David S. Ingalls Rink

73 Sachem Street, New Haven, CT 06501

Amy Huan | Lighting + Electrical |Final Thesis Presentation | 4/14/2014

Building name	**David S. Ingalls Rink**
Location	**New Haven, CT**
Building Occupant	**Yale University**
Architect	**Eero Saarinen**
Total gsf	**61,646 sf**
Total Levels	**2**

Client	Yale University
Architect	Kevin Roche John Dinkeloo and Associates LLC
Lighting Consultant	Atelier Ten Consulting Designers
Structure Engineers	Severud Associates Consulting Engineers, P.C.
Mechanical Consultants	AltieriSeborWieber LLC
Construction Manager	Turner Construction Company
Civil Engineer	Tighe & Bond
Sound System	Cavanaugh Tocci Associates, Incorporated

Project Overview

Scope + concept

LG | Building Exterior

Diving

LG | Circulation Corridor

Coral Reef

LG | Rink

Ocean

EL | branch circuit analysis

EL | copper vs. aluminum cost analysis

Acoustic | reverberation time analysis

Thanks to…

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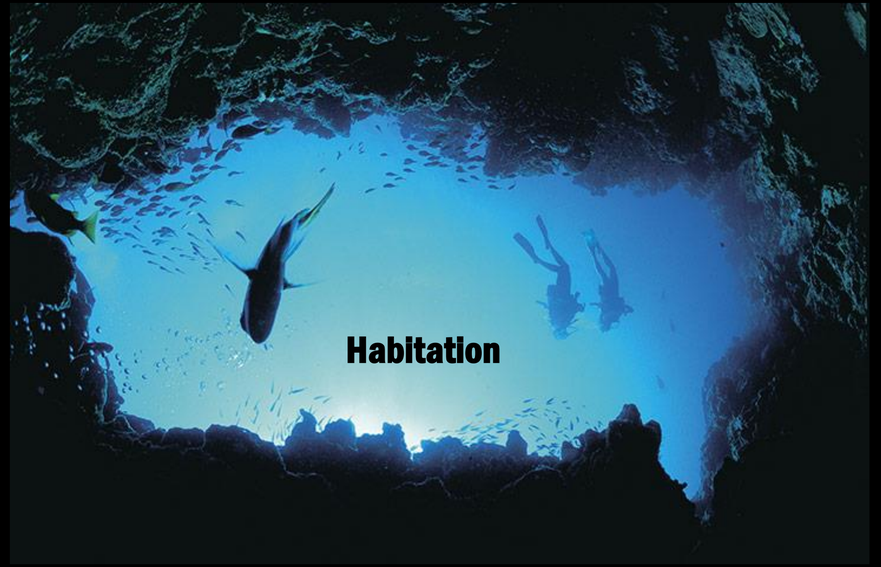

Seeing

|Lighting Depth
Building Exterior
Circulation
Rink
Schley Club Room

|Electrical Depth
Branch Circuit Analysis
Short Circuit Analysis
Copper vs. Aluminum Wire Cost Analysis

Feeling

|Structural Breadth
Wind Load Analysis on Building Entrance

Hearing

|Acoustical Breadth
Reverberation Time Analysis

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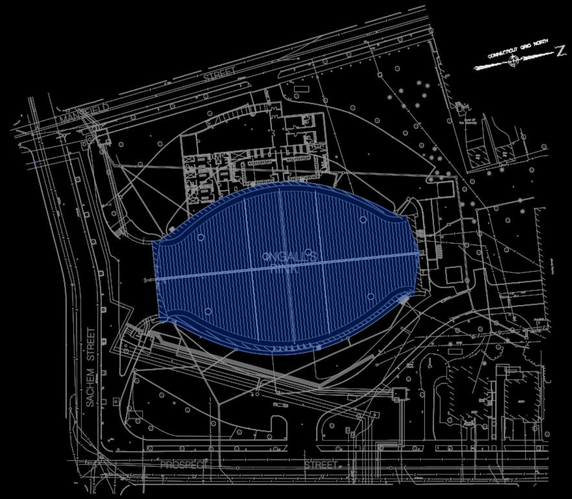

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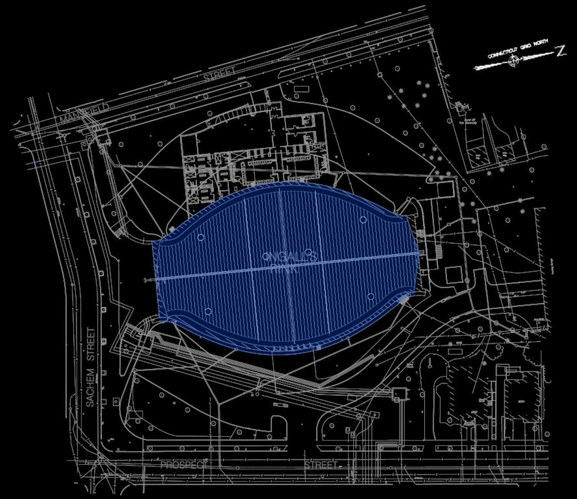

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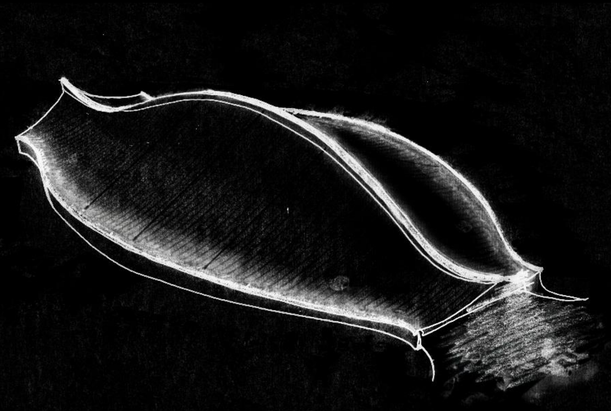

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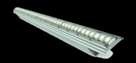
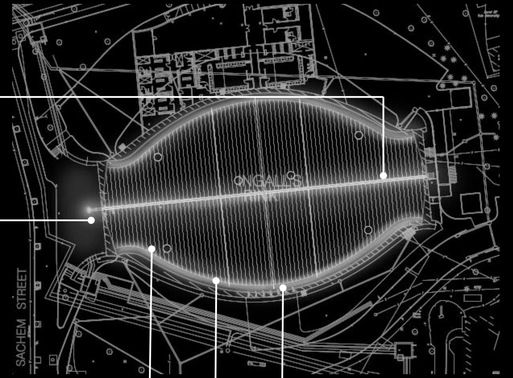
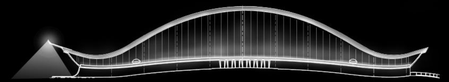
5w LED
linear grazer
adjustable 6" arm

