disinfectant cleaner can be used. No rim holes or mineral deposits to worry about, just a smooth dry surface. Conventional urinals with wet surfaces can become a breeding ground for bacterial growth and odors.

Odorless

Since no water is used, the chemical reaction between urine and water, which typically causes odors, is eliminated. Studies have shown Sloan Waterfree Urinals are odor-free and have lower levels of ammonia than flush urinals.

Touch-Free Operation

Sloan's Waterfree Urinals provide the convenience and comfort of touch-free operation promoting hygiene and cleanliness.

Cartridge

An easily replaceable and disposable patented cartridge installs in seconds. Sloan has a cartridge recycling program. For information on the program go to www.sloanrefills.net/recycling

Quick Return on Your Investment

Sloan's Waterfree Urinals do not use water...saving that precious resource as well as sewage and water supply line costs. Installation is easy in new or retrofit applications. The initial cost of the Waterfree Urinal is often less than conventional no-touch fixtures, lowering your initial investment. The urinal can be used to accumulate water-efficient LEED® credits, including innovation points.

Your Sloan Sales Representative can quickly demonstrate how you can redeem your initial costs with a step-by-step survey or go online to www.sloanwaterfree.com.

SLOAN WATERFREE URINAL

Features

- Touch-free operation
- No water usage
- Vitreous china
- Mechanical-free design
- Patented, sealed locking cartridge
- Smooth, non-porous surfaces
- ADA compliant
- Full size urinals
- Drains to a standard drain line
- No odor
- Start-up cartridge included
- Easy installation

Benefits

- Quick ROI
- Reduces water and sewage costs
- Odor-free, vandal resistant
- Minimal care and cleaning
- Eliminates installation of water supply lines
- On average, saves 40,000 gallons of water per unit per year
- No need for continuously adding liquid to cartridge
- Reduces airborne bacteria



WES-2000



WES-1000



WES-4000



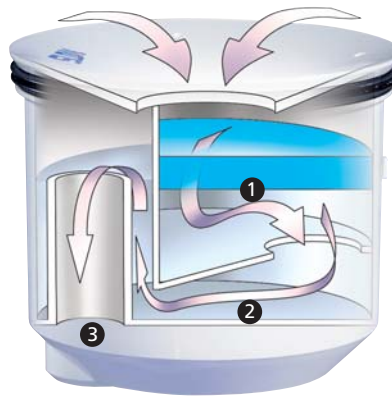
WES-5000

SLOAN WATERFREE TECHNOLOGY



Heavy-Duty Cartridge

- Exclusive patented and sealed – locking design
- Biodegradable sealant liquid
- Odor-controlling engineering
- Designed to last up to 7,000 uses
- Easy replacement with key
- Locks in place
- Recyclable ABS plastic



The cartridge acts as a funnel directing flow through the liquid sealant ①, preventing any odors from escaping. Next, the cartridge collects sediment ②, allowing the remaining waste to pass freely down the drain ③.

Inside

The cartridge is the main component and is installed at the base of the urinal.

A biodegradable sealant liquid is contained within the cartridge.

A barrier is formed between the drain and the open air by the liquid sealant, eliminating odors.

The cartridge is designed to collect uric sediment, the remaining liquid, which is non-corrosive and free of hard water, is allowed to flow into the drainage pipe. The result: no wasted water and an odor-free environment.

Maintenance is performed by replacing the cartridge after 7,000 uses with a provided key.

It's that simple!



► Description

Wall hung, wall outlet, Waterfree Vitreous China Urinal.

► Features

- Touch-free operation
- Uses no water
- Mechanical-free design
- Patented, Sealed Locking Cartridge
- Smooth, non-porous surfaces

► Benefits

- Improved hygiene and safety
- Reduced water and sewer costs
- Water supply piping not required
- Odor-free
- Vandal resistant
- Minimal care and easy cleaning

► Specifications

Wall hung, wall outlet, waterfree, Vitreous China Urinal with the following features:

- Vitreous China Fixture
- Cartridge Housing (H-1, Mod. 3)
- Cartridge Kit † — Engineered to last for an average of 7000 uses
- One piece Wall Bracket with Anchors Included
- Uni-coupler (for new and retrofit installations)
- Drain Line Test Cap

† Additional Cartridges sold separately

► Colors

☐ Standard White

Consult factory for optional colors.

► Cartridge Filter



Patented, Sealed Cartridge uses a Biodegradable Sealant Liquid to control odors.

The patented Cartridge is engineered to last for an average of 7000 uses and to receive waste through drain holes. Waste passes through an immiscible layer of biodegradable Sealant, continues through a Trap System, and flows over a Baffle to prevent the loss of Sealant. A Discharge Tube in the housing directs the flow of waste into the building drain system. The Cartridge is designed as a replaceable component when its function has been exhausted.



Featuring Falcon Waterfree Technology



**The New Sloan Waterfree Urinal —
Preserves our Natural Resources and
saves costs**

Sloan Waterfree Urinals reduce water and sewer costs, maintenance and repair bills, and create more hygienic, odor-free restrooms. A Patented, Sealed Cartridge eliminates the need for water, typically conserving 40,000 gallons per unit per year. Installing Waterfree Urinals along with other Sloan Conservation Products ensures meaningful water savings. In addition, Sloan Waterfree Urinals do not require costly supply piping to fixture.

ANSI/ASME A112.19.19-2006



MEETS THE AMERICAN DISABILITIES ACT
GUIDELINES AND ANSI A117.1
ACCESSIBLE AND USABLE BUILDINGS
AND FACILITIES - CHECK LOCAL CODES.



® Certified

This space for Architect/Engineer approval

Job Name _____ Date _____

Model Specified _____ Quantity _____

Variations Specified _____

Customer/Wholesaler _____

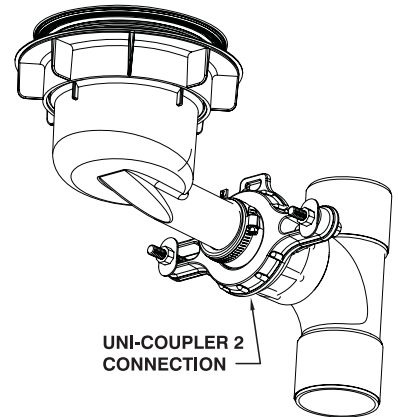
Contractor _____

Architect _____

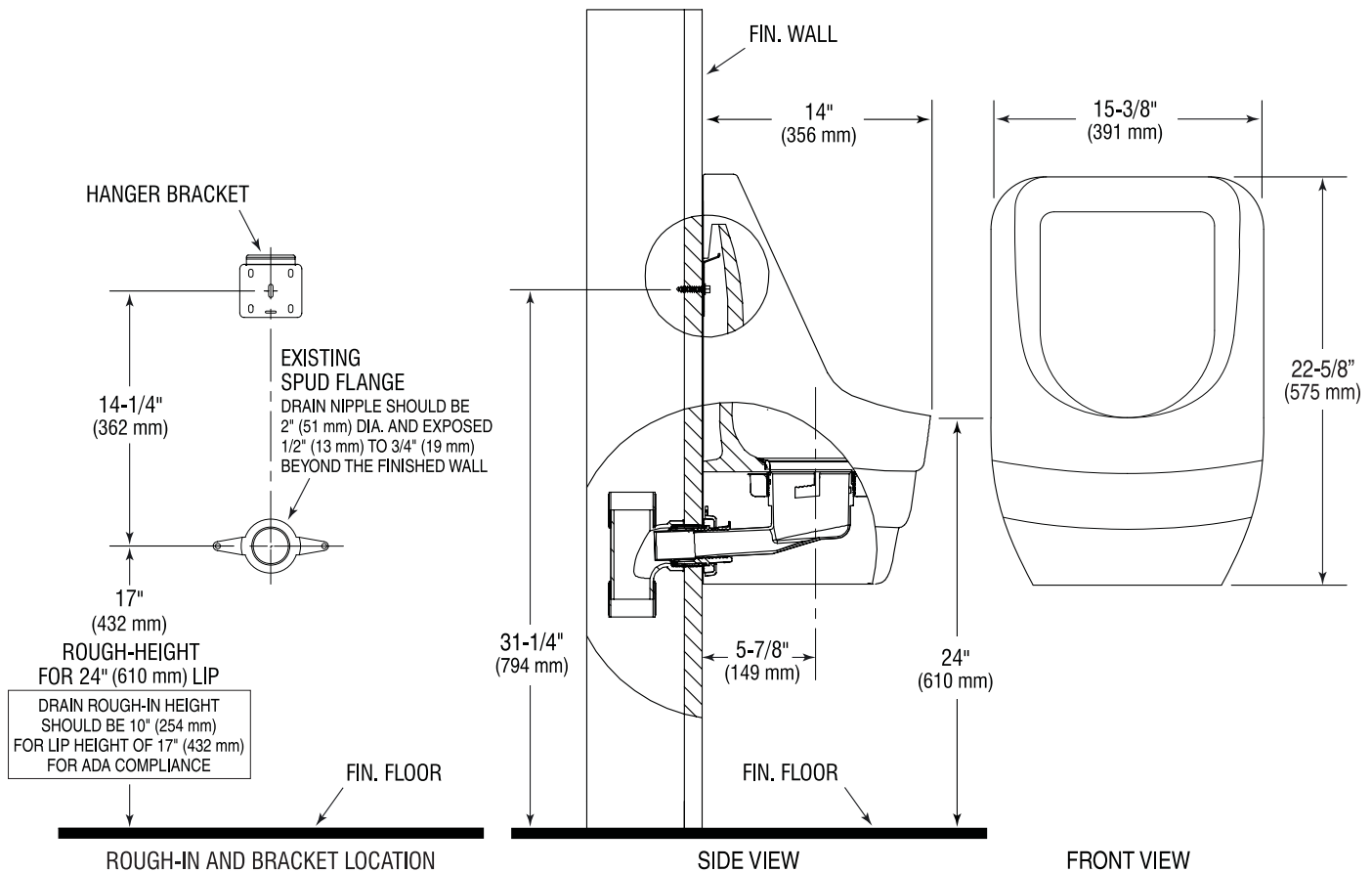
- **Description**
Wall hung, wall outlet, Waterfree Vitreous China Urinal.
- **Dimensions**
22-5/8" (575 mm) X 15-3/8" (391 mm) x 14" (356 mm)
- **Approximate Weight**
35 lbs. (15.8 kg)
- **Mounting For ADA Compliance**
For lip height of 17" (432 mm), distance from finished floor to drain centerline must be 10" (254 mm).
- **Drain Connection and Material**
Installs on standard 2-inch drain connections with spud flange or threaded nipple. Suitable DWV materials include cast iron, galvanized steel, ABS and PVC. Waterfree urinals are not recommended for installation with copper DWV due to copper's susceptibility to corrosion.

