

# Susquehanna Center Renovations and Expansion

Brad Gaugh | Lighting/ Electrical | April 13, 2011



Professors Houser and Dannerth



Electrical Branch Circuit Redesign

Electrical Depths

Motor Control Center

SKM Analysis

Lighting Redesign

Exterior Façade

Main Lobby

Fitness and Weight Room

Auxiliary Gymnasium

Structural Breadth

Mechanical Breadth





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Electrical Depths

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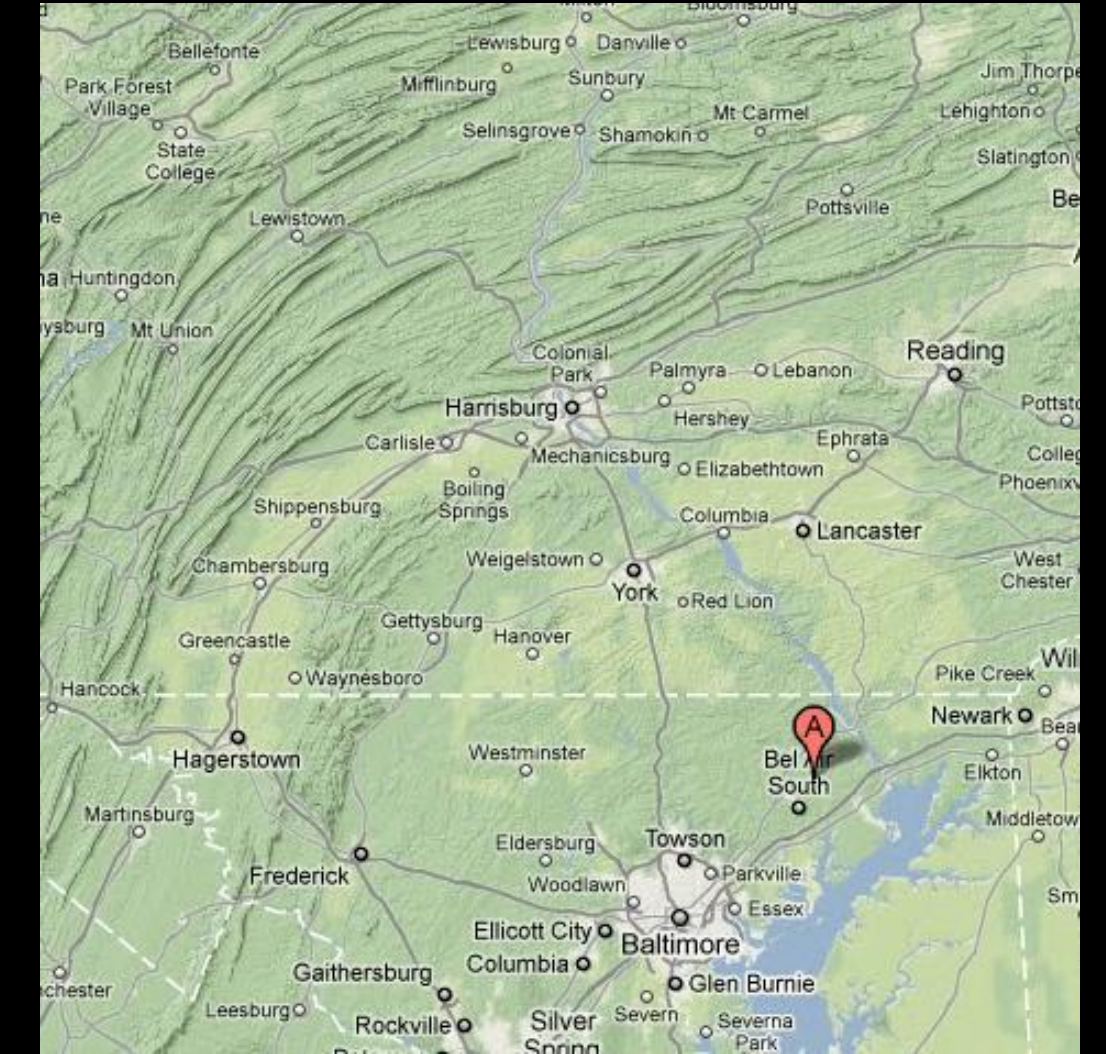
Structural Breadth

Mechanical Breadth



- Introduction/ Building Overview
- Electrical Depth Topics
  - Motor Control Center
- Lighting Redesign
  - Exterior Façade
  - Fitness and Weight Room
  - Auxiliary Gymnasium
- Mechanical Breadth
  - Chiller Redesign
- Conclusions
- Acknowledgments

<u>Location:</u>	Bel Air, MD
<u>Size:</u>	110,000 ft <sup>2</sup>
<u>Cost:</u>	\$28 Million
<u>Construction Dates:</u>	August 2011 – August 2012
<u>Project Delivery Method:</u>	Design – Bid - Build
<u>Architect:</u>	Hord Coplan Macht
<u>General Contractor:</u>	Not Selected
<u>Lighting Design:</u>	Dunlop Lighting Design



Latitude: 39.6° N, Longitude: 76.3° W

- Introduction/ Building Overview

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Occupant :

Harford Community College Fighting Owls

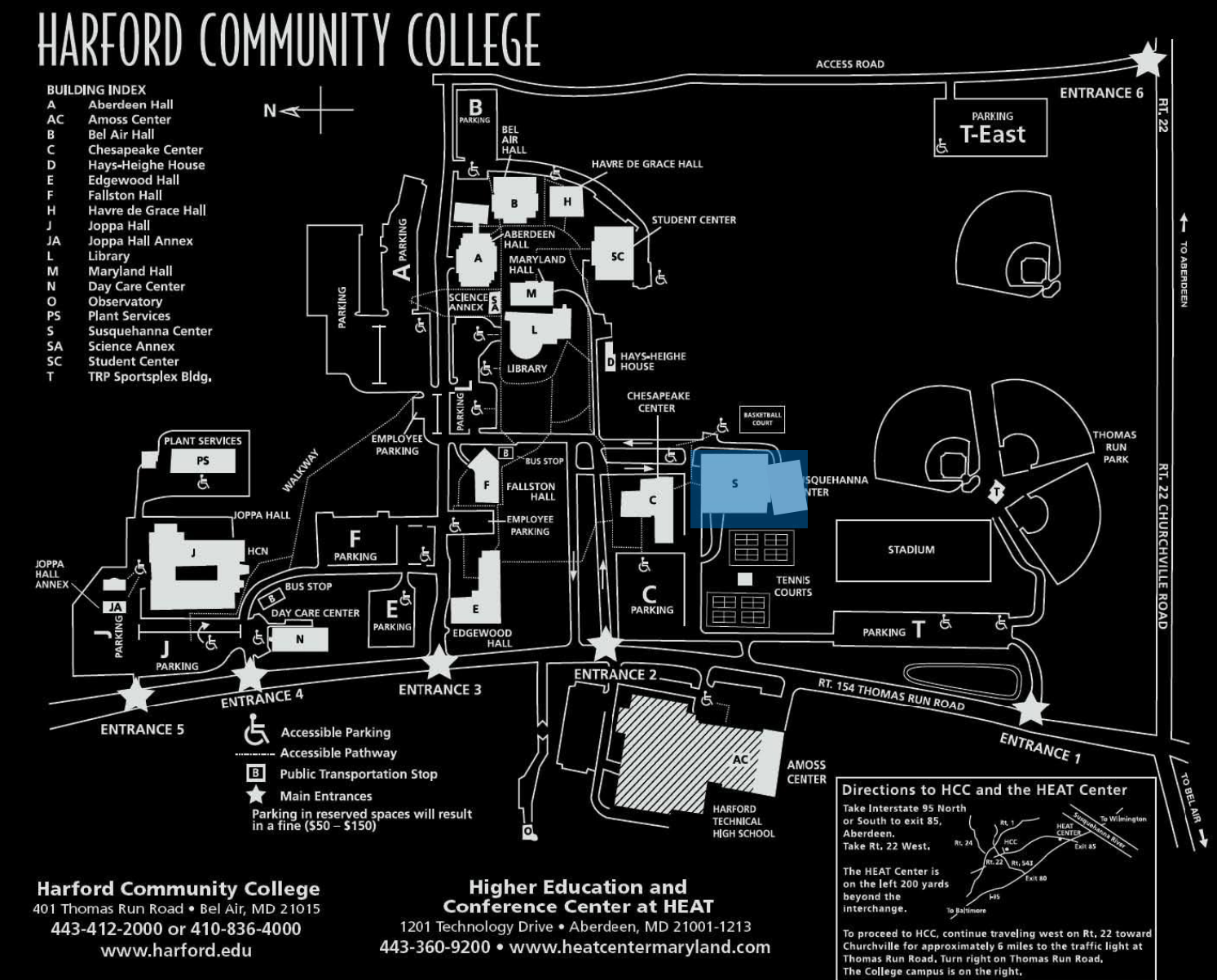
Building Type:

Athletic Facility

Usage:

Division III NCAA basketball Arena

Local and Communal Training/ Activity Center



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### Goals:

- Determine and distinguish motor loads
- Organize motor starters and disconnects
- Locate and Size Motor Control Center



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## Sample Calculation:

40 HP Motor = 52 A (2008 NEC Table 430.250)

FLA = 52 A / 0.9 PF = 55A \* 1.25 = 68A

55A \* 2.5 = 138 A

“2006 Consulting Application Guide Freedom Series”