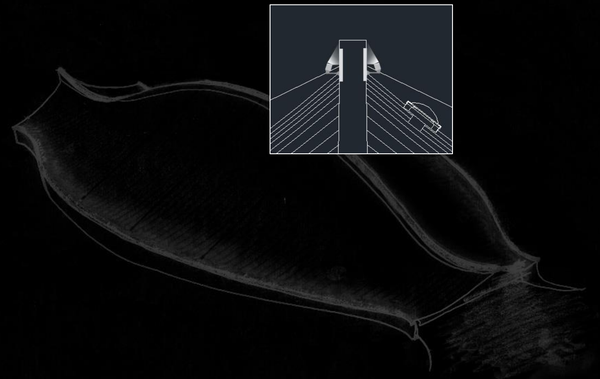
100w LED
exterior downlight
surface



5w/10w/15w LED
linear flood light
surface







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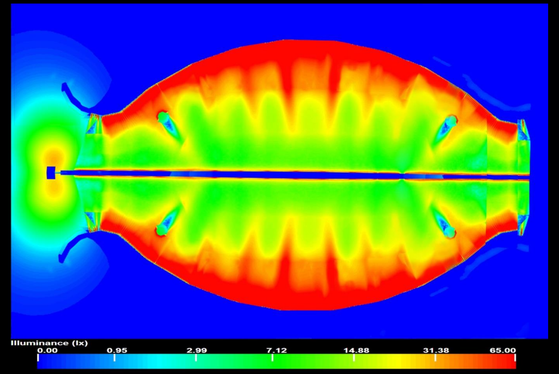
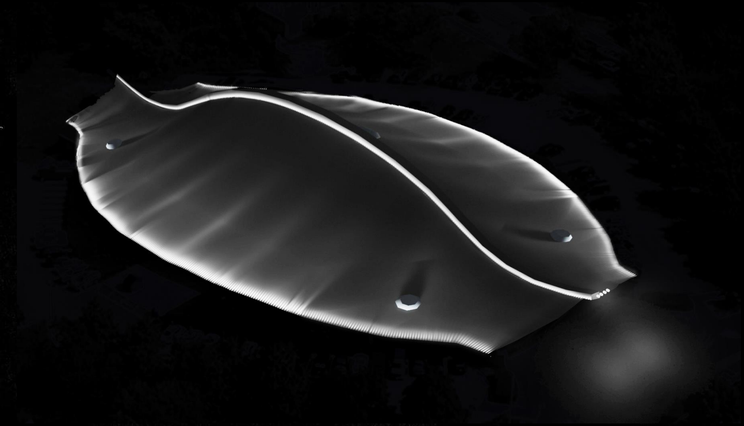


surface	illuminance (fc)
roof spine	50
roof surface	4
front plaza	2.5

LPD	designed	allowable
exterior	0.156	0.15
front Plaza	0.06	0.16



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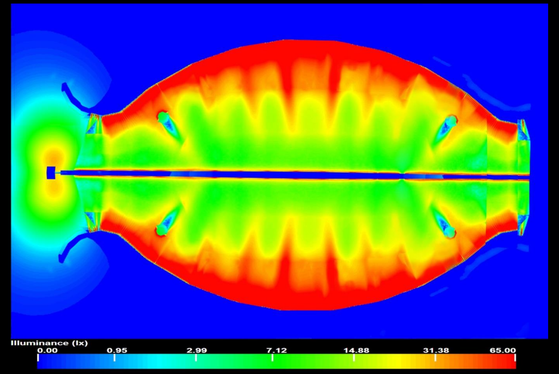

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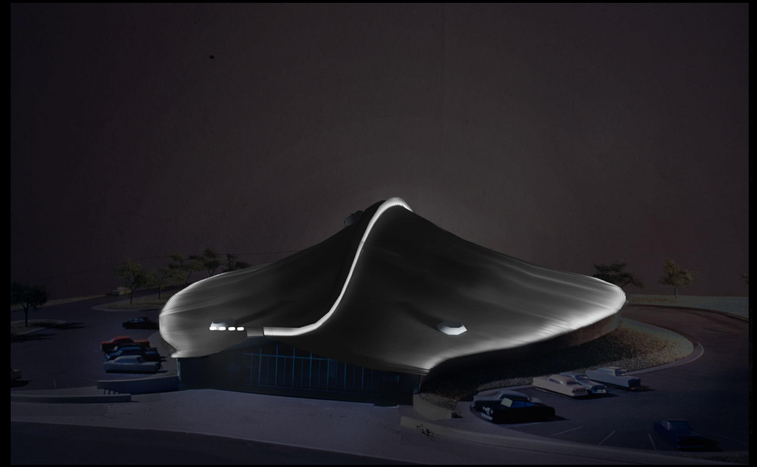

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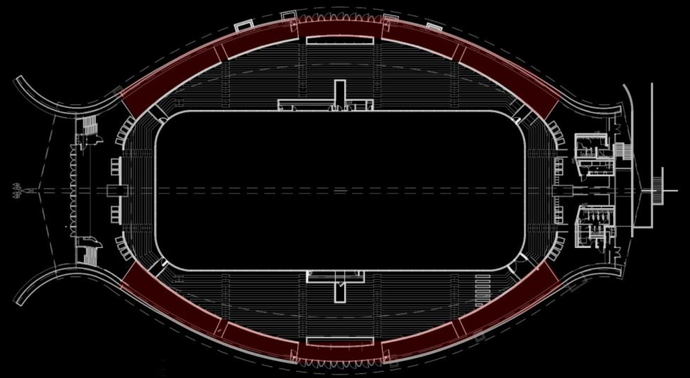

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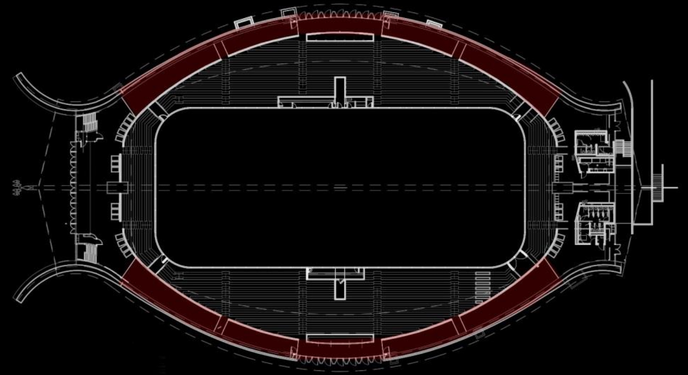

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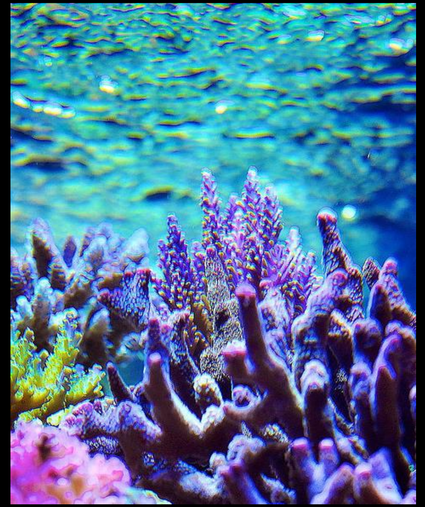

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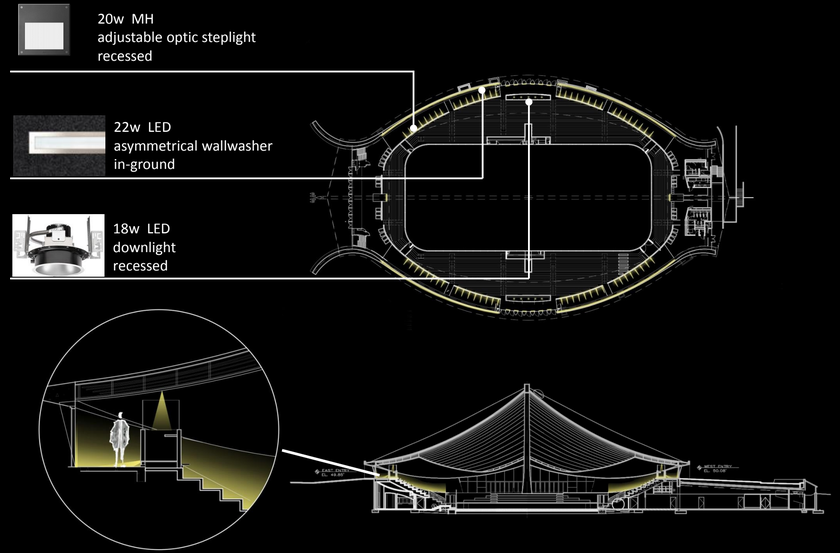