Uni-Coupler

The Uni-coupler connects the urinal housing to the building drain system and conforms to NSF 14 for plastic pipes and fittings. It is designed for use in both new and retrofit applications and offers a variety of configurations to meet most existing drain openings.



ROUGH-IN



MAINTENANCE AND CLEANING

- Perform cleaning once a day, or as needed
- Remove any litter in the bowl and clear cartridge drain slots
- Use mild disinfectant cleaner on a cloth to wipe the bowl
- DO NOT use aggressive/concentrated detergents or any other chemicals
- DO NOT dispose of water into the urinal

SLOAN VALVE COMPANY • 10500 SEYMOUR AVENUE • FRANKLIN PARK, IL 60131

Phone: 1-800-982-5839 or 1-847-671-4300 • Fax: 1-800-447-8329 or 1-847-671-4380 • www.sloanvalve.com

Code Number	Product Number	Description	List Price \$	Est. Wt. (lbs.)	UPC Code
Vitreous China URINAL ONLY. 1.0 gpf Wall Hung washdown Urinal with 3/4" IPS Rear Spud Inlet.					
1101016	SU-1016-A	Urinal fixture ONLY, 1.0 gpf, rear spud inlet	335.00	62.00	671254372597
Vitreous China URINAL ONLY. 0.13 gpf Wall Hung washdown Small Urinal with 3/4" IPS Inlet.					
1107000	SU-7000-A	Small Urinal fixture ONLY, 0.13 gpf top spud	**	48.00	—
1107000	SU-7000-A	Small Urinal Fixture ONLY, 0.13 gpf, top spud inlet	**	48.00	
1107002	SU-7002-A	Small Urinal Fixture ONLY, 0.25 gpf, top spud inlet	**	48.00	
1107005	SU-7005-A	Small Urinal Fixture ONLY, 0.50 gpf, top spud inlet	**	48.00	671254386815
1107006	SU-7006-A	Small Urinal Fixture ONLY, 1.0 gpf, top spud inlet	**	48.00	671254386822
1107010	SU-7010-A	Small Urinal Fixture ONLY, 0.13 gpf, rear spud inlet	**	48.00	
1107012	SU-7012-A	Small Urinal Fixture ONLY, 0.25 gpf, rear spud inlet	**	48.00	
1107015	SU-7015-A	Small Urinal Fixture ONLY, 0.50 gpf, rear spud inlet	**	48.00	671254386839
1107016	SU-7016-A	Small Urinal Fixture ONLY, 1.0 gpf, rear spud inlet	**	48.00	671254386846
Vitreous China URINAL ONLY. Wall Hung washdown Retrofit Urinal with 3/4" IPS Inlet.					
1101200	SU-1200-A	Retrofit Urinal fixture ONLY, 0.13 gpf, top spud	411.90	77.00	671254380332
1101202	SU-1202-A	Retrofit Urinal fixture ONLY, 0.25 gpf, top spud	411.90	77.00	671254380349
1101205	SU-1205-A	Retrofit Urinal fixture ONLY, 0.50 gpf, top spud	345.00	77.00	671254380356
1101210	SU-1210-A	Retrofit Urinal fixture ONLY, 0.13 gpf, rear spud inlet	409.00	70.00	671254380370
1101212	SU-1212-A	Retrofit Urinal fixture ONLY, 0.25 gpf, rear spud inlet	409.00	70.00	671254380387
1101215	SU-1215-A	Retrofit Urinal fixture ONLY, 0.50 gpf, rear spud inlet	378.00	70.00	671254380394
Waterfree Urinal					
1001000	WES-1000	Waterfree Urinal	562.50	65.00	671254279247
1002000	WES-2000	Waterfree Urinal	434.45	53.00	671254279254
1004000	WES-4000	Waterfree Urinal	342.15	40.00	671254312142
1005000	WES-5000	Waterfree Urinal	342.15	32.00	671254312166
0816527	—	Waterfree Instructional DVD	1.50	—	671254326491
Waterfree Cartridges					
1001500	WES-150	Universal Waterfree Urinal Cartridge (Single)	61.90	1.30	671254279261
1001555	WES-155	Universal Waterfree Urinal Cartridge (32-Pack)	1909.90	35.00	671254299450
1001556	WES-160	Universal Waterfree Urinal Cartridge (20-Pack) Not for stock (Facility packaging)	1149.50	22.00	671254299467
Vitreous China Lavatories					
3873001	SS-3001	Standard Undermount Lavatory 19-1/2" x 17-1/2" outside, 17" x 14" Inside dimension	80.00	16.50	671254353619
3873002	SS-3002	Standard Drop In Lavatory 20" x 16-3/4", 4" centerset	85.00	13.20	671254353626
3873003	SS-3003	Standard Wall Hung Lavatory 21" x 19-1/4" with 4" Backsplash, 4" centerset	125.00	36.00	671254371132
3873103	SS-3103	Standard Wall Hung Lavatory 21" x 19-1/4" with 4" Backsplash, 1 Hole	125.00	37.50	671254376885
3873803	SS-3803	Standard Wall Hung Lavatory 21" x 19-1/4" with 4" Backsplash, 8" centerset	130.00	43.00	671254376892
3873804	SS-3804	ADA Wheelchair Wall Hung Lavatory 20" X 27", 8" centerset	265.00	37.50	671254376854



SU-1016-A



SS-3001



WES-1000



WES-150

**Contact Your Local Sloan Representative

Pricing subject to change without notice. For most current pricing, refer to online price sheets at www.sloanvalve.com



University Sciences Building

Northeastern U.S.

APPENDIX N - Current Urinal Specification Sheet

DESCRIPTION

Complete HEU system with exposed manual Royal® urinal Flushometer and vitreous china urinal.

Flush Cycle

Model WEUS 1005.1001-0.5 (0.5 gpf/1.9 Lpf)



Meets the American Disabilities Guidelines and ANSI A117.1 requirements when installed according to these requirements.



NOTE: Plumbing System Requirements
√ Minimum **Flowing** Pressure: 25 PSI

SPECIFICATIONS

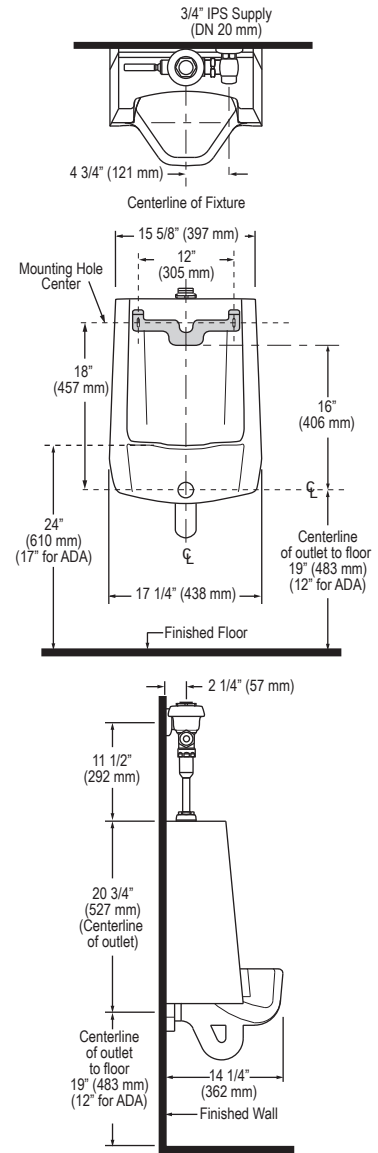
Quiet, exposed, diaphragm type, chrome plated urinal Flushometer and vitreous china urinal with the following features:

Flushometer

- PERMEX® Synthetic Rubber Diaphragm with Dual Filtered Fixed Bypass
- ADA compliant metal oscillating Non-Hold-Open Handle with Triple Seal Handle Packing
- 3/4" I.P.S. Screwdriver Bak-Chek® Angle Stop
- Free spinning Vandal Resistant Stop Cap
- Adjustable Tailpiece
- High Back Pressure Vacuum Breaker Flush Connection with One-piece Bottom Hex Coupling Nut
- Spud Coupling and Flange for 3/4" Top Spud
- Sweat Solder Adapter w/Cover Tube and Cast Wall Flange w/Set Screw
- High copper, low zinc brass castings for dezincification resistance
- Non-Hold-Open Handle, Fixed Metering Bypass and no external volume adjustment to ensure water conservation
- Flush accuracy controlled by CID® technology
- Diaphragm, Handle Packing, Stop Seat and Vacuum Breaker molded from PERMEX® rubber compound for chloramine resistance
- Valve Body, Cover, Tailpiece and Control Stop shall be in conformance with ASTM Alloy Classification for Semi-Red Brass. Valve shall be in compliance to the applicable sections of ASSE 1037/ ASME A112.19.2/CSA B45.1

Urinal

- Wall hung vitreous china
- Washdown flushing action
- 3/4" I.P.S. top spud inlet
- 2" NPT outlet flange
- All mounting hardware included
- Integral flushing rim
- 100 % factory flush tested
- Compliant to the applicable sections of ASME A112.19.2/CSA B45.1
- Carrier not included
- Compatible with Jay R. Smith Carrier 0636 or 0637
- Compliant with Buy American Act when purchased as a combination



Sloan Valve Company is buying renewable energy certificates to meet 100% of the company's purchased electricity use at its Franklin Park, Illinois facility.

SLOAN®

Sloan Valve Company
10500 Seymour Avenue
Franklin Park, IL 60131
Phone: 1-800-9-VALVE-9 (982-5839)
or 1-847-671-4300
Fax: 1-800-447-8329 or 1-847-671-4380
www.sloanvalve.com

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Rev. 0b (07/10)

This space for Architect/Engineer approval

Job Name	Date
Model Specified	Quantity
Variations Specified	
Customer/Wholesaler	
Contractor	
Architect	



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APPENDIX O - Structural Breadth Calculations



Structural Breadth (Using Waterless Urinals)

Girders Supporting Tank #2

- Total Roof Dead Load = 70 psf

- Total Roof Live Load = 25 psf

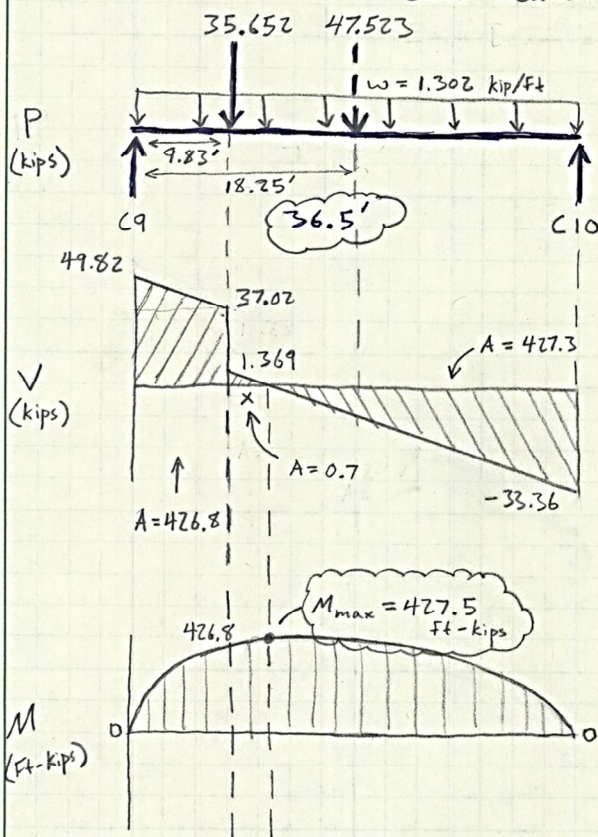
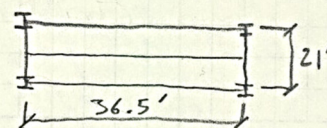
* Total Roof Load = $1.2D + 1.6L$

$$= 1.2(70) + 1.6(25) = 124 \text{ psf}$$

Tank Point Load Per Girder

Total Wt. per tank = 59,420 lbs/ea. (Dead Load)
 x 1.2 Factor of Safety = 71,304 lbs/ea
 Each Beam = $71,304 / 2 = 35,652 \text{ lbs}$

Typical Bay:



$$W = 124 \frac{\text{lb}}{\text{ft}^2} \times 10.5 \text{ ft}$$

$$W = 1.302 \text{ kips/ft}$$

$$R = 1.302 \text{ kips/ft} \times 36.5 \text{ ft}$$

$$R = 47.523 \text{ kips}$$

$$\begin{aligned} \sum M_{C9} &= -(9.83)(35.652) \\ &\quad - (18.25)(47.523) \\ &\quad + (36.5)(P_{C10}) = 0 \end{aligned}$$

$$36.5 P_{C10} = 1217.75$$

$$P_{C10} = 33.36 \text{ kips}$$

$$\begin{aligned} + \uparrow \sum F_y = 0 &= P_{C9} + 33.36 - 35.652 \\ &\quad - 47.523 \end{aligned}$$

$$P_{C9} = 49.82 \text{ kips}$$

$$x = 1.369 / 1.302 = 1.05'$$

** Reference page 3-120, 3-122 of Steel Manual

* Preferred $\rightarrow$ **W14 x 99** ($\phi M_n = 480 \text{ ft-kip}$)

Also Acceptable $\rightarrow$ W21 x 101 and W18 x 106



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Northeastern U.S.

2

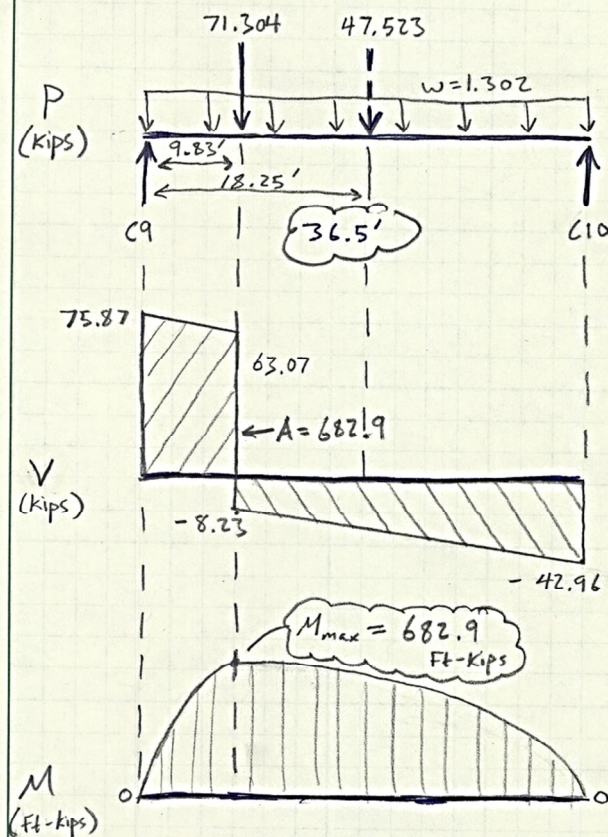
o Girders Supporting Tanks 1 and 3

- Total Roof Load = 124 psf (w/ F.O.S. values)

- Pt. Load From tank = 71.304 kips (w/ F.O.S.)

3-0235 — 50 SHEETS — 5 SQUARES
3-0236 — 100 SHEETS — 5 SQUARES
3-0237 — 200 SHEETS — 5 SQUARES
3-0137 — 200 SHEETS — FILLER

COMET



$$W = 124 \text{ lb/ft}^2 \times 10.5 \text{ ft}$$

$$W = 1.302 \text{ kips/ft}$$

$$R = 1.302 \times 36.5 = 47.523 \text{ kips}$$

$$\sum M_{C9} = -(9.83)(71.304) - (18.25)(47.523) + (36.5)(P_{C10}) = 0$$

$$36.5 P_{C10} = 1568.2$$

$$P_{C10} = 42.96 \text{ kips}$$

$$+\uparrow \sum F_y = 0 = P_{C9} + 42.96 - 71.304 - 47.523$$

$$P_{C9} = 75.87 \text{ kips}$$

** Reference page 3-118 of Steel Manual

* Preferred $\rightarrow$ W24 x 131 ($\phi M_n = 711 \text{ Ft-kip}$)

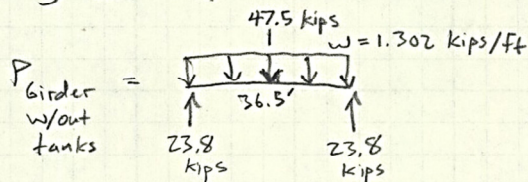
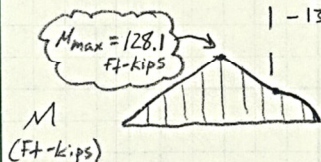
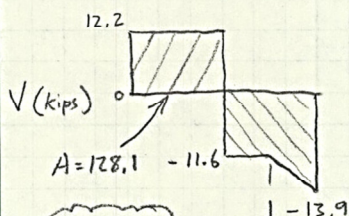
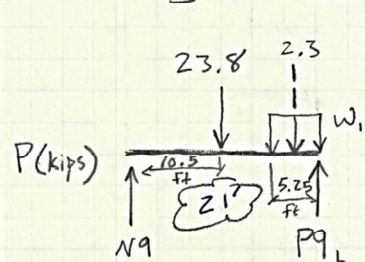
Also Acceptable $\rightarrow$ W21 x 132