40 HP Motor:

100 MCCB, FVR Starter, NEMA 3, 24 in. bucket

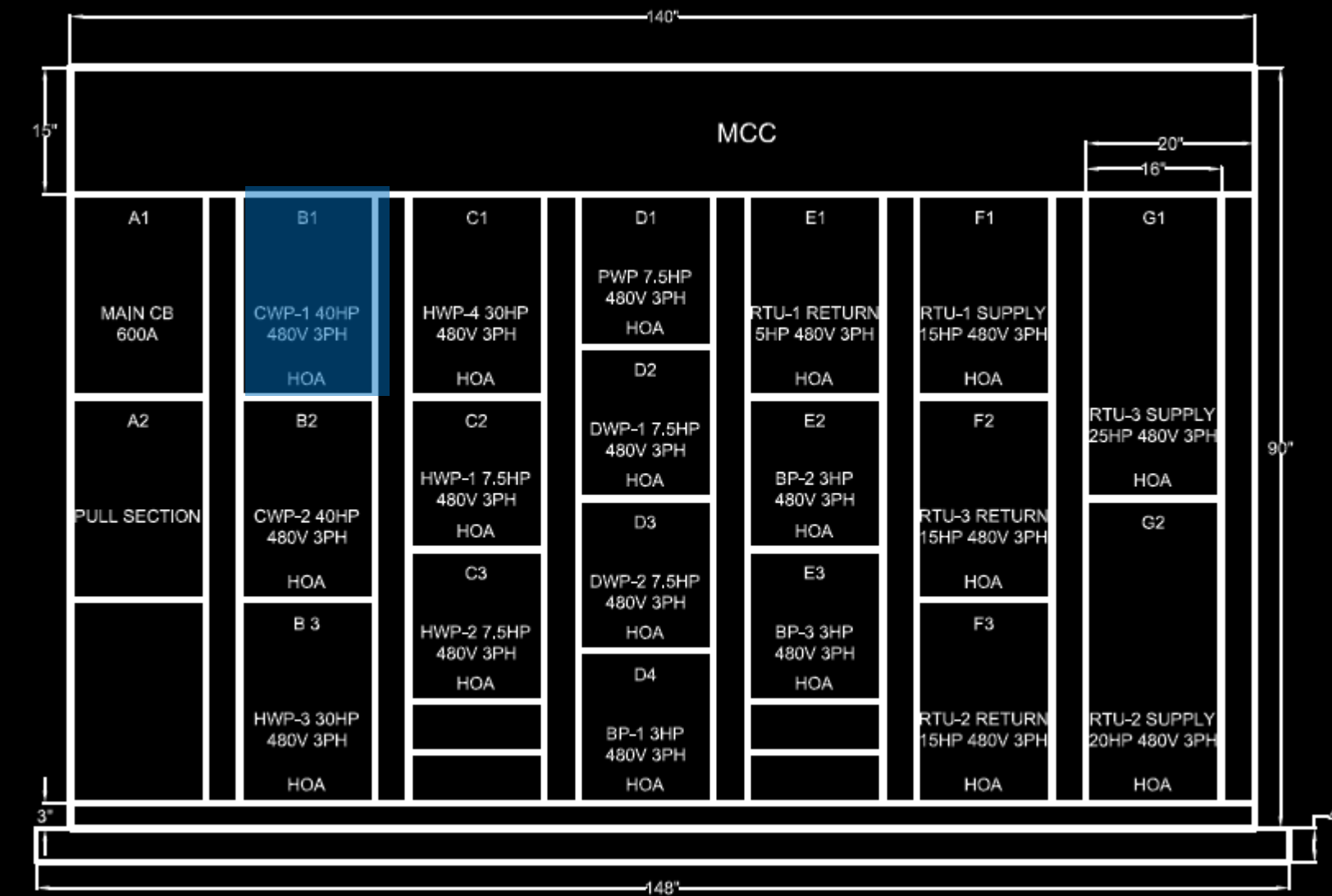
(Table 30.1-2, 30.1-27, 30.1-88)

PANEL MLP		MAIN: 600A MLO			VOLTAGE: 480Y/ 277 3 PH 4 W							
AIC: 42,000		MOUNTING: SURFACE			NOTE: 100% RATEF NEUTRAL BUS							
LOCATION: MECHANICAL ROOM 137												
CKT	EQUIPMENT SERVED	LOAD (KVA)			BREAKER		LOAD (KVA)			EQUIPMENT SERVED	CKT	
		A	B	C	P	AMPS	A	B	C			
1	RTU #1 SUPPLY	5.8			3	40	3	20	2.1		RTU - 1 RETURN	2
3	-----		5.8		-	-	-	-	2.1		-----	4
5	-----			5.8	-	-	-	-		2.1	-----	6
7	RTU #2 SUPPLY	7.5			3	50	3	40	5.8		RTU - 2 RETURN	8
9	-----		7.5		-	-	-	-		5.8	-----	10
11	-----			7.5	-	-	-	-		5.8	-----	12
13	RTU #3 SUPPLY	11.1			3	60	3	40	5.8		RTU - 3 RETURN	14
15	-----		11.1		-	-	-	-		5.8	-----	16
17	-----			11.1	-	-	-	-		5.8	-----	18
19	RTU #4	13			3	70	3	60	7.5		ELEVATOR	20
21	-----		13		-	-	-	-		7.5	-----	22
23	-----			13	-	-	-	-		7.5	-----	24
25	HEATING PUMP - SUSQUE	11.1			3	70	3	70	-		HEATING PUMP - SUSQUE	26
27	-----		11.1		-	-	-	-		-	-----	28
29	-----			11.1	-	-	-	-		-	-----	30
31	HEATING PUMP - CHESA	3			3	20	3	20	-		HEATING PUMP - CHESA	32
33	-----		3		-	-	-	-		-	-----	34
35	-----			3	-	-	-	-		-	-----	36
37	CHD WTR PUMP - SUSQUE	11.1			3	70	3	70	-		HEATING PUMP - SUSQUE	38
39	-----		11.1		-	-	-	-		-	-----	40
41	-----			11.1	-	-	-	-		-	-----	42
43	CHD WTR PUMP - CHESA	14.4			3	90	3	90	-		CHD WTR PUMP CHESA	44
45	-----		14.4		-	-	-	-		-	-----	46
47	-----			14.4	-	-	-	-		-	-----	48
49	POOL PUMP - SUSQUE	3			3	20	3	20	1.3		BOILER #1	50
51	-----		3		-	-	-	-		1.3	-----	52
53	-----			3	-	-	-	-		1.3	-----	54
55	PUMP DWP #:	3			3	20	3	20	1.3		BOILER #2	56
57	-----		3		-	-	-	-		1.3	-----	58
59	-----			3	-	-	-	-		1.3	-----	60
61	PUMP DWP #2	3			3	20	3	20	1.3		BOILER #3	62
63	-----		3		-	-	-	-		1.3	-----	64
65	-----			3	-	-	-	-		1.3	-----	66
67	ATC COMPRESSOR	2.1			3	20	3	20	3		ACCU #6	68
69	-----		2.1		-	-	-	-		3	-----	70
71	-----			2.1	-	-	-	-		3	-----	72
73	SPACE				-	-	-	-		-	SPACE	74
75	SPACE				-	-	-	-		-	SPACE	76
77	SPACE				-	-	-	-		-	SPACE	78
79	PANEL 'MRP' TRANSFORMER	9.1			3	50	3	50	10.1		PANEL 'MRP' TRANSFORMER	80
81	-----		6.3		-	-	-	-		9.9	-----	82
83	-----			6.8	-	-	-	-		6.3	-----	84
		97.2	94.4	94.3			SUB-TOTALS	38.2	38	34.4		

CONNECTED LOAD:  
A: 135.4 KVA = 489 A  
B: 132.4 KVA = 478 A  
C: 129.3 KVA = 467 A

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MOTOR CONTROL CENTER: MCC								LOCATION: MECHANICAL ROOM 137	
AMPS: 600		VOLTS: 480/277V		3 PH, 4 W, 60 Hz		NEMA: 2		AIC: 65,000	
UNIT NO.	CIRCUIT	HP/KVA	FLA	STARTER		CIRCUIT PROTECTION		FEEDER	NOTES
				TYPE	SIZE	TYPE	TRIP		
A1	MAIN CB	-	-	-	-	-	-	(2)3#350MCM+1#6GRDIN3-1/2" C.	-
A2	PULL SECTION	-	-	-	-	-	-	-	-
A3	SPARE	-	-	-	-	-	-	-	-
B1	CWP-1	40 HP	68	FVR	3	MCCB	100	3#3 + 1#8GRD. IN 1-1/4" C.	-
B2	CWP-2	40 HP	68	FVR	3	MCCB	100	3#3 + 1#8GRD. IN 1-1/4" C.	-
B3	HWP-3	30 HP	52	FVR	3	MCCB	70	3#4 + 1#8GRD. IN 1-1/4" C.	-
C1	HWP-4	30 HP	52	FVR	3	MCCB	70	3#4 + 1#8GRD. IN 1-1/4" C.	-
C2	HWP-1	7.5 HP	15	FVR	1	MCCB	25	3#12 + 1#12GRD. IN 3/4" C.	-
C3	HWP-2	7.5 HP	15	FVR	1	MCCB	25	3#12 + 1#12GRD. IN 3/4" C.	-
D1	PWP	7.5 HP	15	FVR	1	MCCB	25	3#12 + 1#12GRD. IN 3/4" C.	-
D2	DWP-1	7.5 HP	15	FVR	1	MCCB	25	3#12 + 1#12GRD. IN 3/4" C.	-
D3	DWP-2	7.5 HP	15	FVR	1	MCCB	25	3#12 + 1#12GRD. IN 3/4" C.	-
D4	BP-1	3 HP	7	FVR	0	MCCB	15	3#12 + 1#12GRD. IN 3/4" C.	-
E1	RTU-1 RETURN	3 HP	7	AFD	0	MCCB	15	3#12 + 1#12GRD. IN 3/4" C.	-
E2	BP-2	3 HP	7	FVR	0	MCCB	15	3#12 + 1#12GRD. IN 3/4" C.	-
E3	BP-3	3 HP	7	FVR	0	MCCB	15	3#12 + 1#12GRD. IN 3/4" C.	-
F1	RTU-1 SUPPLY	15 HP	28	AFD	2	MCCB	45	3#8 + 1#10GRD. IN 3/4" C.	-
F2	RTU-3 RETURN	15 HP	28	AFD	2	MCCB	45	3#8 + 1#10GRD. IN 3/4" C.	-
F3	RTU-2 RETURN	15 HP	28	AFD	2	MCCB	45	3#8 + 1#10GRD. IN 3/4" C.	-
G1	RTU-3 SUPPLY	25 HP	45	AFD	2	MCCB	70	3#6 + 1#8GRD. IN 1" C.	-
G2	RUT-2 SUPPLY	20 HP	36	AFD	2	MCCB	70	3#8 + 1#10GRD. IN 3/4" C.	-





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### Location and Size:

#### Main Circuit Breaker:

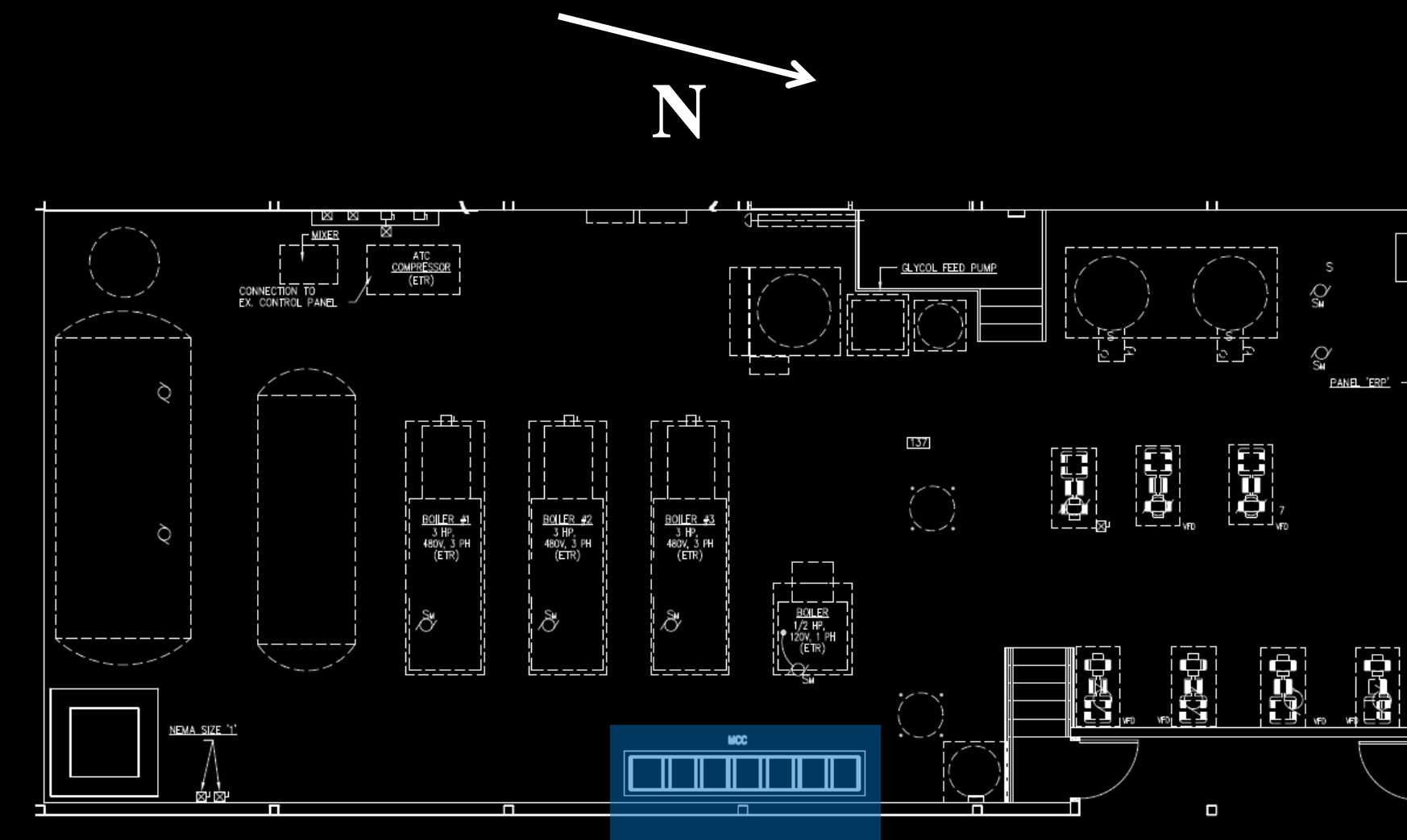
$$(68 \text{ A} * 1.25) + 440 \text{ A} = 526 \text{ A}$$

Protection: 600 A MCB

Feed From: Main Switchboard (MDS)

Feeders: 2 Sets of 3#350 kcmil + 1#6GRD

Conduit: 3- 1/2" EMT



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## Goals:

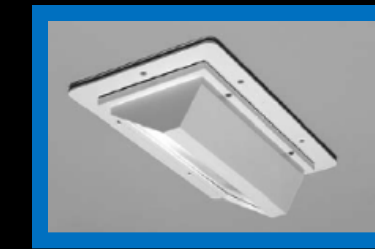
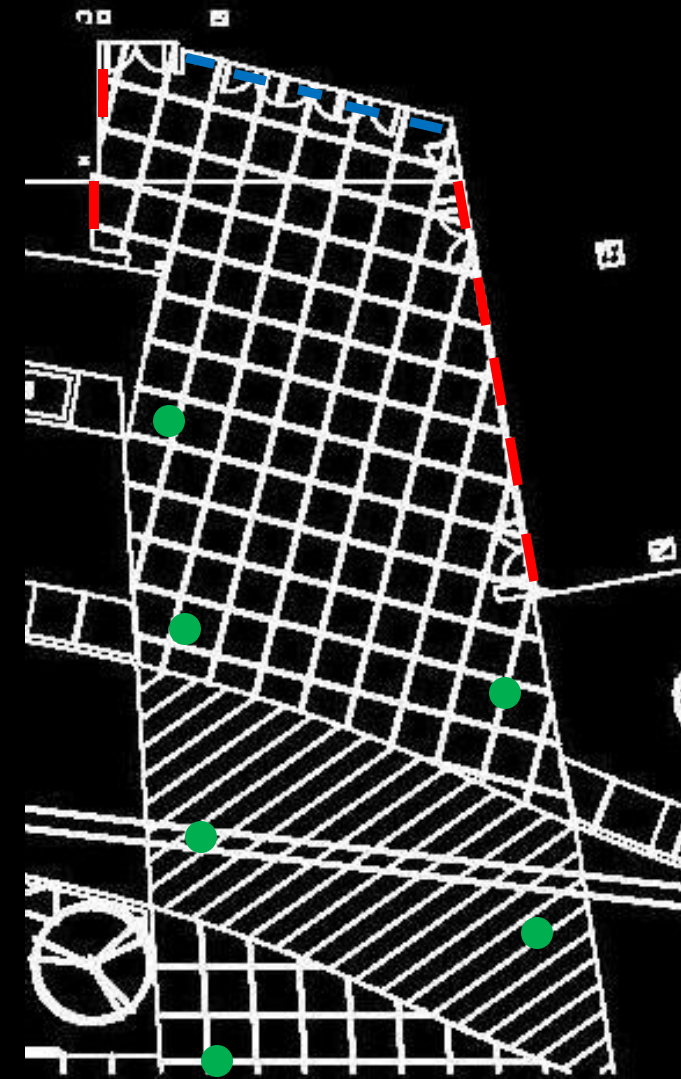
- Highlight architectural elements to emphasize quality of Athletic Facility
- Provide energy efficient design solutions
- Provide adequate illuminance for task oriented spaces

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### Design Goals:

- Highlight entrance to draw and guide visitors to entrance
- Provide adequate illuminance on sidewalks for safety
- Meet IESNA recommendations, ASHRAE 90.1 Standard, and ILE Upward Light Ratio

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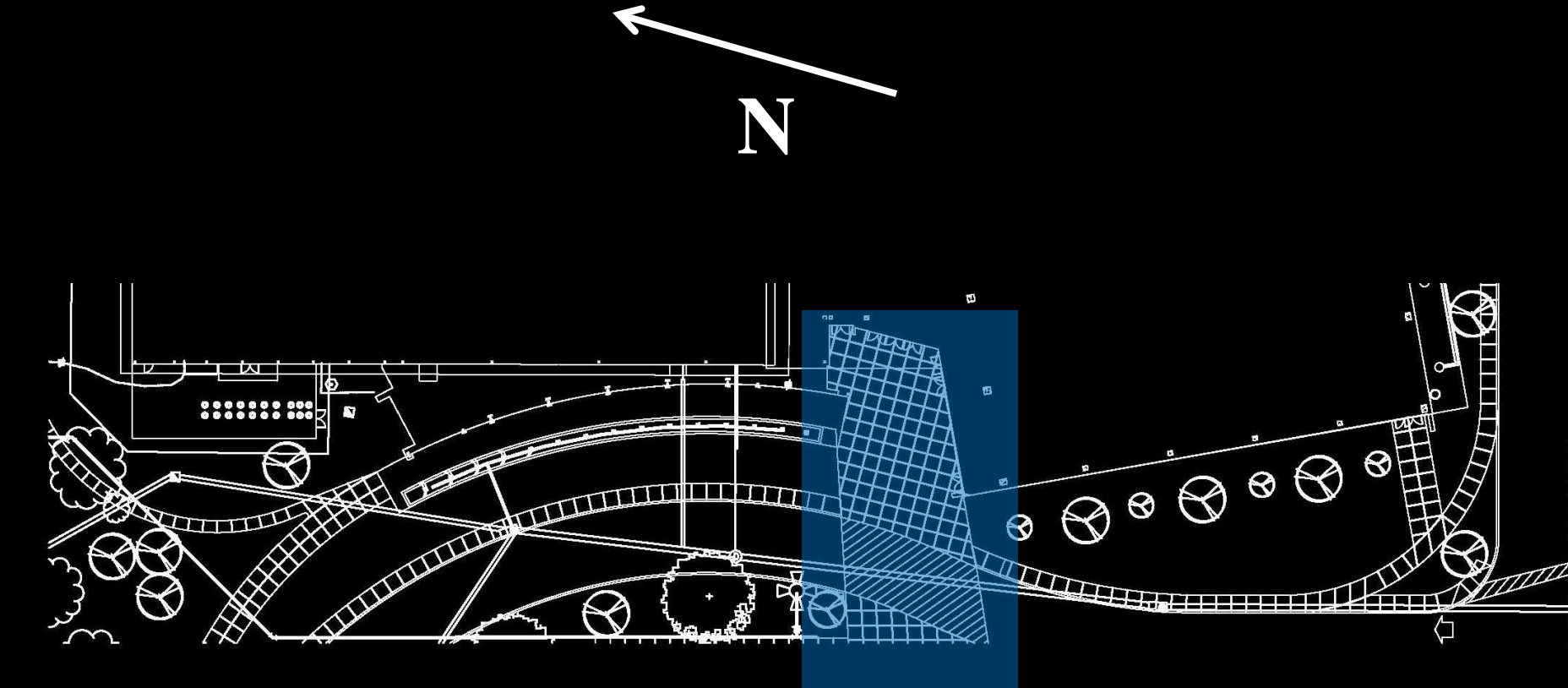
Metal Halide:  
MC70T6/U/G12/830