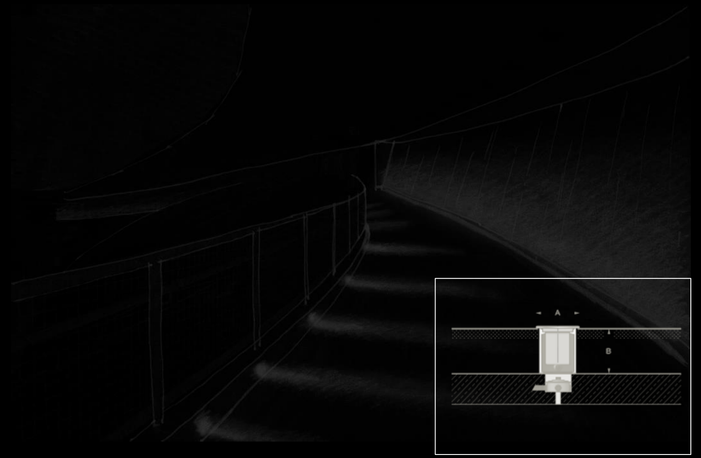

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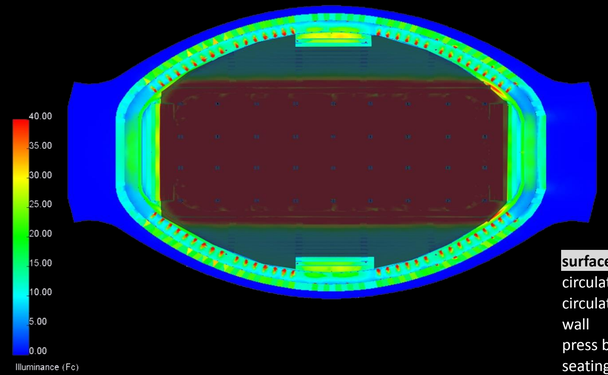
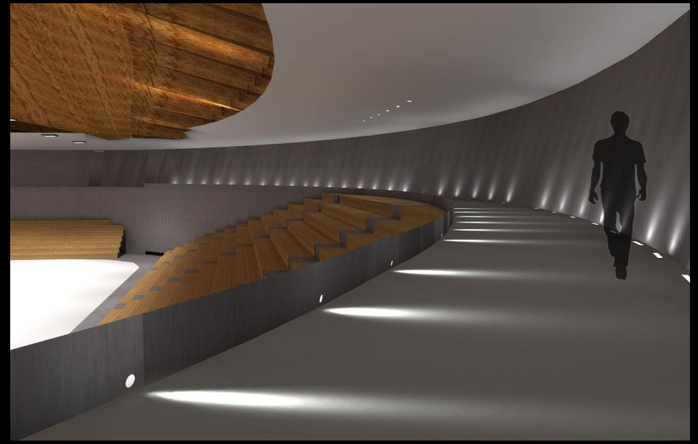


surface	illuminance (fc)
circulation floor	28
circulation @ 6'	11
wall	17
press box	29
seating	19

LPD	designed	allowable
circulation	0.44	0.66



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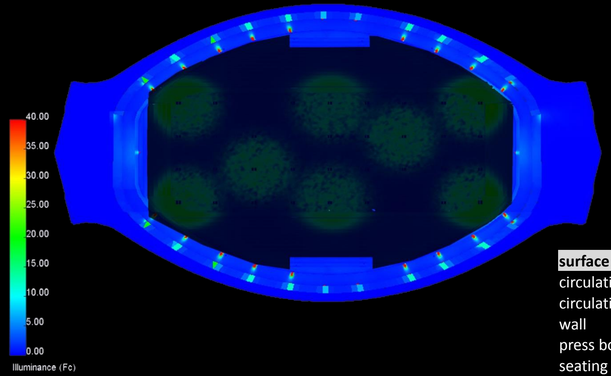

surface	illuminance (fc)
circulation floor	9.5
circulation @ 6'	2
wall	1.5
press box	1.5
seating	3.56

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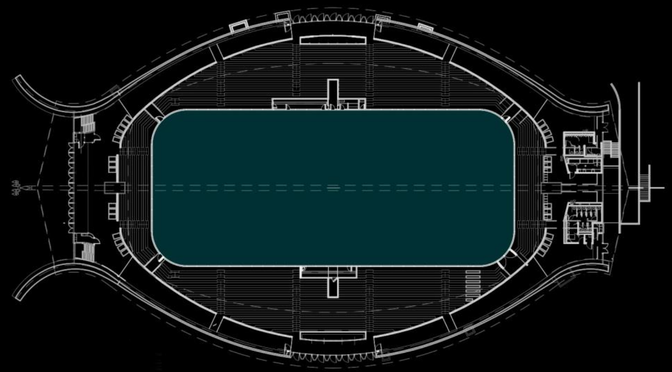

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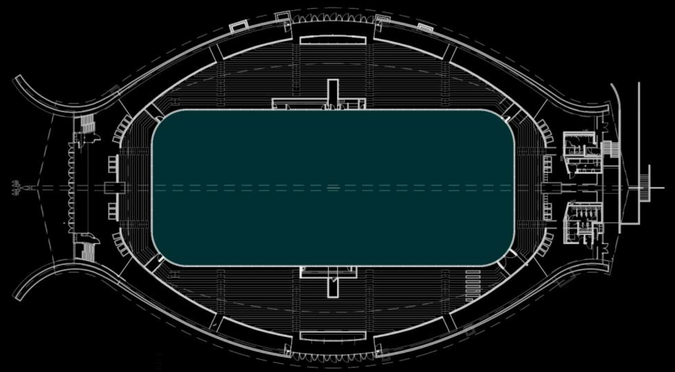

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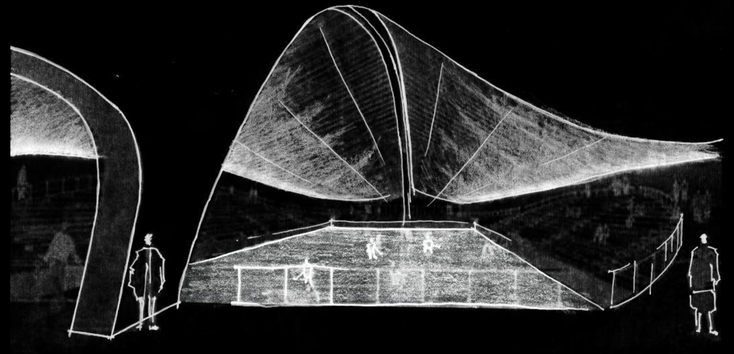