3-0235 — 50 SHEETS — 5 SQUARES
3-0236 — 100 SHEETS — 5 SQUARES
3-0237 — 200 SHEETS — 5 SQUARES
3-0137 — 200 SHEETS — FILLER

COMET

o Loading on beams along column line #9



$$w_1 = 124 \frac{lb}{ft^2} \times \left(\frac{7.083}{2} \right) ft = 0.439 \frac{kip}{ft}$$

trib. area on other side

$$R_{w_1} = 0.439 \times 5.25 = 2.3 \text{ kips}$$

$$\sum M_{P_{N9}} = 0 = (2.3) \left(\frac{5.25}{2} \right) + (10.5)(23.8) - (21)(P_{N9})$$

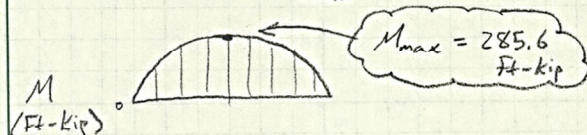
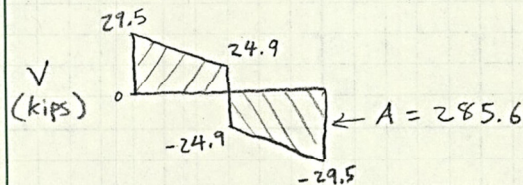
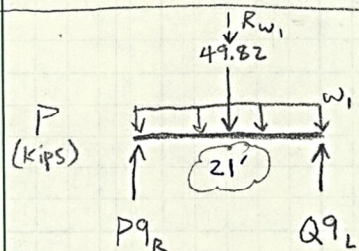
$$P_{N9} = 12.2 \text{ kips}$$

$$+\uparrow \sum F_y = 0 = 12.2 + P_{P_{N9}} - 23.8 - 2.3$$

$$P_{P_{N9}} = 13.9 \text{ kips}$$

** Ref. pg. 3-128 of Steel Manual

* Preferred $\rightarrow$ **W12 x 40** ($\phi M_n = 136 \text{ ft-kip}$)



$$R_{w_1} = 21' \times 0.439 = 9.2 \text{ kips}$$

$$+\uparrow \sum F_y = 0 \rightarrow P_{P_{N9}} = P_{Q_{N9}} = \frac{(49.82 + 9.2)}{2}$$

$$P_{P_{N9}} = P_{Q_{N9}} = 29.5 \text{ kips}$$

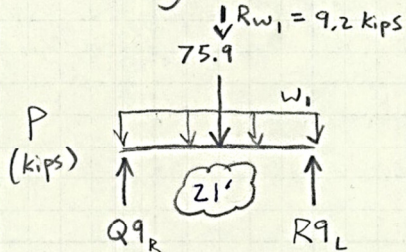
$$\begin{aligned} \text{** TOTAL LOAD ON } P_{N9} \\ &= 75.9 + 29.5 + 13.9 \\ &= 119.3 \text{ kips} \end{aligned}$$

** Ref. pg 3-124 of Steel Manual

* Preferred $\rightarrow$ **W14 x 61** ($\phi M_n = 290 \text{ ft-kips}$)



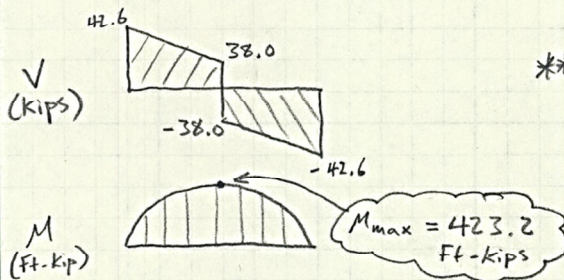
◦ Loading on beams along Column line #9 cont



$$w_1 = 0.439 \text{ kip/ft}$$

$$+\uparrow \Sigma F_y = 0 \rightarrow P_{Q9R} = P_{R9L} = \frac{(9.2 + 75.9)}{2}$$

$$P_{Q9R} = P_{R9L} = 42.6 \text{ kips}$$



**** TOTAL LOAD ON Q9**

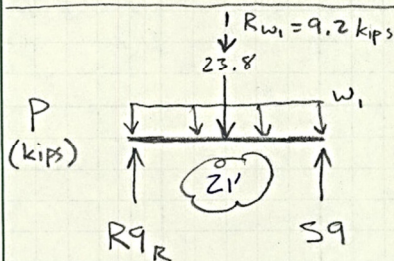
$$= 49.8 + 42.6 + 29.5$$

$$= 121.9 \text{ kips}$$

**** Ref. pg. 3-121, 3-119 of Steel Manual**

* Preferred $\rightarrow$ **W18x76** ($\phi M_n = 460 \text{ ft-kips}$)

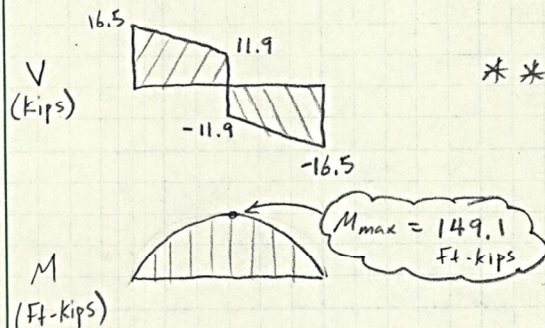
Also Acceptable $\rightarrow$ W21x83, W16x77, W12x87, + W10x100



$$w_1 = 0.439 \text{ ft}$$

$$+\uparrow \Sigma F_y = 0 \rightarrow P_{R9R} = P_{S9} = \frac{(9.2 + 23.8)}{2}$$

$$P_{R9R} = P_{S9} = 16.5 \text{ kips}$$



**** TOTAL LOAD ON R9**

$$= 23.8 + 16.5 + 42.6$$

$$= 82.9 \text{ kips}$$

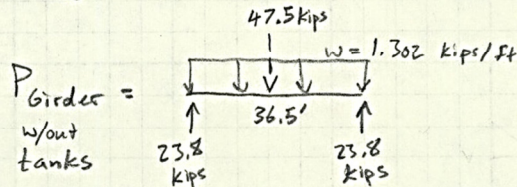
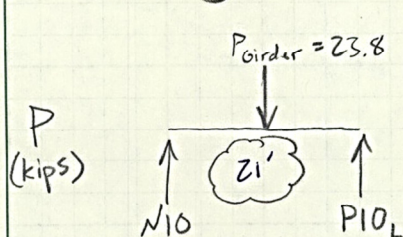
**** Ref. pg. 3-128 of Steel Manual**

* Preferred $\rightarrow$ **W14x43** ($\phi M_n = 153 \text{ ft-kips}$)

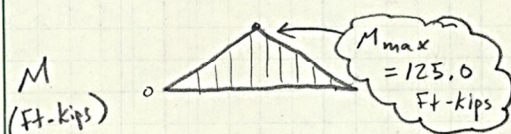
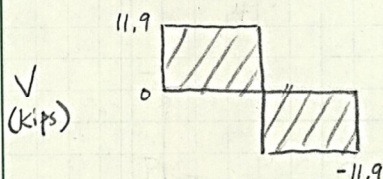
Also Acceptable $\rightarrow$ W8x48 and W10x45



o Loading on beams along column line #10

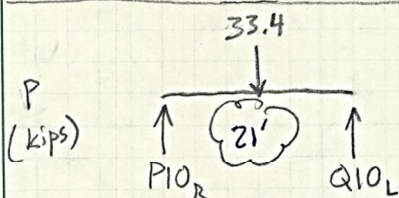


$$P_{N10} = P_{10L} = 11.9 \text{ kips}$$

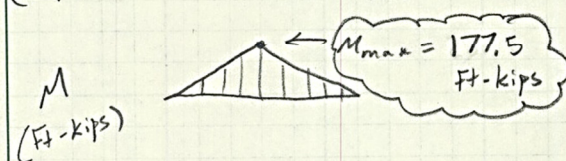
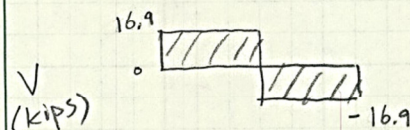


** Ref. pg. 3-128 of Steel Manual

* Preferred $\rightarrow W12 \times 40$ ($\phi M_n = 136 \text{ ft-kip}$)



$$\uparrow \Sigma F_y = 0 \rightarrow P_{10R} = Q_{10L} = 16.9$$



** TOTAL LOAD ON P10

$$= 11.9 + 16.9 + 43.0$$

$$= 71.8 \text{ kips}$$

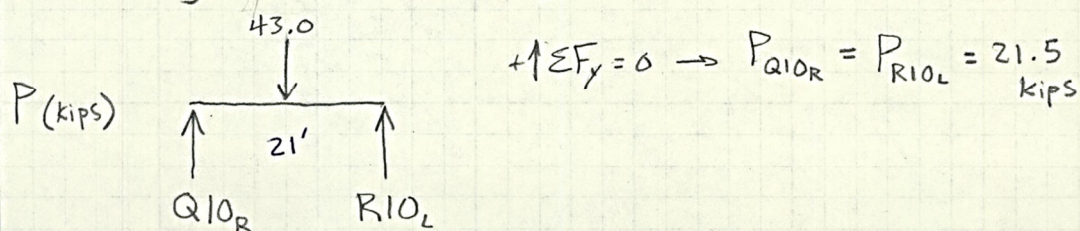
** Ref. pg 3-126 of Steel Manual

* Preferred $\rightarrow W14 \times 48$ ($\phi M_n = 185 \text{ ft-kips}$)