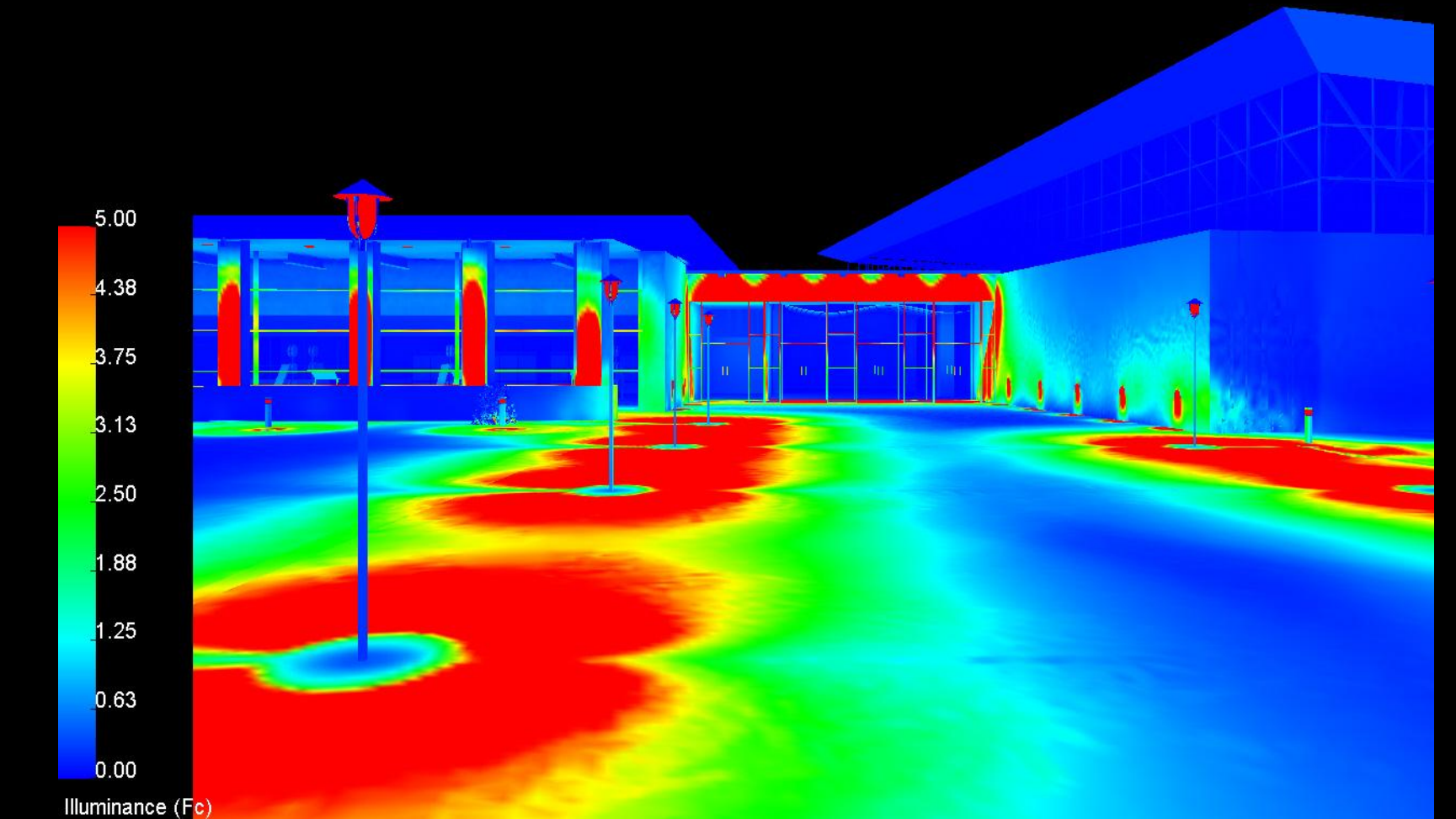
Metal Halide:  
MC39T6/U/G12/830



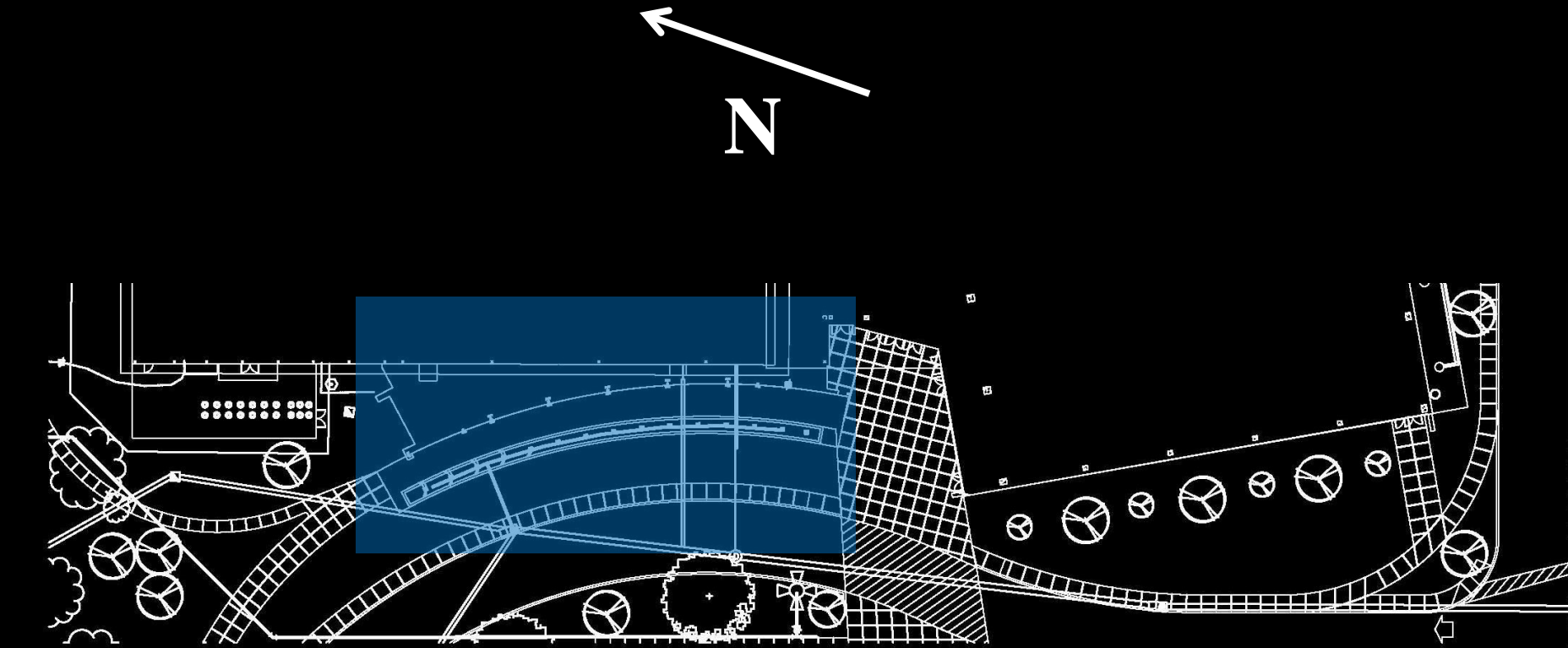
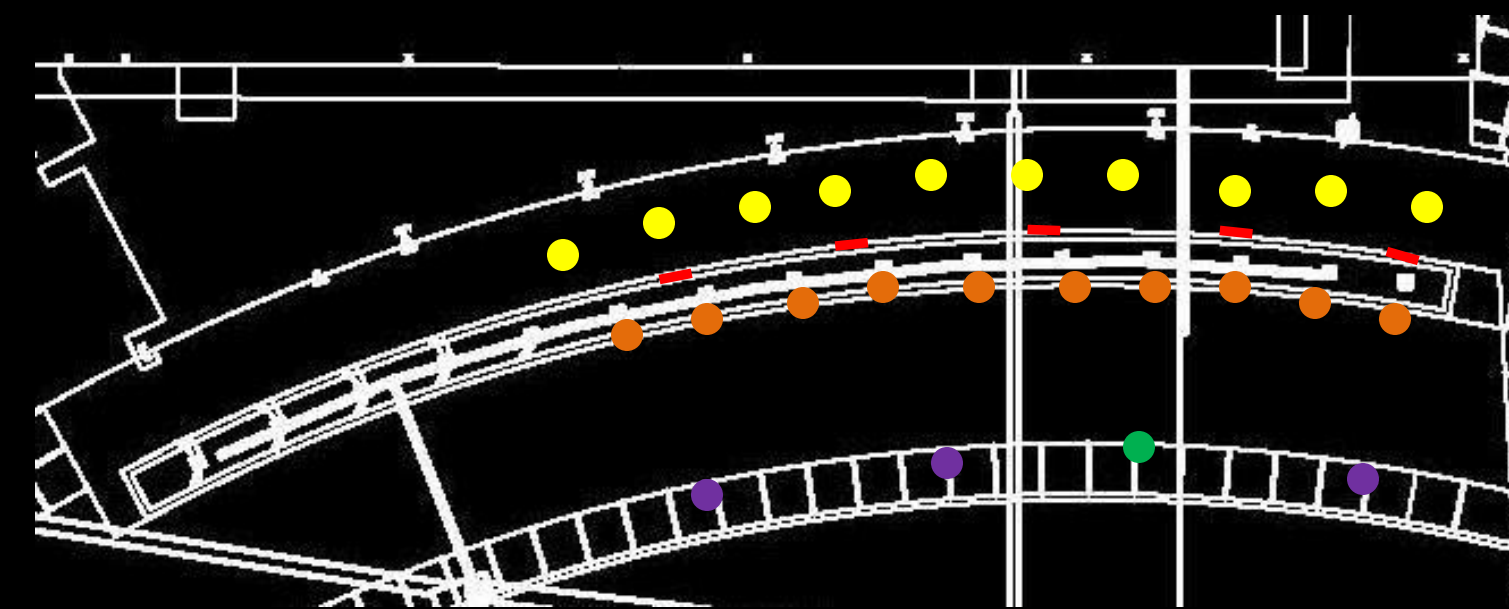
Metal Halide:  
MC70T6/U/G12/830



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Compact Fluorescent:  
F42TBX /830/A/ECO