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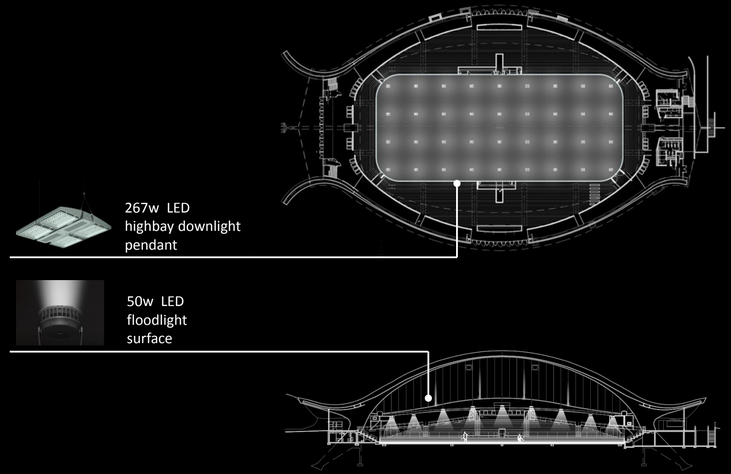

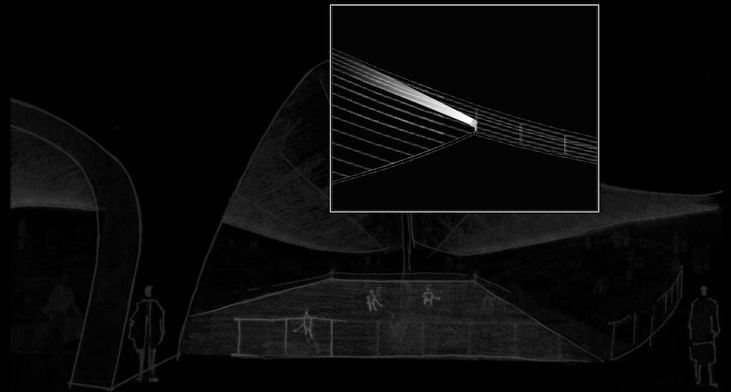

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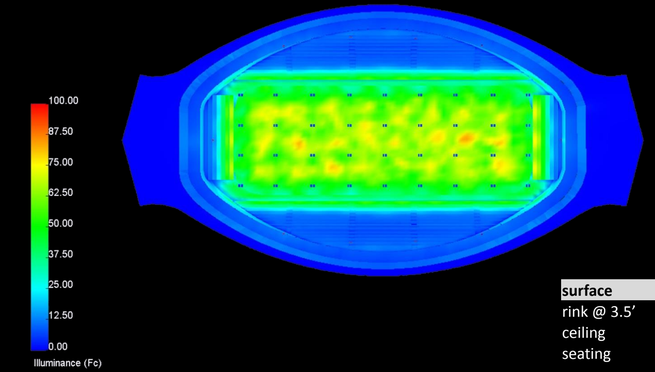
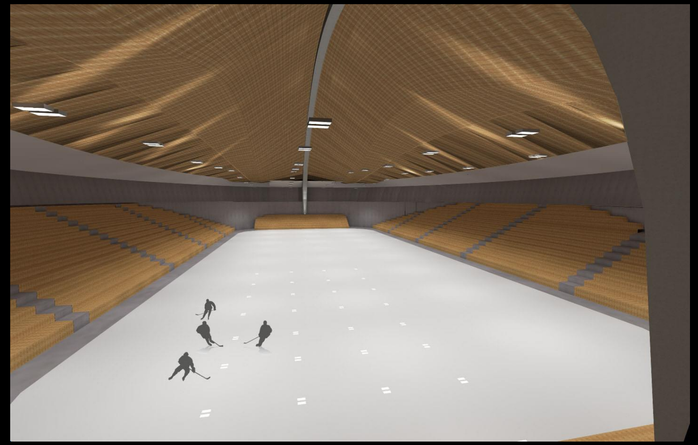


surface	illuminance (fc)
rink @ 3.5'	95
ceiling	20
seating	18

LPD	designed	allowable
rink	1.16	1.92



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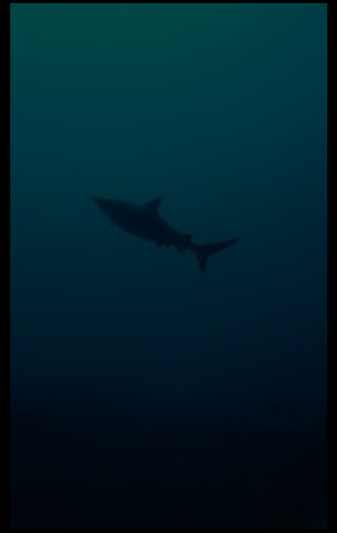

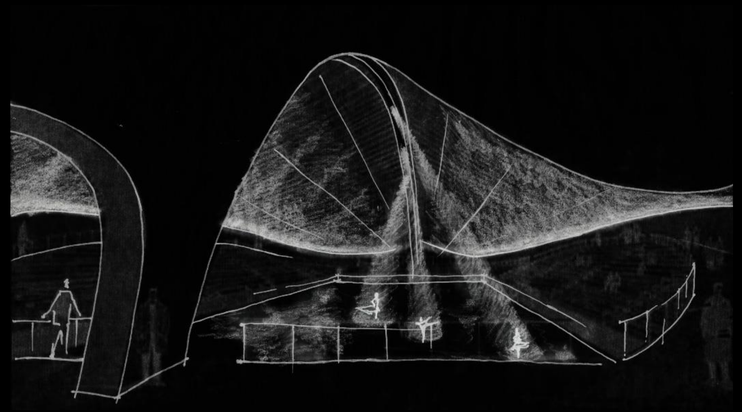

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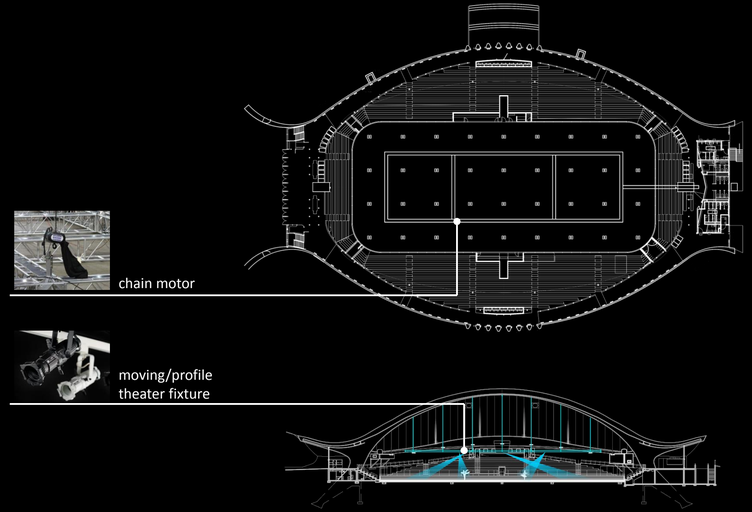