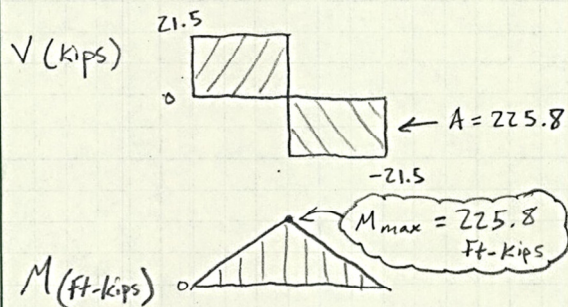
Also Acceptable $\rightarrow W10 \times 49$ and $W12 \times 50$



• Loading on beams along column line # 10 cont.



$$+\uparrow \Sigma F_y = 0 \rightarrow P_{Q10R} = P_{R10L} = 21.5 \text{ kips}$$



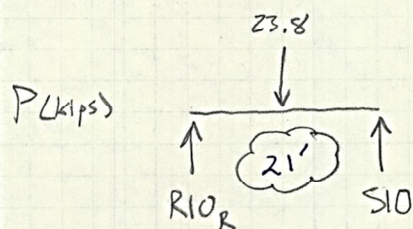
**** TOTAL LOAD ON Q10**

$$= 33.4 + 21.5 + 16.9$$

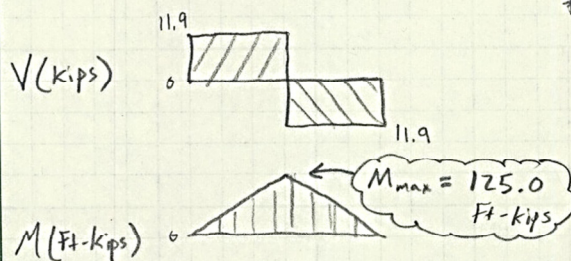
$$= 71.8 \text{ kips}$$

**** Ref. pg. 3-126, 3-124 of Steel Manual**

* Preferred $\rightarrow$ **W12x58** ($\phi M_n = 255 \text{ ft-kip}$)
Also Acceptable $\rightarrow$ W8x67 and W18x60



$$+\uparrow \Sigma F_y = 0 \rightarrow P_{R10R} = P_{S10} = 11.9 \text{ kips}$$



**** TOTAL LOAD ON R10**

$$= 23.8 + 21.5 + 11.9$$

$$= 57.2 \text{ kips}$$

**** Ref. pg. 3-128 of Steel Manual**

* Preferred $\rightarrow$ **W12x40** ($\phi M_n = 136 \text{ ft-kip}$)



Structural Breadth (NOT using waterless urinals)

Girders supporting Tank #2

* Total Roof Load (from before) = 124 psf (w/ Factor of Safety)

* Tank Point Load

↳ Total Wb. per tank = 70,033 lbs/ea. (Dead Load)

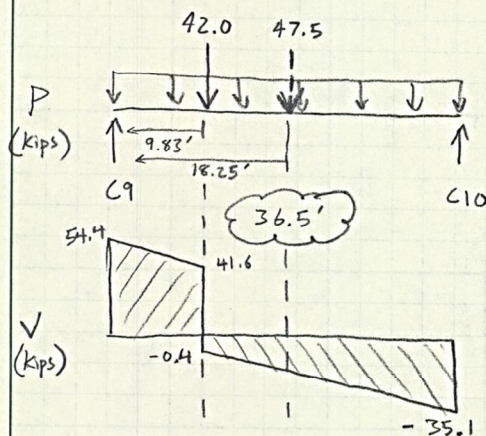
× 1.2 Factor of Safety

= 84,040 lbs/ea.

Each Beam = $84,040/2 = 42.0$ kips

$$w = 124 \text{ psf} \times 10.5' = 1.302 \text{ kips/ft}$$

$$R = 1.302 \times 36.5' = 47.5 \text{ kips}$$



$$\sum M_{C9} = -(9.83)(42) - (18.25)(47.5) + (36.5)(P_{C10}) = 0$$

$$P_{C10} = 35.1 \text{ kips}$$

$$\sum F_y = 0 = P_{C9} + 35.1 - 47.5 - 42$$

$$P_{C9} = 54.4 \text{ kips}$$

$$M_{max} = 471.8 \text{ ft-kips}$$

** Ref. pg. 3-120

* Preferred → **W14 × 99** or W24 × 104 ($\phi M_n = 480 \text{ ft-kips}$)
($\phi M_n = 480 \text{ ft-kips}$)



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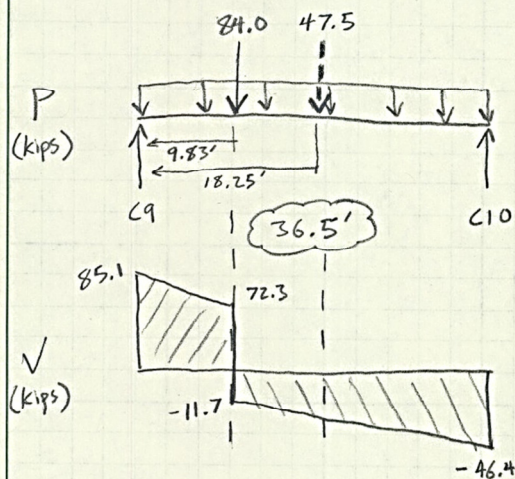
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Girders Supporting Tanks 1 and 3

- Total Roof Load = 124 psf (w/ Fos values)

- Pt. Load From Tank = 84.0 kips



$$w = 124 \text{ lb/ft}^2 \times 10.5' = 1.302 \text{ kips/ft}$$

$$R = 1.302 \times 36.5' = 47.5 \text{ kips}$$

$$\sum M_{C9} = -(9.83)(84.0) - (18.25)(47.5) + (36.5)(P_{C10}) = 0$$

$$P_{C10} = 46.4 \text{ kips}$$

$$+\uparrow \sum F_y = 46.4 - 84 - 47.5 + P_{C9} = 0$$

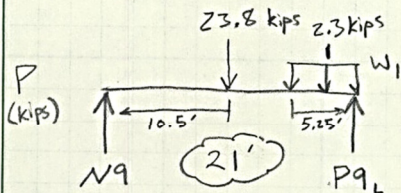
$$P_{C9} = 85.1 \text{ kips}$$

** Ref. Pg. 3-116 of Steel Manual

* Preferred $\rightarrow$ **W18 x 143** ($\phi M_n = 789 \text{ ft-kips}$)

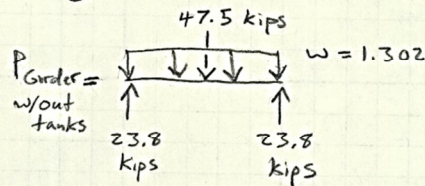


Loading on beams along column line #9



Ref. waterless
Urinal Loading

$$M_{max} = 128.1 \text{ ft-kip}$$



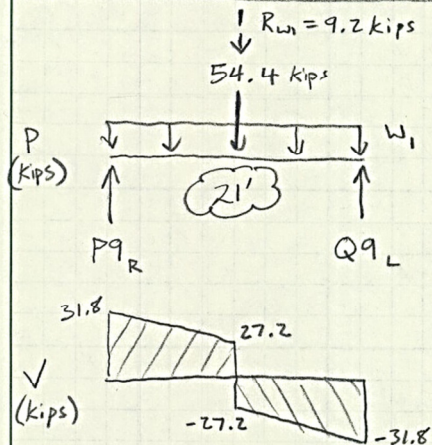
$$W_1 = 124 \text{ lb/ft}^2 \times \left(\frac{7.083}{2} \right) \text{ ft} = 0.439 \text{ kip/ft}$$

trib area
on other
side

$$R_{W1} = 0.439 \times 5.25' = 2.3 \text{ kips}$$

** Ref pg. 3-128 of Steel Manual

* Preferred $\rightarrow$ W12 x 40 ($\phi M_n = 136 \text{ ft-kip}$)



$$W_1 = 0.439 \text{ kip/ft}$$

$$R_{W1} = 21' \times 0.439 = 9.2 \text{ kips}$$

$$+\uparrow \Sigma F_y = 0 \rightarrow P_{P9R} = P_{Q9L} = \left(\frac{54.4 + 9.2}{2} \right)$$

$$P_{P9R} = P_{Q9R} = 31.8 \text{ kips}$$

** TOTAL LOAD ON P9

$$= 31.8 + 13.9 + 85.1$$

$$= 130.8 \text{ kips}$$

$$M_{max} = 309.8 \text{ ft-kips}$$

** Ref pg. 3-121

* Preferred $\rightarrow$ W16 x 67 ($\phi M_n = 360 \text{ ft-kips}$)