Metal Halide  
MC20TC /U /G8.5/830



Metal Halide  
MC39T6 /U /G8.5/830

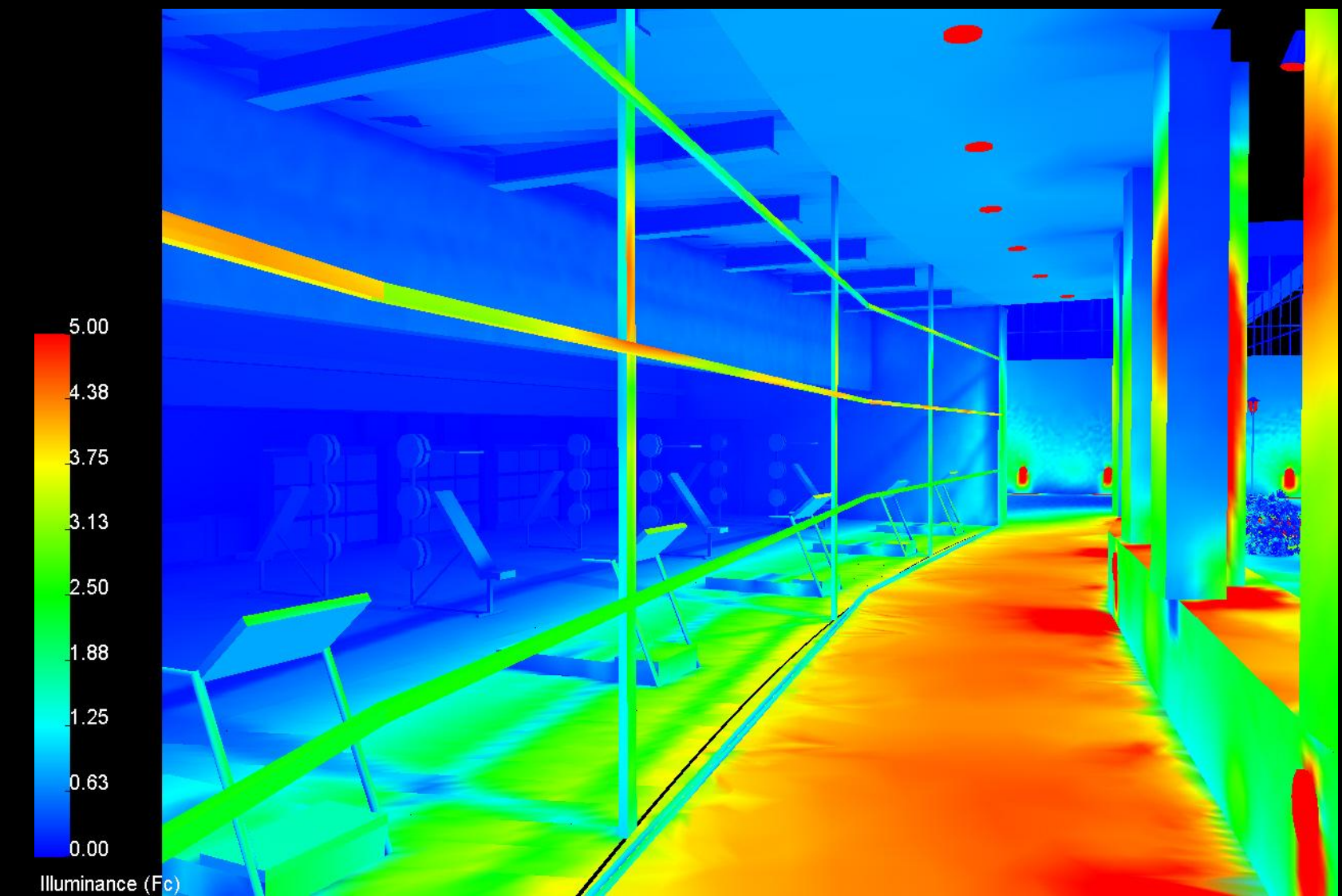


Metal Halide  
MC70T6 /U /G8.5/830

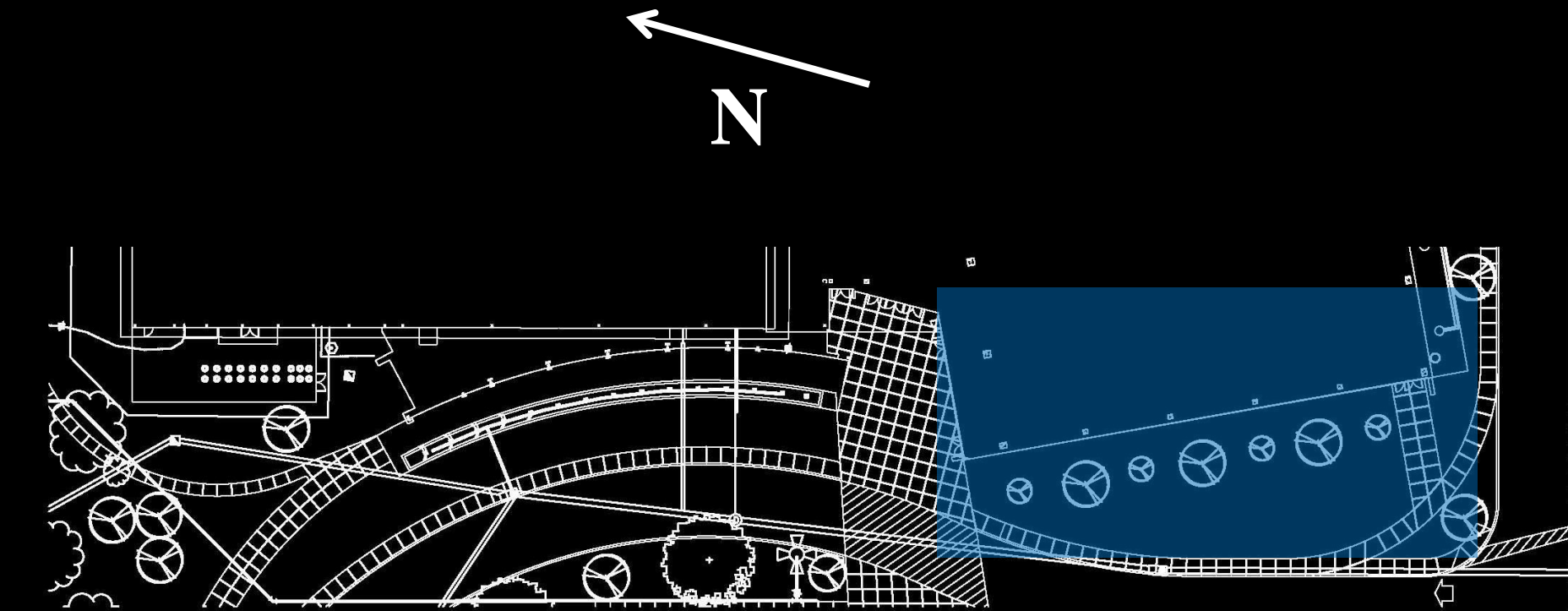
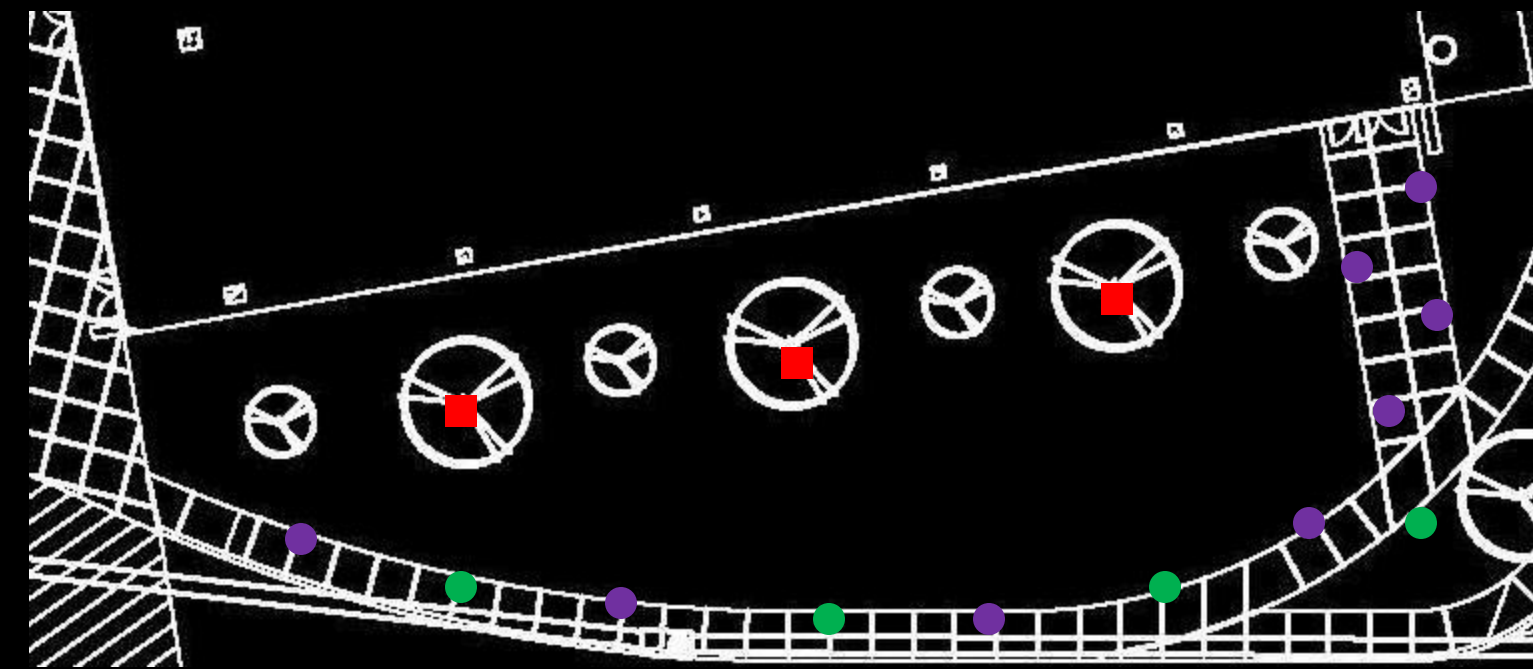


Metal Halide  
MC39T6 /U /G8.5/830

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LED 3000K



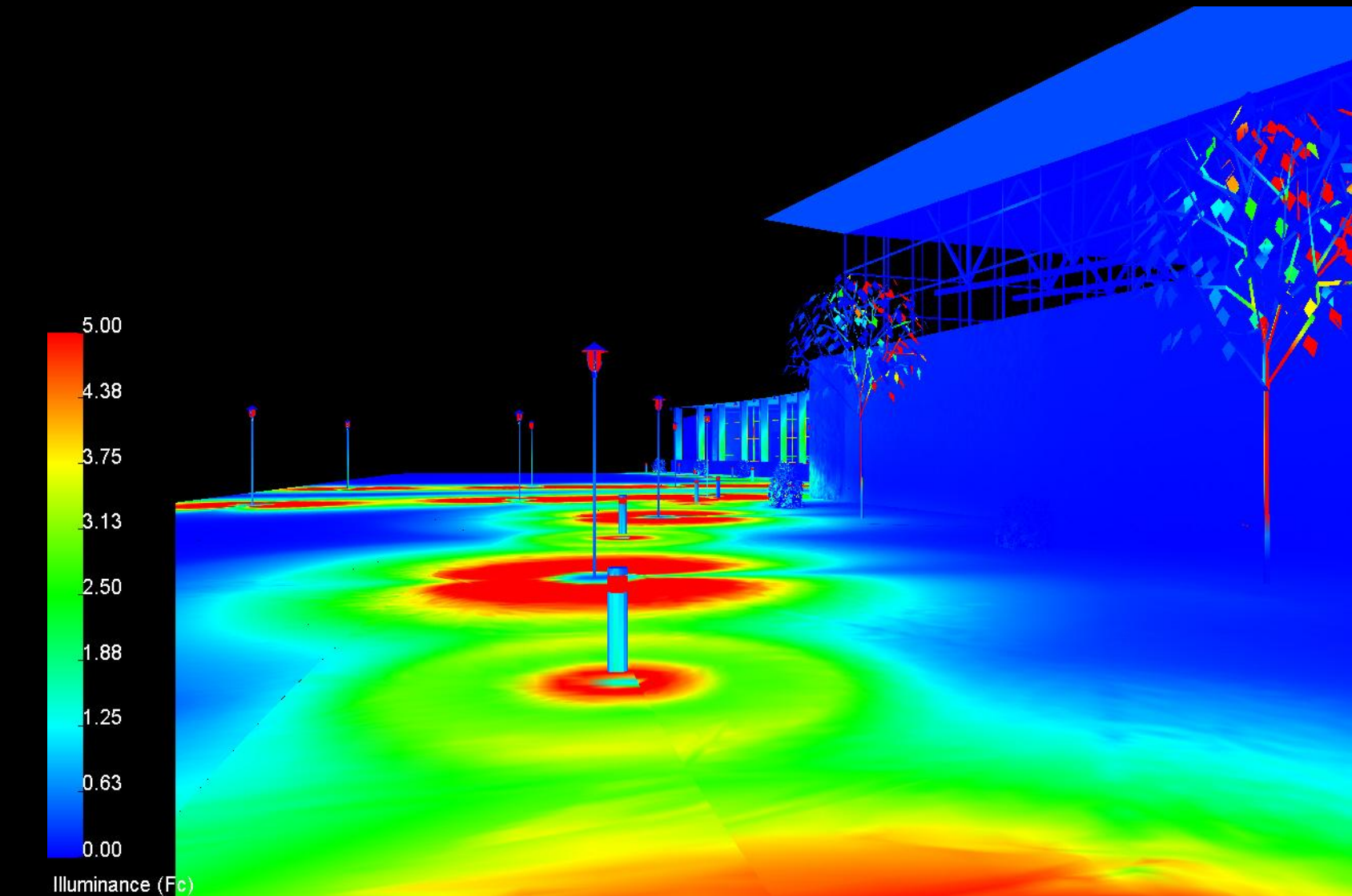
Metal Halide  
MC70T6 /U /G8.5/830



Metal Halide  
MC39T6 /U /G8.5/830



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### Performance Summary:

Criterion	IESNA Recommended	Design
Average Illuminance	5 fc	4.8 fc
LPD Wall/ Surfaces (8400SF)	0.2 W/SF (1680W)	0.23 W/SF (1950W)
LPD Canopies (1400 SF)	1.25 W/SF (1750 W)	0.6 W/SF (775)
Total LPD (W Allowable)	3430 W	2725 W
ILE Upward Light Ratio	E2 – 0.02	0.018

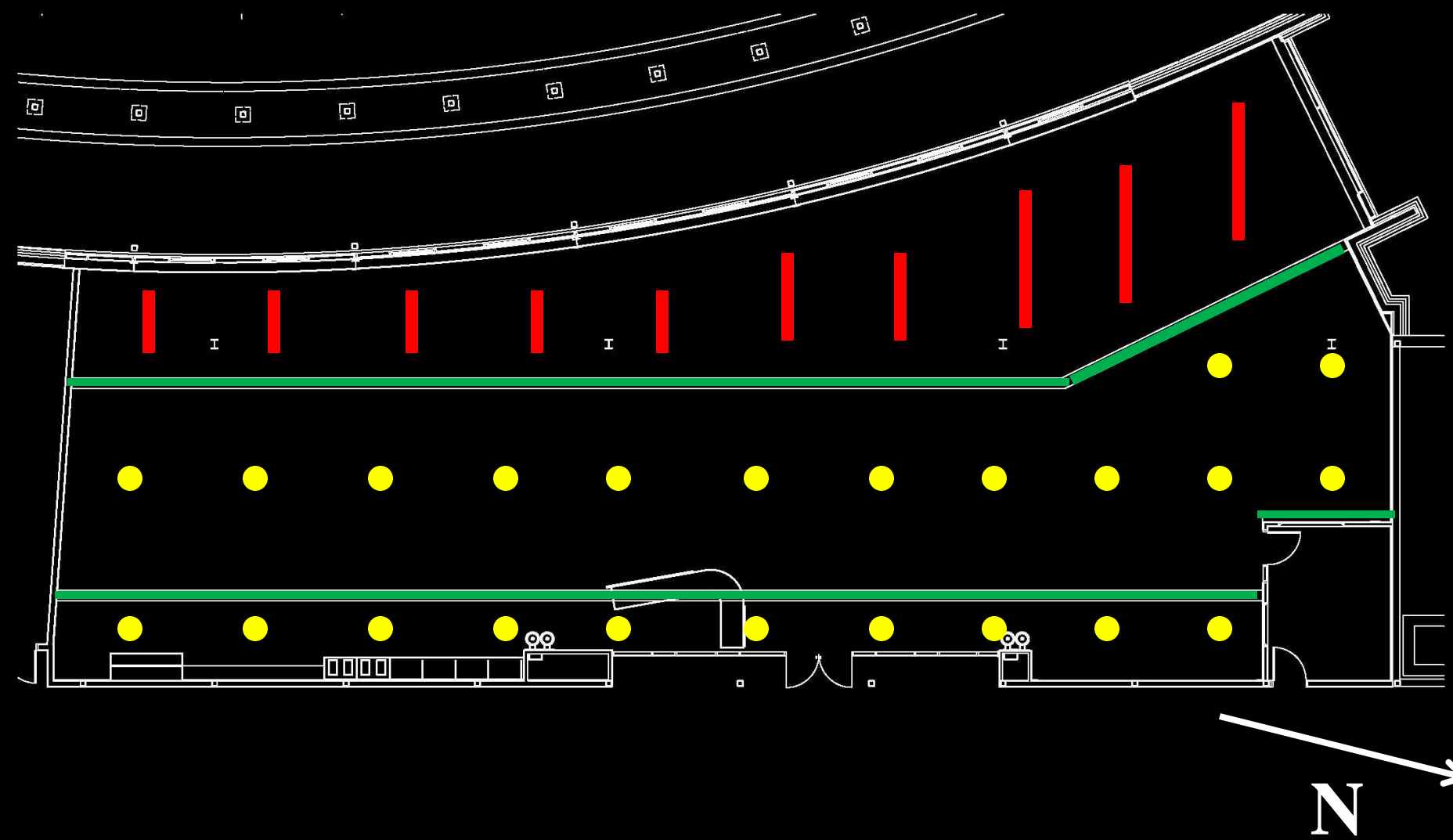


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### Design Goals:

- Highlight architectural elements
- Provide adequate and uniform illuminance for tasks on work plane
- Meet IESNA recommendations, ASHRAE 90.1 Standard

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Luminaires:



Compact Fluorescent  
CF32DT/E/IN/841/ECO

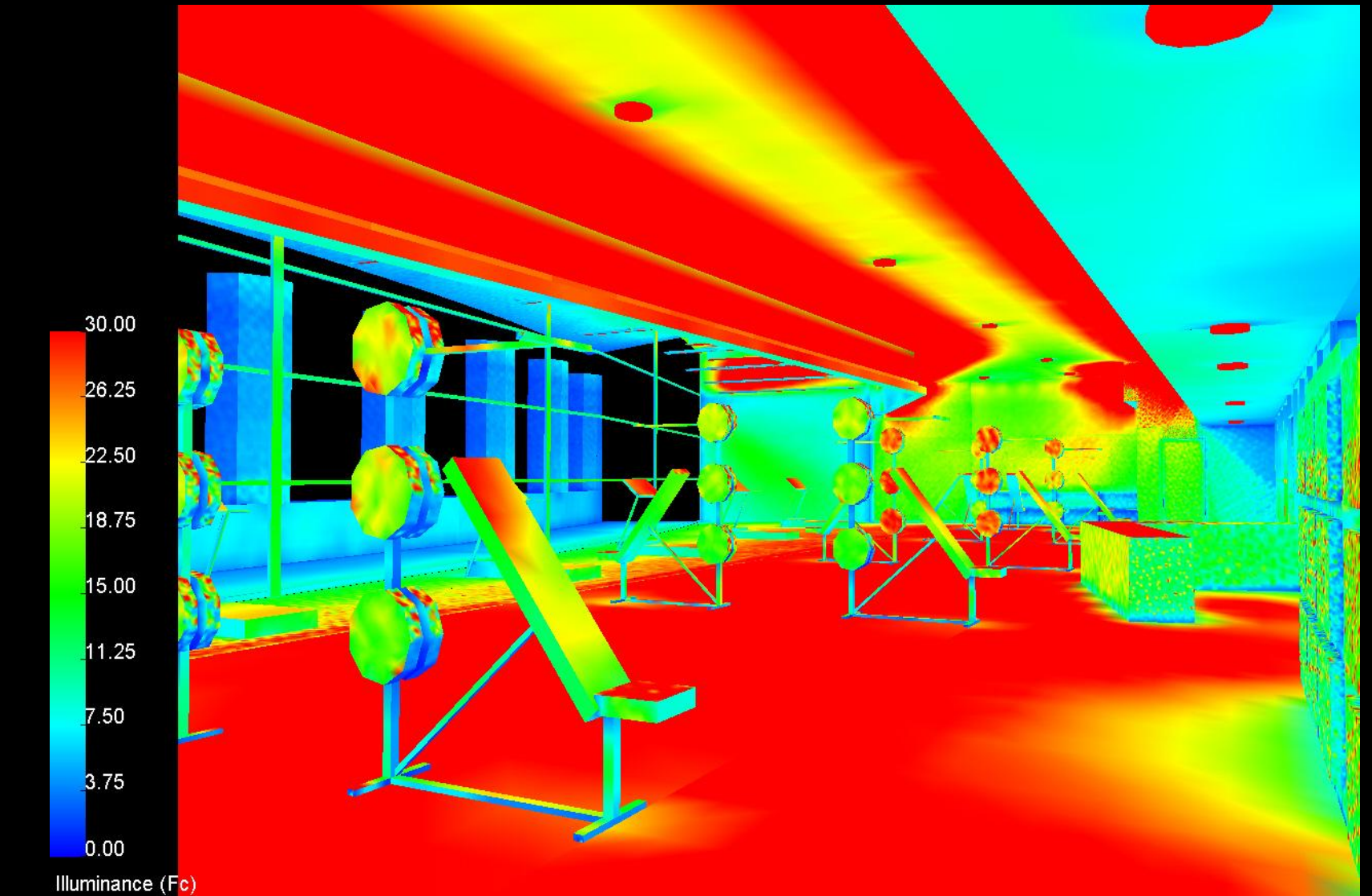


Linear Fluorescent  
FP54/841/HO/ECO



Linear Fluorescent  
FP28/841/PM/ECO

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Performance Summary:

Criterion	IESNA Recommended	Design
Average Illuminance	30 fc	29 fc
Max : Min Ratio	-	2.2 : 1
Coefficient of Variance	-	0.16
LPD Wall/ Surfaces (5015SF)	09 W/SF (4514W)	0.83 W/SF (4142 W)

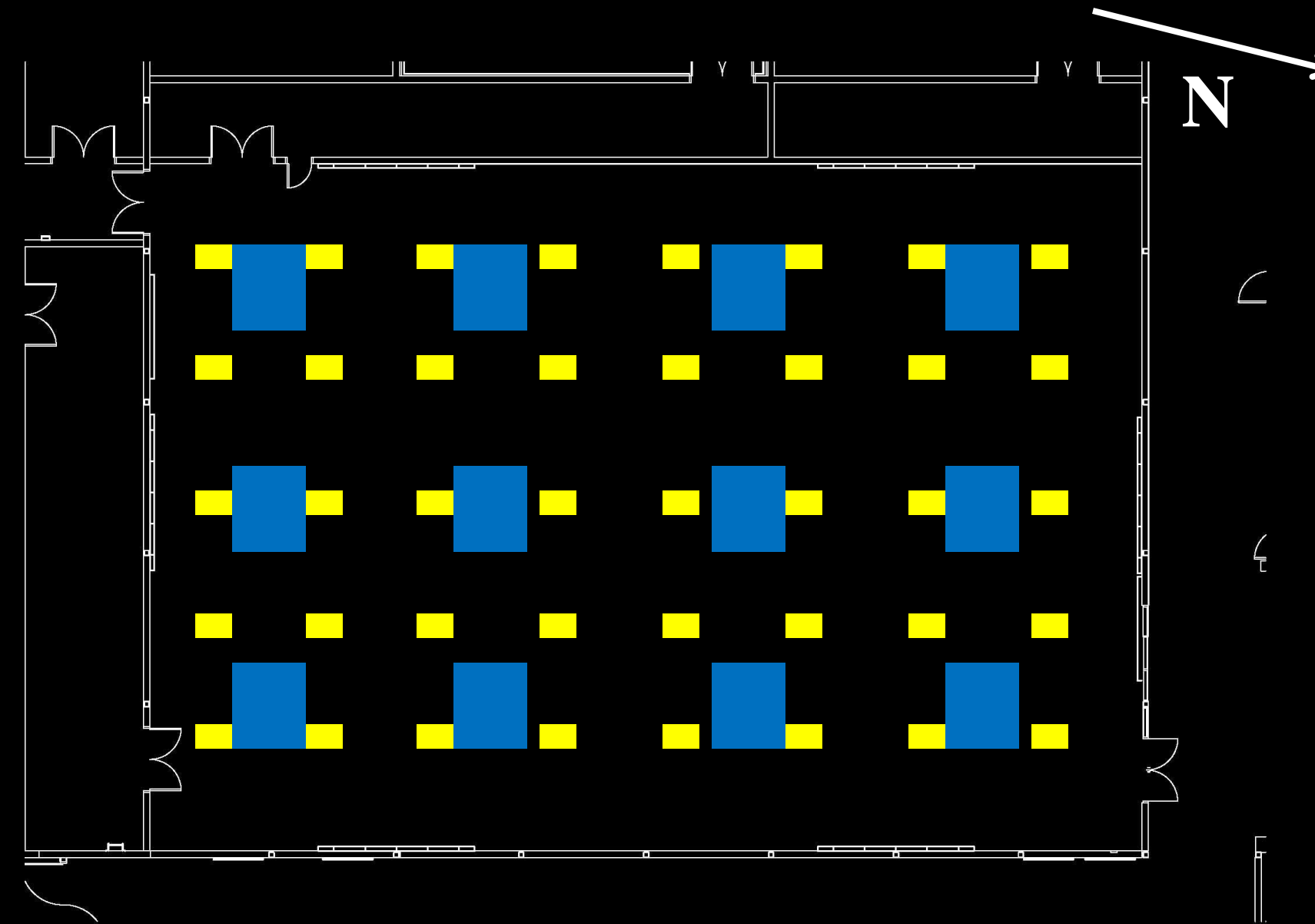


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## Design Goals:

- Highlight architectural elements
- Provide adequate and uniform illuminance for tasks on work plane
- Incorporate Daylight into space
- Meet IESNA recommendations, ASHRAE 90.1 Standard

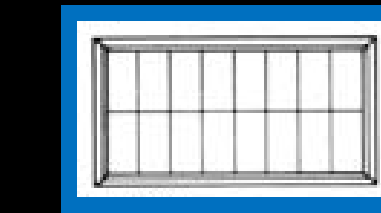
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### Luminaires:



Linear Fluorescent  
FP54/841/HO/ECO

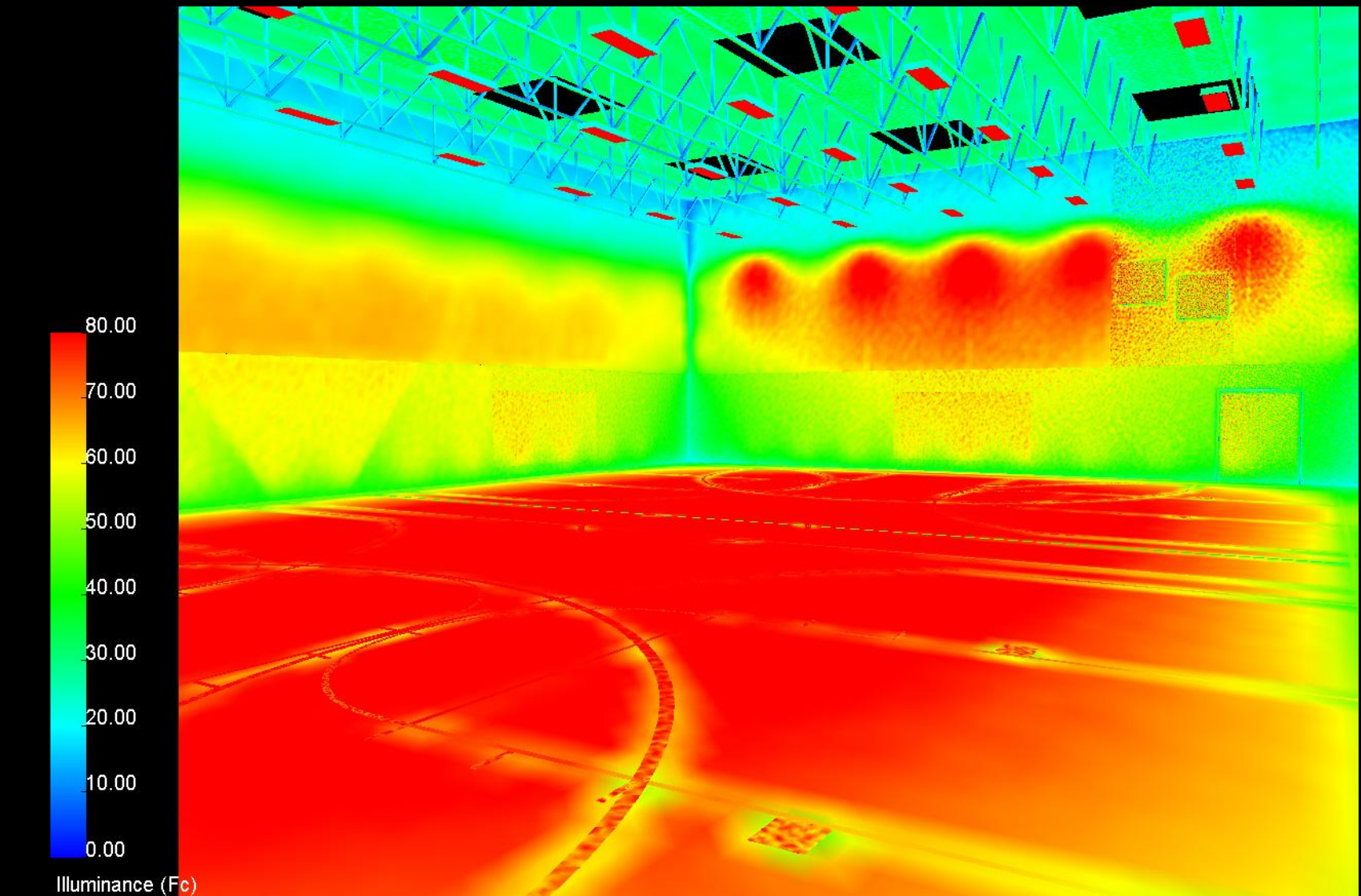


### Skylight

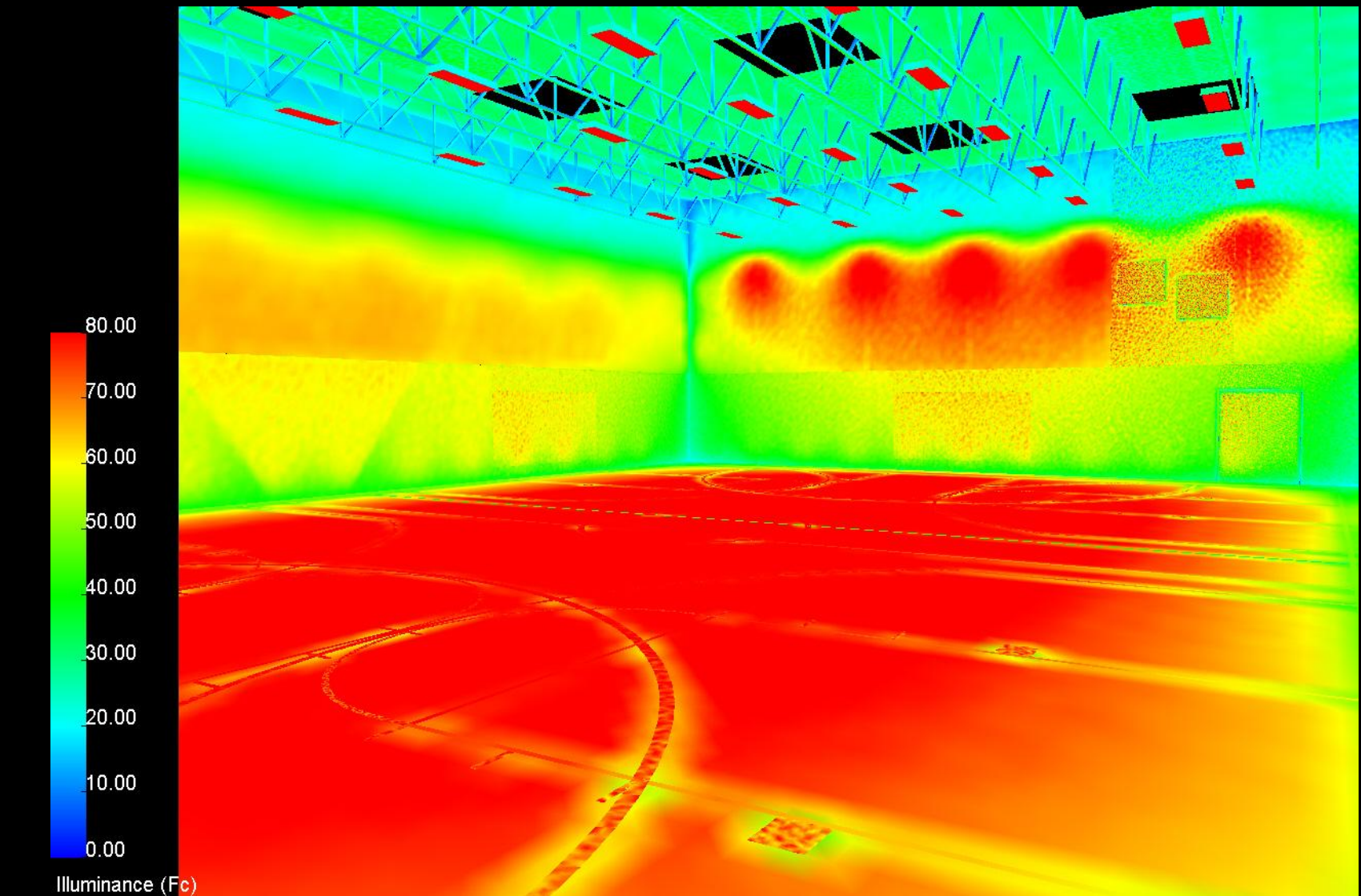
Dimension:	8' x 8'
Skylight/ Floor Ratio	10.8%
$\tau$ (Transmittance)	0.30
$\rho$ (Reflectance)	0.80
U (Insulation)	0.23 Btu/hr-sq ft °F
SHGC (Solar Heat Gain)	0.26



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Performance Summary:

Criterion	IESNA Recommended	Design
Average Illuminance	80 fc	81 fc
Max : Min Ratio	2.5 : 1	2.2 : 1
Coefficient of Variance	0.21	0.16
LPD Wall/ Surfaces (6270SF)	2.3 W/SF (14421W)	1.6 W/SF (9640W)



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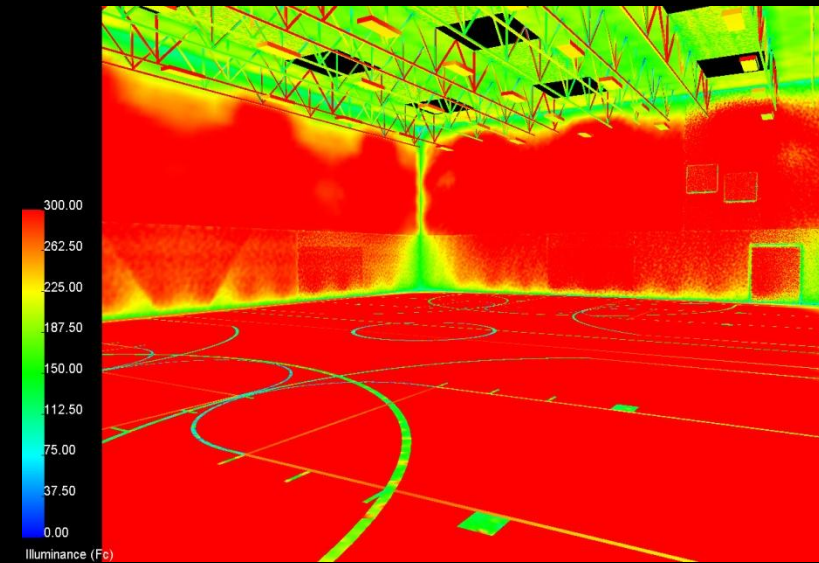
## Daylight Contribution:

### Scenarios:

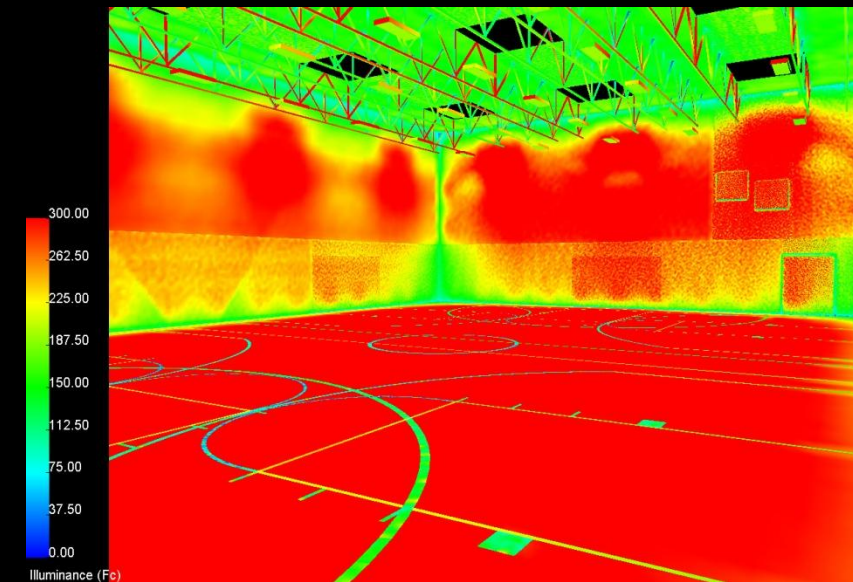
- Summer Solstice (June 21, 2011 1:15 PM)
  - Clear Sky
  - Overcast Sky
- Winter Solstice (December 22, 2011 1:15 PM)
  - Clear Sky
  - Overcast Sky
- Fall/ Spring Equinox (September 23, 2011 1:15 PM)
  - Clear Sky
  - Overcast Sky

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### Summer Solstice:

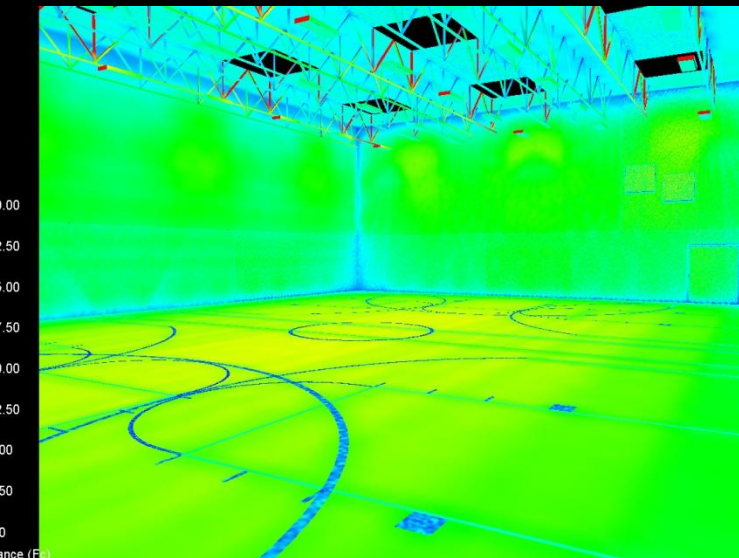


Clear Sky

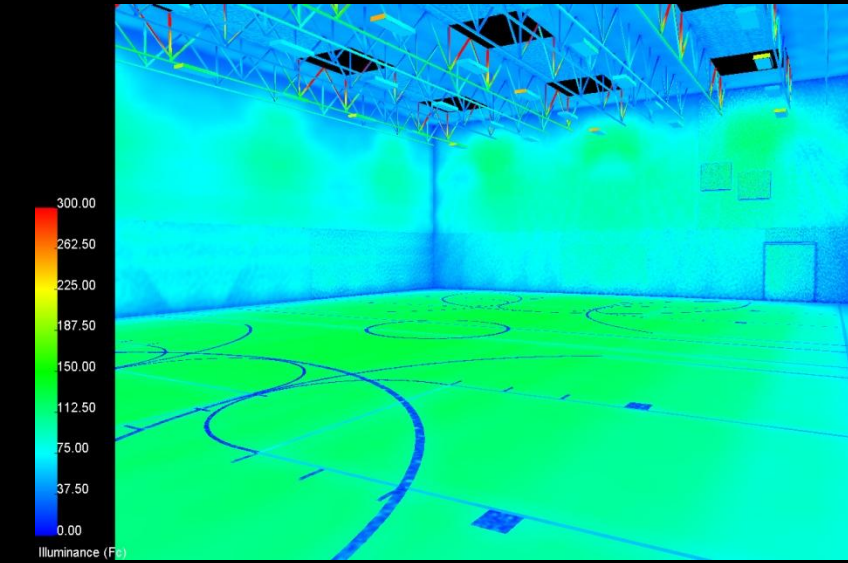


Overcast Sky

### Winter Solstice:



Clear Sky



Overcast Sky

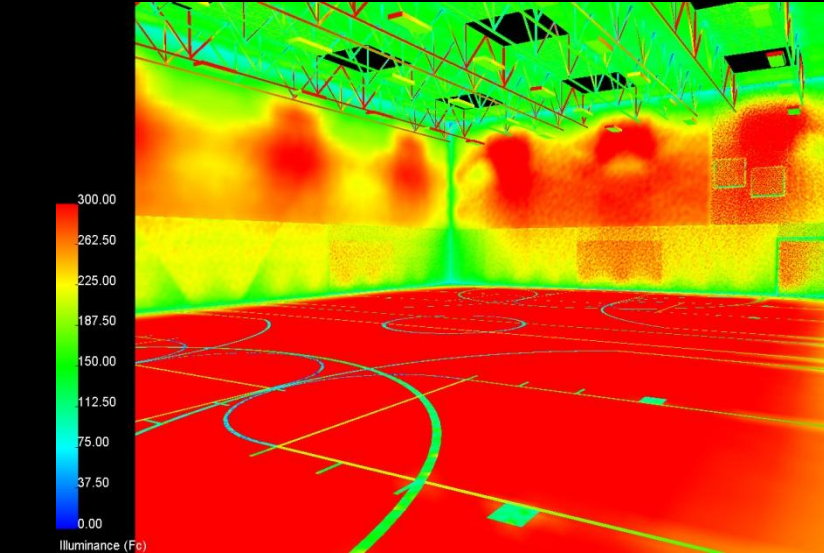
- Introduction/ Building Overview
- Electrical Depth Topics
  - Motor Control Center
- **Lighting Redesign**
  - Exterior Façade
  - Fitness and Weight Room
  - **Auxiliary Gymnasium**
- Mechanical Breadth
  - Chiller Redesign
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## Sky Calc Energy Savings:

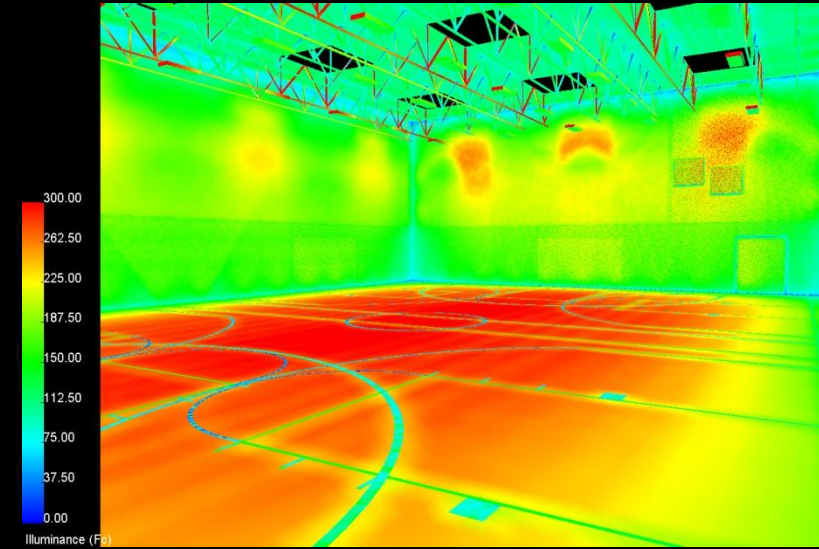
Electric Lighting Usage		kWh/yr	
Ltg. Energy without Skylights	49,172	Lighting Fraction Saved	44%
Lighting Energy w/ Skylights	27,651	Full daylighting (h/yr)	2,130

Savings from Design Skylighting System		
Savings	Annual Energy Savings (kWh/yr)	Annual Cost Savings (\$/yr)
Lighting	21,522	\$2,518
Cooling	-1,570	-\$184
<b>Total</b>	<b>19,951</b>	<b>\$2,334</b>

## Fall/Spring Equinox:



Clear Sky



Overcast Sky

- Introduction/ Building Overview
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- Design Goals:

- Determine additional cooling load to Auxiliary Gymnasium
- Establish whether existing chiller can supply new cooling load



- Introduction/ Building Overview

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### Existing Chiller:

Manufacturer:

York

Type:

Air Cooled Screw Chiller

Capacity:

213 ton

Flow Rate:

516 GPM

Pressure Drop:

14.4 ft

Power

260 kW

Voltage:

480 V

Amperage:

392 A

### Existing Design Load:

Building Peak Demand:

204 tons

Auxiliary Demand Load:

17 tons



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### Trace Model Inputs:

Roof U-Value: 0.065 Btu/hr-sq ft °F  
 Slab U- Value: 0.73 Btu/hr-sq ft °F  
 Wall U- Value: 0.064 Btu/hr-sq ft °F  
 Density: 50 Persons  
 Schedule: College  
 LPD: 2.3 W/SF  
 Setpoint: 74 °F

### Additional Design Load:

New Auxiliary Load: 20 tons  
 New Total Building Demand: 207 tons  
 Existing Chiller Capacity: 213 tons

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### Electrical

- Localize Motor Control Center in Mechanical Room

### Lighting

- Highlight architectural elements to emphasize quality of Athletic Facility
- Provide energy efficient design solutions
- Provide adequate illuminance for task oriented spaces

### Lighting

- Confirm the utilization of the existing chiller to supply new cooling load to Auxiliary Gymnasium



## Questions/ Comments?

- Introduction/ Building Overview
- Electrical Depth Topics
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- Mechanical Breadth
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- Acknowledgments

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  - Larry Fritts and Jack Stitz
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- All Family Friends and PSBC