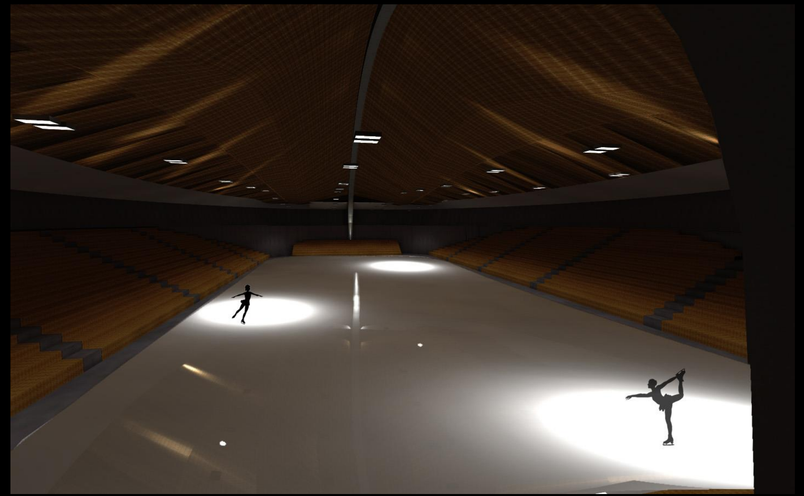

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Type	Location	Lamps	#of fixtures	Total KVA
A01	Rink	(1) 400W PS MH	72	28.8
A02	Circulation Corridoor	(1) 32W TTT (830)	82	2.624
A03	Circulation Corridoor	(1) 32W TTT (830)	48	1.536
A10	Schley Club Room	(1) 26W Quad Tube (835)	12	0.312
A11	Schley Club Room	75 W PAR 30 flood	24	1.8
A12	Schley Club Room	(1) 28W T5 (835)	36	1.008
A24	Schley Club Room	(1) 26W TTT (830)	4	0.104
			Total	36.184

Annual Savings: 34,776 KWh

Type	Location	Lamps	#of fixtures	Total KVA
AD01	Pressbox, Schley Club Room	13W LED	42	0.546
AD02	Schley Club Room	11W LED	15	0.165
AF01	Rink	50W LED	10	0.5
AG01	Schley Club Room	24W LED	19	0.456
AG01(a)	Schley Club Room	6W LED	1	0.006
AP01	Rink	267W LED	72	19.224
AS01	Circulation Corridoor	20W MH	70	1.4
AW01	Circulation Corridoor	27W LED	85	2.295
			Total	24.592

Copper

Tag	From	To	Length	No. of sets	Conduit (Per Set)			Conductors								Total Cost
								Phase Conductors				Ground Conductors				
					Size	Type	Cost/LF	No.	Size	Type	Cost/LF	No.	Size	Type	Cost/LF	
1	Service Transformer	MDP	65	2	4"	EMT	26	10	600	XHHW-2	54.25	4		4 THHN/THWN	5.68	64650.8
2	MDP	EX - MCC	27	2	3"	EMT	19.6	8	350	XHHW-2	40.25	2		1 XHHW-2	6.83	10123.22
3		EX - GARAGE	16	1	2 1/2"	EMT	16.65	4	250	XHHW-2	32.15	1		4 THHN/THWN	5.68	2414.88
4		PP - N	12	1	2 1/2"	EMT	16.65	4	4/0	XHHW-2	27.05	1		4 THHN/THWN	5.68	1566.36
5		PP - S	195	1	2 1/2"	EMT	16.65	4	4/0	XHHW-2	27.05	1		4 THHN/THWN	5.68	25453.35
6		PP - W	195	1	2 1/2"	EMT	16.65	4	4/0	XHHW-2	27.05	1		4 THHN/THWN	5.68	30728.1
7		MDP XF - N	2	1	4"	EMT	26	8	600	XHHW-2	54.25	4		2/0 XHHW-2	7.76	501.52
8		XF-N SDP - N	2	1	4"	EMT	26	8	600	XHHW-2	54.25	4		2/0 XHHW-2	7.76	501.04
9		SDP - N RP - N3	15	1	2 1/2"	EMT	16.65	4	4/0	XHHW-2	27.05	1		4 THHN/THWN	5.68	1957.95
10		RP - N1	129	1	2 1/2"	EMT	16.65	4	4/0	XHHW-2	27.05	1		4 THHN/THWN	5.68	16838.37
11		RP - N2	118	1	2 1/2"	EMT	16.65	4	4/0	XHHW-2	27.05	1		4 THHN/THWN	5.68	15402.54
12		RP - S1	240	1	2 1/2"	EMT	16.65	4	4/0	XHHW-2	27.05	1		4 THHN/THWN	5.68	31327.2
13		RP - S2	188	1	2 1/2"	EMT	16.65	4	4/0	XHHW-2	27.05	1		4 THHN/THWN	5.68	24539.64
14		MDP XF - W	190	1	2 1/2"	EMT	16.65	4	4/0	XHHW-2	27.05	1		4 THHN/THWN	5.68	24800.7
15		XF - W SDP - W	9	1	2"	EMT	19.6	4	1/0	XHHW-2	40.25	2		1 XHHW-2	6.83	3373.74
16		SDP - W RP - W1	3	1	2"	EMT	19.6	4	1/0	XHHW-2	27.05	1		4 THHN/THWN	5.68	391.59
17		RP - W2	142	1	2 1/2"	EMT	16.65	4	4/0	XHHW-2	27.05	1		4 THHN/THWN	5.68	18535.26
															Total	273612.3

Copper $273,612.30

Aluminum $206,852.20

Aluminum

Tag	From	To	Length	No. of sets	Conduit (Per Set)			Conductors								Total Cost
								Phase Conductors				Ground Conductors				
					Size	Type	Cost/LF	No.	Size	Type	Cost/LF	No.	Size	Type	Cost/LF	
1	Service Transformer	MDP	65	2	4"	EMT	26	10	500	XHHW	26.25	4		4 THHN/THWN	4.82	69312.4
2	MDP	EX - MCC	27	2	2 1/2"	EMT	16.65	8	400	XHHW	19.95	2		2/0 XHHW-2	6.29	5541.48
3		EX - GARAGE	16	1	2 1/2"	EMT	16.65	4	350	XHHW	16.43	1		2 THHN/THWN	5.24	1401.76
4		PP - N	12	1	2 1/2"	EMT	16.65	4	300	XHHW	16.43	1		4 THHN/THWN	4.82	1046.28
5		PP - S	195	1	2 1/2"	EMT	16.65	4	300	XHHW	16.43	1		4 THHN/THWN	4.82	17002.05
6		PP - W	195	1	2 1/2"	EMT	16.65	4	300	XHHW	16.43	1		4 THHN/THWN	4.82	20205.9
7	MDP	XF - N	2	1	4"	EMT	26	8	500	XHHW	26.25	4		2/0 XHHW-2	6.29	538.43
8	XF-N	SDP - N	2	1	4"	EMT	26	8	500	XHHW	26.24	4		2/0 XHHW-2	6.29	549
9	SDP - N	RP - N3	15	1	2 1/2"	EMT	16.65	4	300	XHHW	16.43	1		4 THHN/THWN	4.82	1307.85
10		RP - N1	129	1	2 1/2"	EMT	16.65	4	300	XHHW	16.43	1		4 THHN/THWN	4.82	11247.51
11		RP - N2	118	1	2 1/2"	EMT	16.65	4	300	XHHW	16.43	1		4 THHN/THWN	4.82	10288.43
12		RP - S1	240	1	2 1/2"	EMT	16.65	4	300	XHHW	16.43	1		4 THHN/THWN	4.82	20925.6
13		RP - S2	188	1	2 1/2"	EMT	16.65	4	300	XHHW	16.43	1		4 THHN/THWN	4.82	16391.76
14	MDP	XF - W	190	1	2 1/2"	EMT	16.65	4	300	XHHW	16.43	1		4 THHN/THWN	4.82	16566.3
15	XF - W	SDP - W	9	2	2 1/2"	EMT	16.65	8	400	XHHW	19.95	2		2/0 XHHW-2	6.29	1847.16
16	SDP - W	RP - W1	3	1	2 1/2"	EMT	16.65	4	300	XHHW	16.43	1		4 THHN/THWN	4.82	263.57
17		RP - W2	142	1	2 1/2"	EMT	16.65	4	300	XHHW	16.43	1		4 THHN/THWN	4.82	12380.98
															Total	206852.2