Also Acceptable $\rightarrow$ W10 x 77, W14 x 68, + W24 x 68

21x73

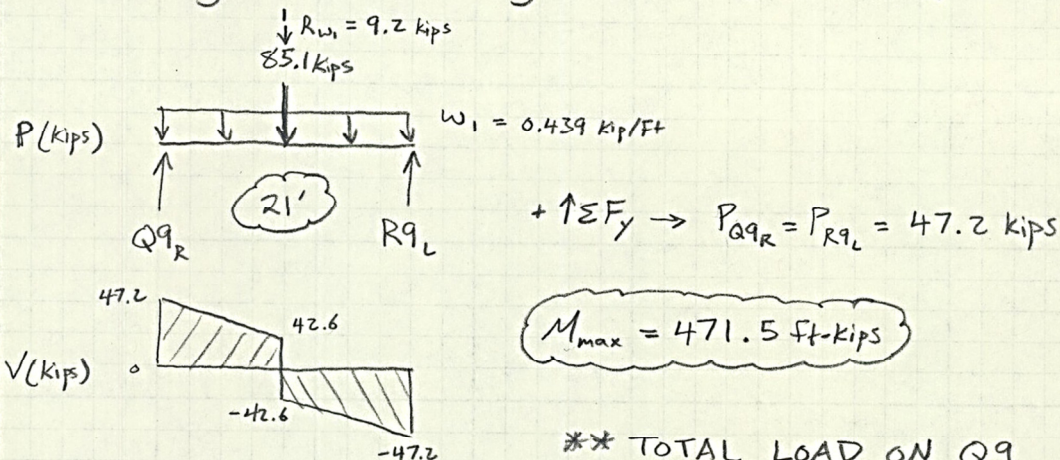


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◦ Loading on beams along Column Line # 9 cont.



**** TOTAL LOAD ON Q9**

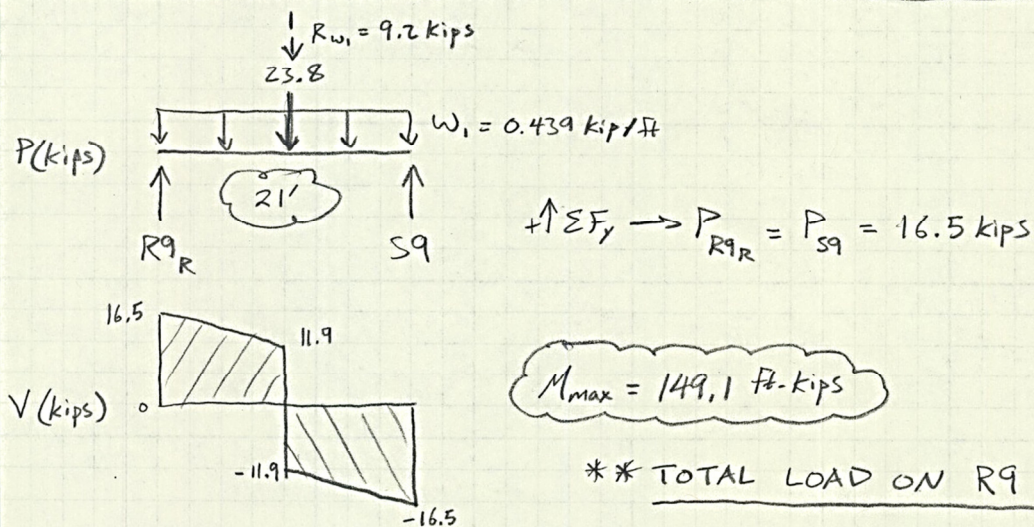
$$= 47.2 + 31.8 + 54.4$$

$$= 133.4 \text{ kips}$$

**** Ref. pg. 3-119 of Steel Manual**

* Preferred $\rightarrow W24 \times 84$ ($\phi M_n = 486 \text{ ft-kips}$)

Also Acceptable $\rightarrow W12 \times 96$



**** TOTAL LOAD ON R9**

$$= 16.5 + 47.2 + 23.8$$

$$= 87.5 \text{ kips}$$

**** Ref pg. 3-128 of Steel Manual**

* Preferred $\rightarrow W14 \times 43$ ($\phi M_n = 153 \text{ ft-kips}$)

Also Acceptable $\rightarrow W8 \times 48$ and $W10 \times 45$

3-0235 — 50 SHEETS — 5 SQUARES
3-0236 — 100 SHEETS — 5 SQUARES
3-0237 — 200 SHEETS — 5 SQUARES
3-0137 — 200 SHEETS — FILLER

COMET

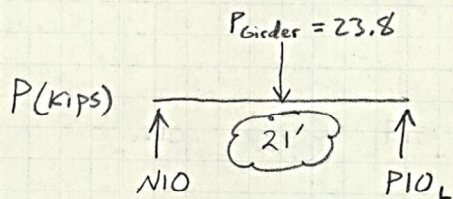


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◦ Loading on beams along column line #10



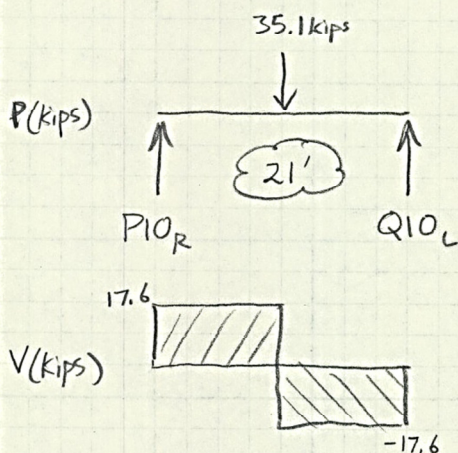
$$P_{N10} = P_{P10L} = 11.9 \text{ kips}$$

Ref. waterless
urinal loading

$$M_{max} = 125.0 \text{ Ft-kips}$$

** Ref. pg. 3-128 of
Steel Manual

* Preferred → W12 x 40
($\phi M_n = 136 \text{ Ft-kips}$)



$$+\uparrow \Sigma F_y \rightarrow P_{P10R} = P_{Q10L} = 17.6$$

$$M_{max} = 184.8 \text{ Ft-kips}$$

** TOTAL LOAD ON P10

$$= 11.9 + 17.6 + 46.4$$

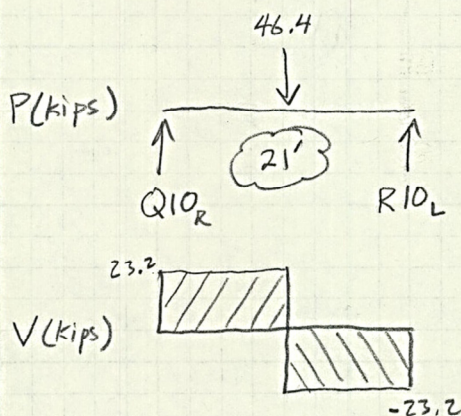
$$= \underline{75.9 \text{ kips}}$$

** Ref. pg. 3-126

* Preferred → W14 x 48 or W12 x 50 ($\phi M_n = 185.5 \text{ Ft-kips}$)
($\phi M_n = 185 \text{ Ft-kips}$)



- Loading on beams along column line #10 cont.



$$+\uparrow \Sigma F_y \rightarrow P_{Q10R} = P_{R10L} = 23.2 \text{ kips}$$

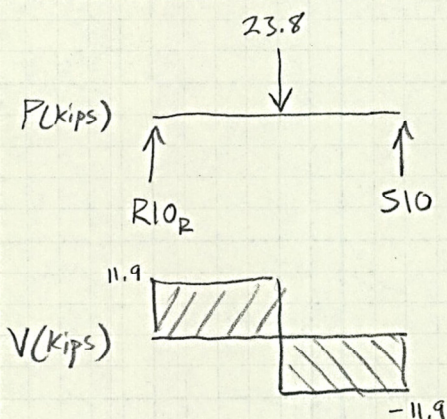
$$M_{max} = 243.6 \text{ Ft-kips}$$

$$\begin{aligned} \text{** TOTAL LOAD ON Q10} \\ &= 23.2 + 17.6 + 35.1 \\ &= \underline{75.9 \text{ kips}} \end{aligned}$$

** Ref. pg. 3-124 of Steel Manual

* Preferred $\rightarrow$ W12 x 58 ($\phi M_n = 255 \text{ Ft-kip}$)