Savings $66,760.10

Reverberation time can be calculated using the following two equations:

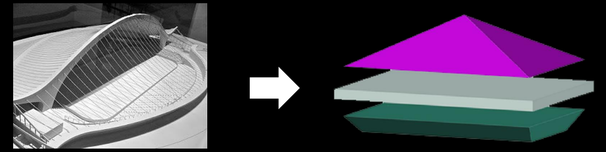
Sabine (Avg.α≤0.2): $T = \frac{0.161V}{S\bar{\alpha}}$

Norris Eyring (Avg.α>0.2): $T = \frac{0.161V}{-\sum_i S_i \ln(1-\alpha_{Ei})}$

Where V = room volume in ft^3

S= Room surface areas

ā = average absorption coefficients



Project Overview
Scope + concept

LG | Building Exterior
Diving

LG | Circulation Corridor
Coral Reef

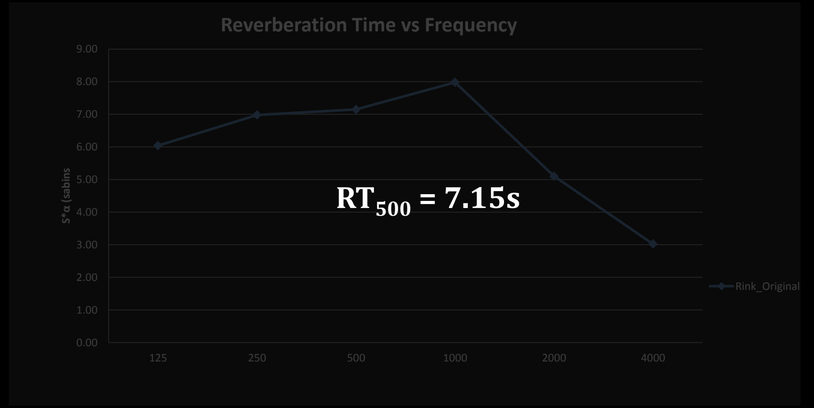
LG| Rink
Ocean

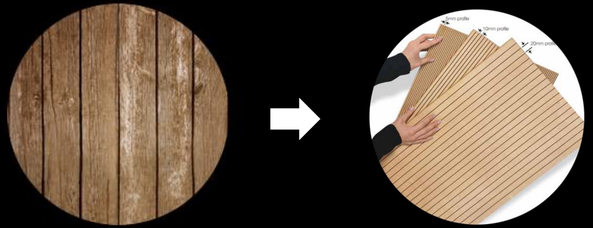
EL | branch circuit analysis

EL | copper vs. aluminum cost analysis

Acoustic | reverberation time analysis

Thanks to…





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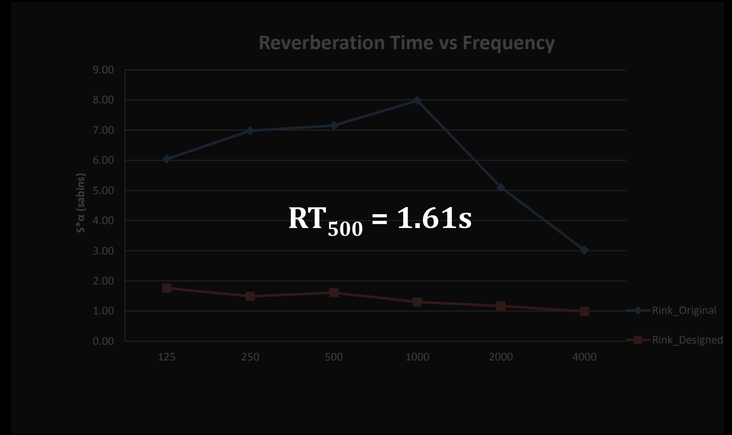
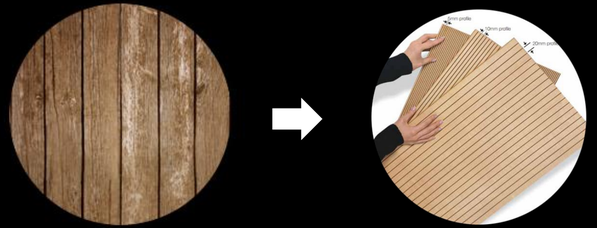
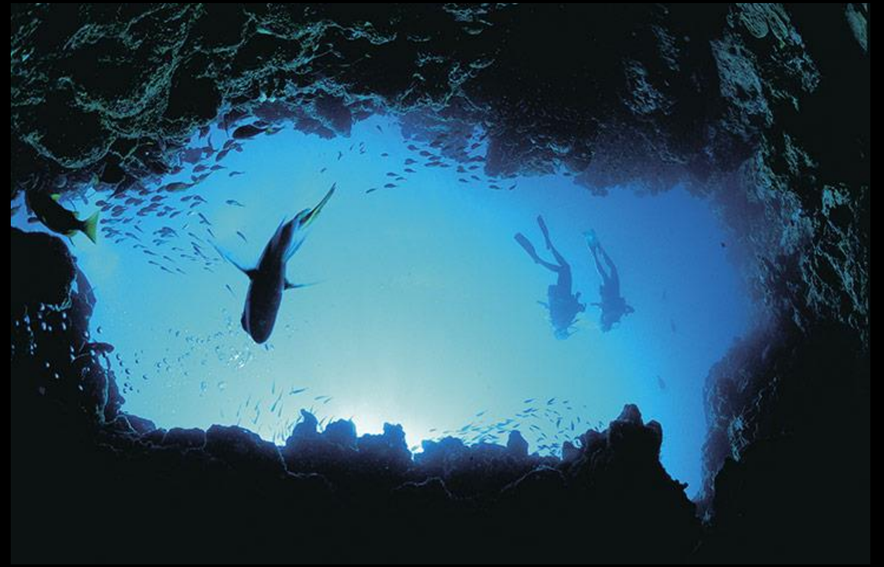


$RT_{500} = 1.61s$





Thanks to...

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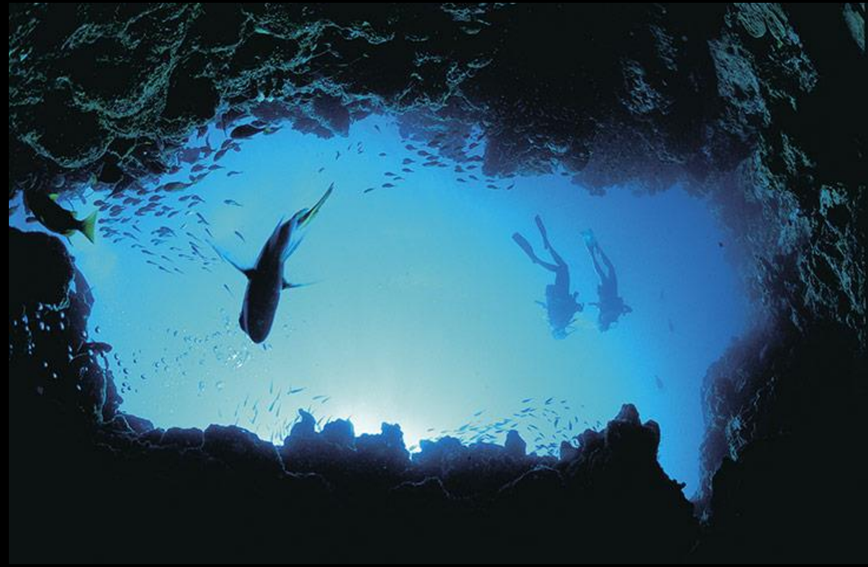
All fellow AEs



Appendix

Illuminance Recommendation

Space Type	E_v
Facades Activity Level [Medium][Low] Lighting Zone[LZ3]	200lux high activity/100lux low activity for darker toned surface materials (reflectance <0.5); 100 lux high activity/50lux low activity for lighter-toned façade materials (reflectance ≥0.5)

IES Lighting Handbook 10th Edition (Table 26.2, 26.4, 22.4)

Energy Allowance

Space Type(zone3)	Power Density (W/sqf)
Main Entries	30W/linear foot of door width
Entry Canopies	0.4W/ft^2
Building Façade	0.15W/ft^2 for each illuminated wall or surface or 3.75 W/linear foot for each illuminated wall or surface length
Building Grounds	0.8W/linear foot for walkways less than 10 ft wide. 0.16W/ft^{2}for walkway 10 ft wide or greater, plaza areas, and special feature areas.