Also Acceptable $\rightarrow$ W18 x 65 and W21 x 62



$$+\uparrow \Sigma F_y \rightarrow P_{R10R} = P_{S10} = 11.9 \text{ kips}$$

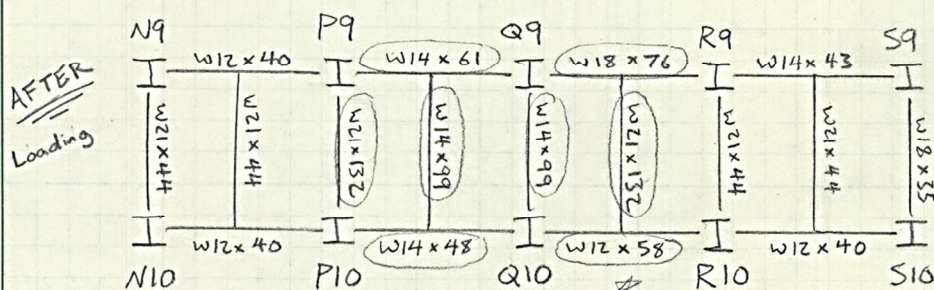
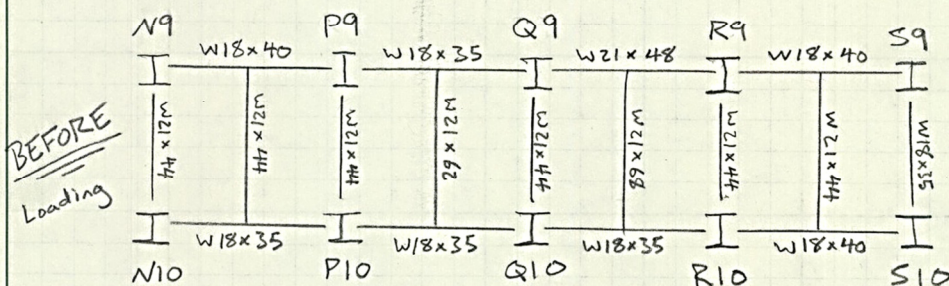
$$M_{max} = 125.0 \text{ Ft-kips}$$

$$\begin{aligned} \text{** TOTAL LOAD ON R10} \\ &= 11.9 + 23.2 + 23.8 \\ &= \underline{58.9 \text{ kips}} \end{aligned}$$

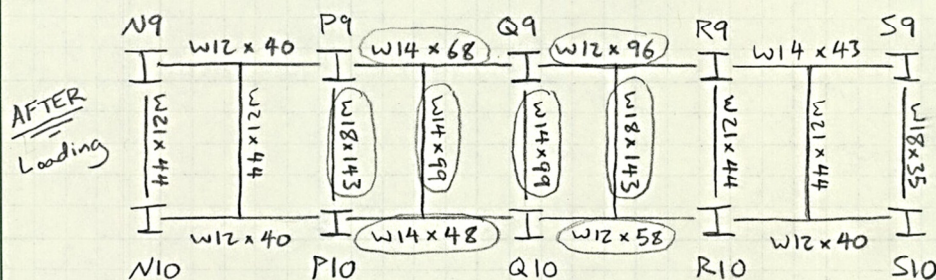
** Ref. pg. 3-128 of Steel Manual

* Preferred $\rightarrow$ W12 x 40 ($\phi M_n = 136 \text{ Ft-kip}$)

- Steel Beam/Girder Comparison:



**** USING WATERLESS URINALS ****



**** NOT Using Waterless Urinals ****

Added Cost $\rightarrow$ Using 21,000 gal. = \$ 13,251

↳ Using 25,000 gal. = \$ 14,838

Difference = \$ 1,587



★ Live Load Reduction

• Columns P9, Q9, R9

$K_{LL} = 3$ (edge columns w/ cantilever slabs)

$L_o = 27.2$ kips

$A_T = 532.0$ SF

$$L = L_o \left(0.25 + \frac{15}{\sqrt{K_{LL} \cdot A_T}} \right) = (27.2) \left(0.25 + \frac{15}{\sqrt{3 \times 532}} \right) = \boxed{17.0 \text{ Kips}}$$

$$* L \geq 0.40 L_o \rightarrow 17 \geq (0.4)(27.2)$$

$$17 \geq 10.88$$

✓

• Columns P10, Q10, R10

$K_{LL} = 4$ (exterior columns w/out cantilever slabs)

$L_o = 15.3$

$A_T = 383.25$ SF

$$L = (15.3) \left(0.25 + \frac{15}{\sqrt{4 \times 383}} \right) = \boxed{9.7 \text{ Kips}}$$

$$* L \geq 0.40 L_o \rightarrow 9.7 \geq (0.4)(15.3)$$

$$9.7 \geq 6.12$$

✓



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STEEL BEAM / GIRDER COMPARISON

ORIGINAL MEMBER SIZE (using RS Means Costworks)

Size	Count	Total Length (LF)	Total Weight (Tons)	Material Cost/LF	Total Material Cost	Labor Cost/LF	Total Labor Cost	Equipment Cost/LF	Total Equipment Cost
W18 x 35	3 ea.	63.0	2.205	42.67	\$ 2,688.21	5.35	\$ 337.05	1.75	\$ 110.25
W21 x 44	2 ea.	73.0	3.212	53.46	\$ 3,902.58	4.82	\$ 351.86	1.59	\$ 116.07
W21 x 48	1 ea.	21.0	1.008	60.82	\$ 1,277.22	4.82	\$ 101.22	1.59	\$ 33.39
W21 x 62	1 ea.	36.5	2.263	75.05	\$ 2,739.33	4.96	\$ 181.04	1.62	\$ 59.13
W21 x 68	1 ea.	36.5	2.482	82.40	\$ 3,007.60	4.96	\$ 181.04	1.62	\$ 59.13
				\$	\$ 13,614.94		\$ 1,152.21		\$ 377.97

NEW MEMBER SIZE - With 21,000 Gallons of Water (using RS Means Costworks)

Size	Count	Total Length (LF)	Total Weight (Tons)	Material Cost/LF	Total Material Cost	Labor Cost/LF	Total Labor Cost	Equipment Cost/LF	Total Equipment Cost
W12 x 58	1 ea.	21	58	70.63	\$ 1,483.23	4.74	\$ 99.54	2.10	\$ 44.10
W14 x 48	1 ea.	21	48	58.13	\$ 1,220.63	4.42	\$ 92.72	1.97	\$ 41.27
W14 x 61	1 ea.	21	61	77.01	\$ 1,617.21	4.57	\$ 95.87	2.03	\$ 42.53
W14 x 99	2 ea.	73	198	121.32	\$ 8,856.36	4.84	\$ 353.32	2.15	\$ 156.95
W18 x 76	1 ea.	21	76	92.21	\$ 1,936.41	5.71	\$ 119.91	1.87	\$ 39.27
W21 x 132	2 ea.	73	264	160.27	\$ 11,699.71	5.13	\$ 374.49	1.68	\$ 122.64
				\$	\$ 26,813.55		\$ 1,135.84		\$ 446.75

TOTAL INCREASE IN COST = \$ 13,251

NEW MEMBER SIZE - With 25,000 Gallons of Water (using RS Means Costworks)

Size	Count	Total Length (LF)	Total Weight (Tons)	Material Cost/LF	Total Material Cost	Labor Cost/LF	Total Labor Cost	Equipment Cost/LF	Total Equipment Cost
W12 x 58	1 ea.	21	58	70.63	\$ 1,483.23	4.74	\$ 99.54	2.10	\$ 44.10
W12 x 96	1 ea.	21	96	116.56	\$ 2,447.76	5.55	\$ 116.55	2.46	\$ 51.66
W14 x 48	1 ea.	21	48	58.13	\$ 1,220.63	4.42	\$ 92.72	1.97	\$ 41.27
W14 x 68	1 ea.	21	68	82.11	\$ 1,724.31	4.61	\$ 96.81	2.04	\$ 42.84
W14 x 99	2 ea.	73	198	120.07	\$ 8,765.11	4.84	\$ 353.32	2.15	\$ 156.95
W18 x 143	2 ea.	73	286	173.87	\$ 12,692.51	5.71	\$ 416.83	1.87	\$ 136.51
				\$	\$ 28,333.55		\$ 1,175.77		\$ 473.33

TOTAL INCREASE IN COST = \$ 14,718.61

TOTAL DIFFERENCE IN INCREASED COST = \$ 1,587



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WATERLESS URINALS USED - 21,000 GALLONS OF WATER