ASHRAE standard 90.1 – 2010 (Table 9.4.3A, 9.4.3B)

Illuminance Levels

Location	Avg	Max	Min	Avg/Min	Max/Min
Roof Surface	4	110	0	NA	NA
Roof Spine	50	68	26	1.92	2.62
Front Plaza	2.5	3.6	.4	6.25	9

Light Loss Factor

All light loss factors for LED fixtures are assumed to be 0.7.

Lighting Power Density

Location	Fixture	#of fixtures	Power$_{total}$(W)	Area(ft^2)	LPD$_{designed}$	LPD$_{allowed}$
Façade/Exterior	*Lumen Pulse* 5W LED	646	3230	65660	0.156	0.15
	Philips 15W LED	192	2880			
	Philips 10W LED	344	3440			
	Philips 5W LED	136	680			
		TOTAL	10230			
Front Plaza	100W LED	4	400	6667	0.060	0.16

Illuminance Recommendation

- Circulation Corridors

Space Type	E_h	E_v	Avg:Min
Public adjacency passageway	avg ≥0.2 times task E_h of adjacent space or as cameras require, but with min≥10lx	avg ≥0.2 times task E_h of adjacent space or as cameras require	3:01

IES Lighting Handbook 10th Edition (Table 22.2)

- Reading and Writing

Space Type	E_h	E_v	Avg:Min
CSA/ISO types I and II Positive Polarity	300 lx	150 lx	1.5:1

IES Lighting Handbook 10th Edition (Table 22.2)

Energy Allowance

Space Type	Power Density (W/sqf)
Corridor/Transition	0.66

ASHRAE standard 90.1 – 2010 (Table 9.6.1)

Location	Avg(fc)	Max(fc)	Min(fc)	Avg/Min	Max/Min
Circulation Floor	27.68	335	7.5	3.5	42.46
Circulation @ 5'6	10.50	12.50	5.80	1.86	2.16
Press Box	17.69	19.00	14.80	1.20	1.28
Wall (vertical)	16.9	37.70	12.80	1.32	2.95
Seating	18.72	53.80	9.50	1.97	5.66

Illuminance Levels - Emergency

Location	Avg(fc)	Max(fc)	Min(fc)	Avg/Min	Max/Min
Circulation Floor	7.53	324	1	7.53	324.4
Circulation @ 5'6	1.71	2.4	1.2	1.43	2
Press Box	1.24	1.4	1.1	1.13	1.27
Wall (vertical)	1.13	1.3	0.8	1.41	1.63
Seating	3.56	16.7	0.9	3.96	18.56

Illuminance Levels

Location	Avg	Max	Min	Avg/Min	Max/Min
Rink	95.85	125	61.90	1.55	2.01
Seating	18.72	53.80	9.50	1.97	5.66
Ceiling	19.34	60.50	9.50	2.04	6.37

Light Loss Factor

All light loss factors for LED fixtures are assumed to be 0.7.

Lighting Power Density

Location	Fixture	#of fixtures	Power$_{total}$(W)	Area(ft^2)	LPD$_{designed}$	LPD$_{allowed}$
Rink	*Philips* 267W LED	72	19224	17000	1.16	1.92
	Lumen Pulse 56W LED	10	560			
		TOTAL	19784			

Illuminance Levels

Location	Avg	Max	Min	Avg/Min	Max/Min
Floor	95.85	39.70	4.90	2.60	8.10
Wall	11.84	26.60	2.70	4.39	9.85
Ceiling	20.96	150	1.5	13.97	100

Light Loss Factor

All light loss factors for LED fixtures are assumed to be 0.7.

Lighting Power Density

Location	Fixture	#of fixtures	Power$_{total}$(W)	Area(ft^2)	LPD$_{designed}$	LPD$_{allowed}$
Schley Memorial Club Room	*Cree* 13W LED	6	48	1754	0.38	1.23
	Wac Lighting 11W LED	15	165			
	Lumen Pulse 6W LED	77	462			
		TOTAL	675			

Copper

Tag	From	To	Length	No. of sets	Conduit (Per Set)			Conductors									Total Cost
								Phase Conductors				Ground Conductors					
					Size	Type	Cost/LF	No.	Size	Type	Cost/LF	No.	Size	Type	Cost/LF		
1	Service Transformer	MDP	65	4	4"	EMT	26	16	600	XHHW-2	54.25	4	4	THHN/THWN	5.68		64656.8
2	MDP	EX. MCC	27	2	3"	EMT	19.6	8	350	XHHW-2	40.25	2	1	XHHW-2	6.83		10121.22
3		EX. GARAGE	16	1	2 1/2"	EMT	16.65	4	250	XHHW-2	32.15	1	4	THHN/THWN	5.68		2414.88
4		PP - N	12	1	2 1/2"	EMT	16.65	4	4/0	XHHW-2	27.05	1	4	THHN/THWN	5.68		1566.36
5		PP - S	195	1	2 1/2"	EMT	16.65	4	4/0	XHHW-2	27.05	1	4	THHN/THWN	5.68		25453.35
6		PP - W	195	1	2 1/2"	EMT	16.65	5	4/0	XHHW-2	27.05	1	4	THHN/THWN	5.68		30728.1
7	MDP	XF - N	2	1	4"	EMT	26	4	600	XHHW-2	54.25	1	2/0	XHHW-2	7.76		501.52
8	XF-N	SDP - N	2	2	4"	EMT	26	8	600	XHHW-2	54.25	2	2/0	XHHW-2	7.76		1003.04
9	SDP - N	RP - N3	15	1	2 1/2"	EMT	16.65	4	4/0	XHHW-2	27.05	1	4	THHN/THWN	5.68		1957.95
10		RP - N1	129	1	2 1/2"	EMT	16.65	4	4/0	XHHW-2	27.05	1	4	THHN/THWN	5.68		16838.37
11		RP - N2	118	1	2 1/2"	EMT	16.65	4	4/0	XHHW-2	27.05	1	4	THHN/THWN	5.68		15402.54
12		RP - S1	240	1	2 1/2"	EMT	16.65	4	4/0	XHHW-2	27.05	1	4	THHN/THWN	5.68		31327.2
13		RP - S2	188	1	2 1/2"	EMT	16.65	4	4/0	XHHW-2	27.05	1	4	THHN/THWN	5.68		24539.64
14	MDP	XF - W	190	1	2 1/2"	EMT	16.65	4	4/0	XHHW-2	27.05	1	4	THHN/THWN	5.68		24800.7
15	XF - W	SDP - W	9	2	3"	EMT	19.6	8	350	XHHW-2	40.25	2	1	XHHW-2	6.83		3373.74
16	SDP - W	RP - W1	3	1	2 1/2"	EMT	16.65	4	4/0	XHHW-2	27.05	1	4	THHN/THWN	5.68		391.59
17		RP - W2	142	1	2 1/2"	EMT	16.65	4	4/0	XHHW-2	27.05	1	4	THHN/THWN	5.68		18535.26
																Total	273612.3