Column	Material	Span	Effective Length (ft.)	Above Floor Load (kips)	Total Load From Above (kips)	Total Combined Load On Column (kips)	Original Size (in)	New Size (in)	Page Ref.
P9	Steel	5th - Pent	14.6	119.3	0	119.3	W8 x 40	W8 x 40	4-21 Steel Manual
P9	Concrete	4th - 5th	14.0	173.3	119.3	292.6	36 x 16		
P9	Concrete	3rd - 4th	14.0	173.3	292.6	465.9	36 x 16		
P9	Concrete	2nd - 3rd	14.0	173.3	465.9	639.2	36 x 16		
P9	Concrete	1st - 2nd	15.2	173.3	639.2	812.5	28 dia.		
P9	Concrete	Base - 1st	11.7	173.3	812.5	985.8	24 x 24		
P10	Steel	5th - Pent	14.6	71.8	0	71.8	W8 x 48	W8 x 48	4-21 Steel Manual
P10	Concrete	4th - 5th	14.0	120.7	71.8	192.5	34 x 16		
P10	Concrete	3rd - 4th	14.0	120.7	192.5	313.2	34 x 16		
P10	Concrete	2nd - 3rd	14.0	120.7	313.2	433.9	34 x 16		
P10	Concrete	1st - 2nd	15.2	120.7	433.9	554.6	40 x 28		
P10	Concrete	Base - 1st	11.7	120.7	554.6	675.3	40 x 28		
Q9	Steel	5th - Pent	14.6	121.9	0	121.9	W8 x 40	W8 x 40	4-21 Steel Manual
Q9	Concrete	4th - 5th	14.0	173.3	121.9	295.2	36 x 16		
Q9	Concrete	3rd - 4th	14.0	173.3	295.2	468.5	36 x 16		
Q9	Concrete	2nd - 3rd	14.0	173.3	468.5	641.8	36 x 16		
Q9	Concrete	1st - 2nd	15.2	173.3	641.8	815.1	28 dia.		
Q9	Concrete	Base - 1st	11.7	173.3	815.1	988.4	24 x 24		
Q10	Steel	5th - Pent	14.6	71.8	0	71.8	W8 x 48	W8 x 48	4-21 Steel Manual
Q10	Concrete	4th - 5th	14.0	120.7	71.8	192.5	34 x 16		
Q10	Concrete	3rd - 4th	14.0	120.7	192.5	313.2	34 x 16		
Q10	Concrete	2nd - 3rd	14.0	120.7	313.2	433.9	34 x 16		
Q10	Concrete	1st - 2nd	15.2	120.7	433.9	554.6	40 x 28		
Q10	Concrete	Base - 1st	11.7	120.7	554.6	675.3	40 x 28		
R9	Steel	5th - Pent	14.6	82.9	0	82.9	W8 x 40	W8 x 40	4-21 Steel Manual
R9	Concrete	4th - 5th	14.0	173.3	82.9	256.2	36 x 16		
R9	Concrete	3rd - 4th	14.0	173.3	256.2	429.5	36 x 16		
R9	Concrete	2nd - 3rd	14.0	173.3	429.5	602.8	36 x 16		
R9	Concrete	1st - 2nd	15.2	173.3	602.8	776.1	28 dia.		
R9	Concrete	Base - 1st	11.7	173.3	776.1	949.4	28 dia.		
R10	Steel	5th - Pent	14.6	57.2	0	57.2	W8 x 48	W8 x 48	4-21 Steel Manual
R10	Concrete	4th - 5th	14.0	120.7	57.2	177.9	34 x 16		
R10	Concrete	3rd - 4th	14.0	120.7	177.9	298.6	34 x 16		
R10	Concrete	2nd - 3rd	14.0	120.7	298.6	419.3	34 x 16		
R10	Concrete	1st - 2nd	15.2	120.7	419.3	540	40 x 28		
R10	Concrete	Base - 1st	11.7	120.7	540	660.7	40 x 28		



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WATERLESS URINALS USED - 21,000 GALLONS OF WATER

Column	Material	Span	Effective Length (ft.)	Above Floor Load (kips)	Total Load From Above (kips)	Total Combined Load On Column (kips)	Original Size (in)	New Size (in)	Page Ref.
P9	Steel	5th - Pent	14.6	130.8	0	130.8	W8 x 40	W8 x 40	4-21 Steel Manual
P9	Concrete	4th - 5th	14.0	173.3	130.8	304.1	36 x 16		
P9	Concrete	3rd - 4th	14.0	173.3	304.1	477.4	36 x 16		
P9	Concrete	2nd - 3rd	14.0	173.3	477.4	650.7	36 x 16		
P9	Concrete	1st - 2nd	15.2	173.3	650.7	824	28 dia.		
P9	Concrete	Base - 1st	11.7	173.3	824	997.3	24 x 24		
P10	Steel	5th - Pent	14.6	75.9	0	75.9	W8 x 48	W8 x 48	4-21 Steel Manual
P10	Concrete	4th - 5th	14.0	120.7	75.9	196.6	34 x 16		
P10	Concrete	3rd - 4th	14.0	120.7	196.6	317.3	34 x 16		
P10	Concrete	2nd - 3rd	14.0	120.7	317.3	438	34 x 16		
P10	Concrete	1st - 2nd	15.2	120.7	438	558.7	40 x 28		
P10	Concrete	Base - 1st	11.7	120.7	558.7	679.4	40 x 28		
Q9	Steel	5th - Pent	14.6	133.4	0	133.4	W8 x 40	W8 x 40	4-21 Steel Manual
Q9	Concrete	4th - 5th	14.0	173.3	133.4	306.7	36 x 16		
Q9	Concrete	3rd - 4th	14.0	173.3	306.7	480	36 x 16		
Q9	Concrete	2nd - 3rd	14.0	173.3	480	653.3	36 x 16		
Q9	Concrete	1st - 2nd	15.2	173.3	653.3	826.6	28 dia.		
Q9	Concrete	Base - 1st	11.7	173.3	826.6	999.9	24 x 24		
Q10	Steel	5th - Pent	14.6	75.9	0	75.9	W8 x 48	W8 x 48	4-21 Steel Manual
Q10	Concrete	4th - 5th	14.0	120.7	75.9	196.6	34 x 16		
Q10	Concrete	3rd - 4th	14.0	120.7	196.6	317.3	34 x 16		
Q10	Concrete	2nd - 3rd	14.0	120.7	317.3	438	34 x 16		
Q10	Concrete	1st - 2nd	15.2	120.7	438	558.7	40 x 28		
Q10	Concrete	Base - 1st	11.7	120.7	558.7	679.4	40 x 28		
R9	Steel	5th - Pent	14.6	82.9	0	87.5	W8 x 40	W8 x 40	4-21 Steel Manual
R9	Concrete	4th - 5th	14.0	173.3	87.5	260.8	36 x 16		
R9	Concrete	3rd - 4th	14.0	173.3	260.8	434.1	36 x 16		
R9	Concrete	2nd - 3rd	14.0	173.3	434.1	607.4	36 x 16		
R9	Concrete	1st - 2nd	15.2	173.3	607.4	780.7	28 dia.		
R9	Concrete	Base - 1st	11.7	173.3	780.7	954	28 dia.		
R10	Steel	5th - Pent	14.6	58.9	0	58.9	W8 x 48	W8 x 48	4-21 Steel Manual
R10	Concrete	4th - 5th	14.0	120.7	58.9	179.6	34 x 16		
R10	Concrete	3rd - 4th	14.0	120.7	179.6	300.3	34 x 16		
R10	Concrete	2nd - 3rd	14.0	120.7	300.3	421	34 x 16		
R10	Concrete	1st - 2nd	15.2	120.7	421	541.7	40 x 28		
R10	Concrete	Base - 1st	11.7	120.7	541.7	662.4	40 x 28		



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Floor Slab Loads (DL)							
Column Line 9				Column Line 10			
Tributary Area =	21' x 25.3' =	532.0 SF		Tributary Area =	21' x 18.25' =	383.25 SF	
Depth of Slab =	8" =	0.7 FT		Depth of Slab =	8" =	0.67 FT	
Tributary Volume =		354.7 CF		Tributary Volume =		255.5 CF	
Unit Wt. of Conctete =		150.0 lbs/CF		Unit Wt. of Conctete =		150.0 lbs/CF	
Floor Slab Loads =	255.5 x 150 =	53199 lbs		Floor Slab Loads =	255.5 x 150 =	38325 lbs	
		53.20 kips				38.32 kips	
Floor Beam Loads (DL)							
Column Line 9				Column Line 10			
Tributary Area =	8' x 25.3' =	202.7 SF		Tributary Area =	8' x 18.25' =	146 SF	
Depth of Beams =	26" =	2.2 FT		Depth of Beams =	26" =	2.17 FT	
Tributary Volume =		439.1 CF		Tributary Volume =		316.3 CF	
Unit Wt. of Conctete =		150.0 lbs/CF		Unit Wt. of Conctete =		150.0 lbs/CF	
Floor Beam Loads =	316.3 x 150 =	65866 lbs		Floor Beam Loads =	316.3 x 150 =	47450 lbs	
		65.87 kips				47.45 kips	
Other Dead Loads (DL)							
Column Line 9				Column Line 10			
Equipment - Assume 5 lb/sf		5.0 PSF		Equipment - Assume 5 lb/sf		5.0 PSF	
Tributary Area =	21' x 25.3' =	532.0 SF		Tributary Area =	21' x 18.25' =	383.25 SF	
Other Dead Loads =		2660.0 lbs		Other Dead Loads =		1916.3 lbs	
		2.66 kips				1.92 kips	
TOTAL FLOOR DEAD LOADS (DL)							
Column Line 9				Column Line 10			
Floor + Beam + Other		121.73 kips		Floor + Beam + Other		87.69 kips	
TOTAL LIVE LOADS (LL)							
ASCE 7-10 - Chapter 4 - Live Loads							
Classrooms =		40 PSF					
Corridors =		80 PSF					
Column Line 9				Column Line 10			
Tributary Area (Cooridor) =		148.75 SF		Tributary Area (Classroom) =		383.25 SF	
Live Load (Cooridor) =		80 PSF		Live Load (Classroom) =		40 PSF	
Subtotal =		11.9 kips		TOTAL LIVE LOAD		15.3 kips	
Tributary Area (Classroom) =		383.25 SF					
Live Load (Classroom) =		40 PSF					
TOTAL LIVE LOAD		27.2 kips					
LIVE LOAD REDUCTION		17.0 kips				9.7 kips	
ADDED FACTORS OF SAFETY (TOTAL LOAD)							
Column Line 9				Column Line 10			
TOTAL DL =	121.73 kips			TOTAL DL =		87.69 kips	
TOTAL LL =	17.0 kips			TOTAL LL =		9.7 kips	
Total Load = (1.2 * DL) + (1.6 * LL)				Total Load = (1.2 * DL) + (1.6 * LL)			
TOTAL LOAD ON EACH COLUMN =		173.3 kips		TOTAL LOAD ON EACH COLUMN =		120.7 kips	