Aluminum

Tag	From	To	Length	No. of sets	Conduit (Per Set)			Conductors									Total Cost
								Phase Conductors				Ground Conductors					
					Size	Type	Cost/LF	No.	Size	Type	Cost/LF	No.	Size	Type	Cost/LF		
1	Service Transformer	MDP	65	8	4"	EMT	26	32	500	XHHW	26.24	4	4	THHN/THWN	4.82		69352.4
2	MDP	EX. MCC	27	2	2 1/2"	EMT	16.65	8	400	XHHW	19.92	2	2/0	XHHW-2	6.29		5541.48
3		EX. GARAGE	16	1	2 1/2"	EMT	16.65	4	350	XHHW	16.43	1	2	THHN/THWN	5.24		1401.76
4		PP - N	12	1	2 1/2"	EMT	16.65	4	300	XHHW	16.43	1	4	THHN/THWN	4.82		1046.28
5		PP - S	195	1	2 1/2"	EMT	16.65	4	300	XHHW	16.43	1	4	THHN/THWN	4.82		17002.05
6		PP - W	195	1	2 1/2"	EMT	16.65	5	300	XHHW	16.43	1	4	THHN/THWN	4.82		20205.9
7	MDP	XF - N	2	2	4"	EMT	26	8	500	XHHW	26.24	1	2/0	XHHW-2	6.29		536.42
8	XF-N	SDP - N	2	2	4"	EMT	26	8	500	XHHW	26.24	2	2/0	XHHW-2	6.29		549
9	SDP - N	RP - N3	15	1	2 1/2"	EMT	16.65	4	300	XHHW	16.43	1	4	THHN/THWN	4.82		1307.85
10		RP - N1	129	1	2 1/2"	EMT	16.65	4	300	XHHW	16.43	1	4	THHN/THWN	4.82		11247.51
11		RP - N2	118	1	2 1/2"	EMT	16.65	4	300	XHHW	16.43	1	4	THHN/THWN	4.82		10288.42
12		RP - S1	240	1	2 1/2"	EMT	16.65	4	300	XHHW	16.43	1	4	THHN/THWN	4.82		20925.6
13		RP - S2	188	1	2 1/2"	EMT	16.65	4	300	XHHW	16.43	1	4	THHN/THWN	4.82		16391.72
14	MDP	XF - W	190	1	2 1/2"	EMT	16.65	4	300	XHHW	16.43	1	4	THHN/THWN	4.82		16566.1
15	XF - W	SDP - W	9	2	2 1/2"	EMT	16.65	8	400	XHHW	19.92	2	2/0	XHHW-2	6.29		1847.16
16	SDP - W	RP - W1	3	1	2 1/2"	EMT	16.65	4	300	XHHW	16.43	1	4	THHN/THWN	4.82		261.57
17		RP - W2	142	1	2 1/2"	EMT	16.65	4	300	XHHW	16.43	1	4	THHN/THWN	4.82		12380.98
																Total	206852.2

Surface Description	Surface Area, S (ft^2)	Material Description	Sound Absorption Coefficient, α						S*α (sabins)					
			Frequency (Hz)						Frequency (Hz)					
			125	250	500	1000	2000	4000	125	250	500	1000	2000	4000
Wall_Concrete	6789.50	Unfinished concrete	0.010	0.020	0.040	0.060	0.080	0.100	67.895	135.79	271.58	407.37	543.16	678.95
Wall_Glass	1600.00	Glass, large panels	0.180	0.060	0.040	0.030	0.020	0.020	288	96	64	48	32	32
Corridor_Floor	8044.00	Sealed Concrete	0.010	0.010	0.010	0.020	0.020	0.020	80.44	80.44	80.44	160.88	160.88	160.88
Ceiling	43317.00	Oak wood	0.240	0.190	0.140	0.080	0.130	0.100	10396	8230	6064	3465	5631	4332
Ceiling	5895.00	Plaster	0.140	0.120	0.080	0.060	0.060	0.060	825.30	707.40	471.6	353.7	353.7	353.7
People - Seats	20011.17	Seating, empty, wood	0.080	0.110	0.150	0.160	0.180	0.200	1600.8936	2201.23	3001.68	3201.7872	3602.0106	4002.234
Rink_Floor	18669.00	Sealed Concrete	0.010	0.010	0.010	0.020	0.020	0.020	186.69	186.69	186.69	373.38	373.38	373.38
								ΣSα=	13445.30	11637.78	10140.366	8010.4772	10696.341	9932.844
								Avg. α=	0.13	0.11	0.10	0.08	0.10	0.10
							Air absorption constant for 20°C and 40% RH, m		0	0	1.83E-04	3.26E-04	7.86E-04	2.56E-03
								Sabine Reverb Time: (s) RT=	6.04	6.98	7.15	7.98	5.10	3.02
								Norris-Eyring Reverb Time: (s) RT=	5.64	6.58	6.83	7.74	4.92	2.96
								Calculated RT (s)	6.04	6.98	7.15	7.98	5.1	3.02

Surface Description	Surface Area, S (ft^2)	Material Description	Sound Absorption Coefficient, α						S*α (sabins)					
			Frequency (Hz)						Frequency (Hz)					
			125	250	500	1000	2000	4000	125	250	500	1000	2000	4000
Wall_Concrete	6789.50	Unfinished concrete	0.010	0.020	0.040	0.060	0.080	0.100	67.895	135.79	271.58	407.37	543.16	678.95
Wall_Glass	1600.00	Glass, large panels	0.180	0.060	0.040	0.030	0.020	0.020	288	96	64	48	32	32
Corridor_Floor	8044.00	Sealed Concrete	0.010	0.010	0.010	0.020	0.020	0.020	80.44	80.44	80.44	160.88	160.88	160.88
Ceiling	43317.00	QUADRILLO	0.790	0.900	0.810	0.950	**0.990**	**0.990**	34220	38985	35087	41151	42884	42884
Ceiling	5895.00	Plaster	0.140	0.120	0.080	0.060	0.060	0.060	825.30	707.40	471.6	353.7	353.7	353.7
People - Seats	20011.17	Seating, empty, wood	0.080	0.110	0.150	0.160	0.180	0.200	1600.8936	2201.23	3001.68	3201.7872	3602.0106	4002.234
Rink_Floor	18669.00	Sealed Concrete	0.010	0.010	0.010	0.020	0.020	0.020	186.69	186.69	186.69	373.38	373.38	373.38
								ΣSα=	37269.65	42392.85	39162.756	45696.267	47948.961	48484.974
								Avg. α=	0.36	0.41	0.38	0.44	0.46	0.46
							Air absorption constant for 20°C and 40% RH, m		0	0	1.83E-04	3.26E-04	7.86E-04	2.56E-03
								Sabine Reverb Time: (s) RT=	2.18	1.92	2.01	1.70	1.53	1.24
								Norris-Eyring Reverb Time: (s) RT=	1.76	1.49	1.61	1.30	1.17	0.99
								Calculated RT (s)	1.76	1.49	1.61	1.3	1.17	0.99