Indianapolis International Airport - Midfield Terminal

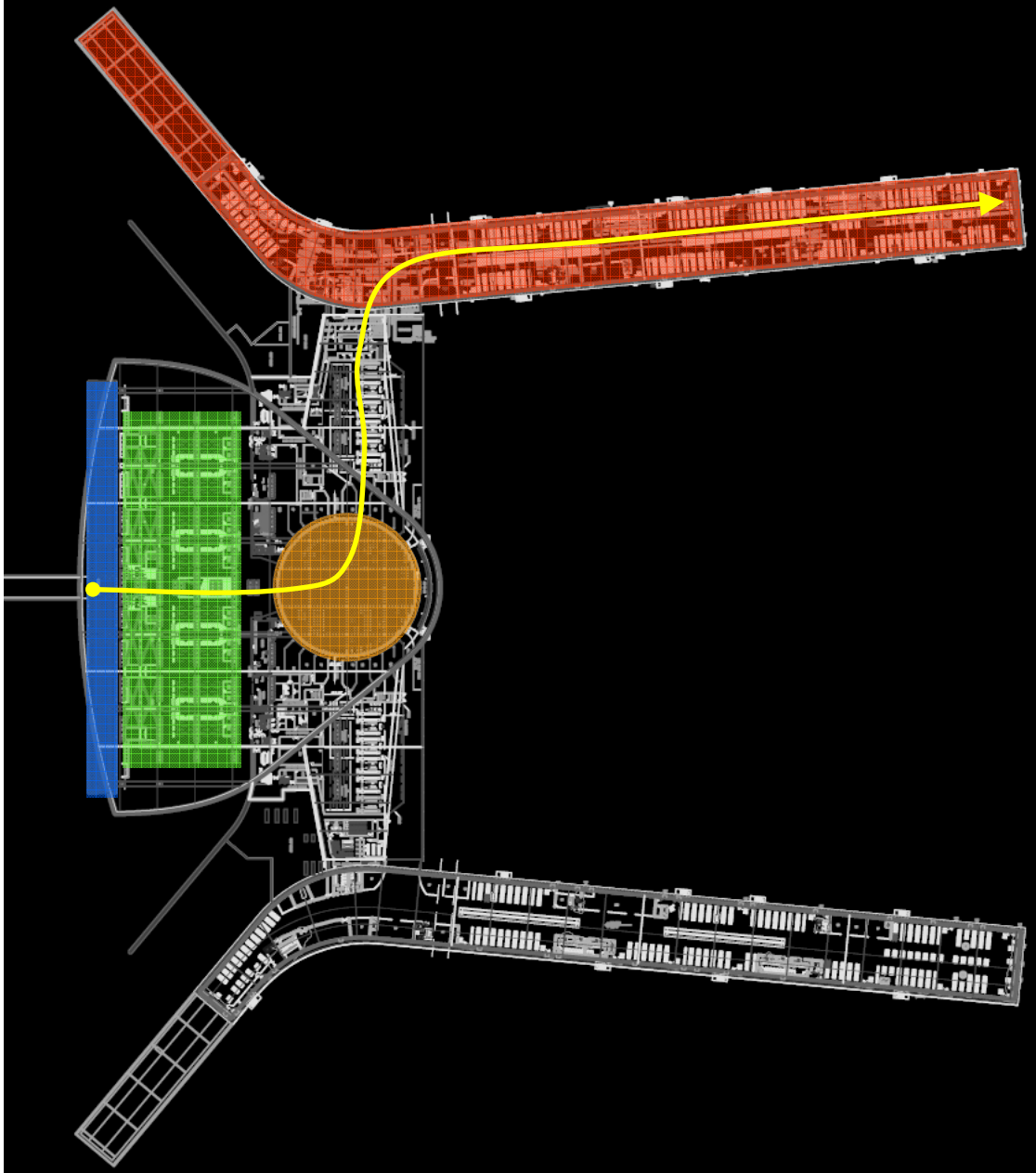
Indianapolis, IN

Ming Norman Tsui

Lighting/Electrical Option
Advisor: Dr. Moeck
Architectural Engineering

Background

Owner:	Indianapolis Airport Authority
Design Architect:	Hellmuth, Obata + Kassabaum. (HOK) Inc.
Architect of Record:	AeroDesign Group
Structural Consultants:	Thornton-Tomasetti
MEP Consultants:	Syska Hennessy
Lighting Consultants:	HOK Lighting Group
Construction Managers:	Turner Construction & Trotter Construction
General Contractors:	Hunt Construction & Smoot Construction
Size:	1.2 Million Sq.ft
Total Level:	5 Stories + Roof
Construction Date:	2005 - 2008
Overall Project Cost:	$975 millions
Delivery Method:	Design-Bid-Build



Outline

Lighting Depth

- Exterior Departure
- Terminal Ticket Hall
- Civic Plaza
- Passenger Concourse

Electrical Depth

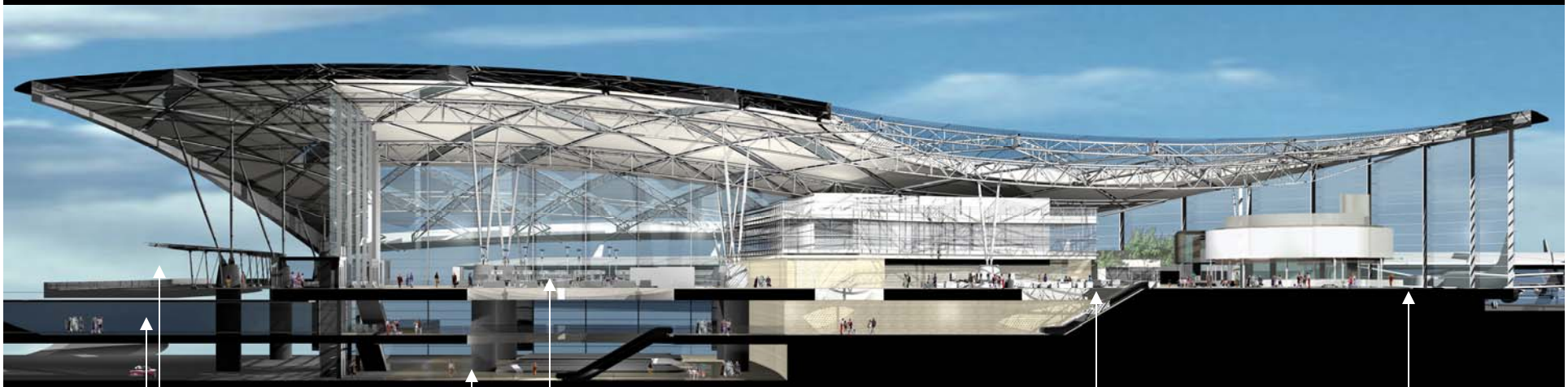
Sustainable Design Breadth

Construction Management Breadth

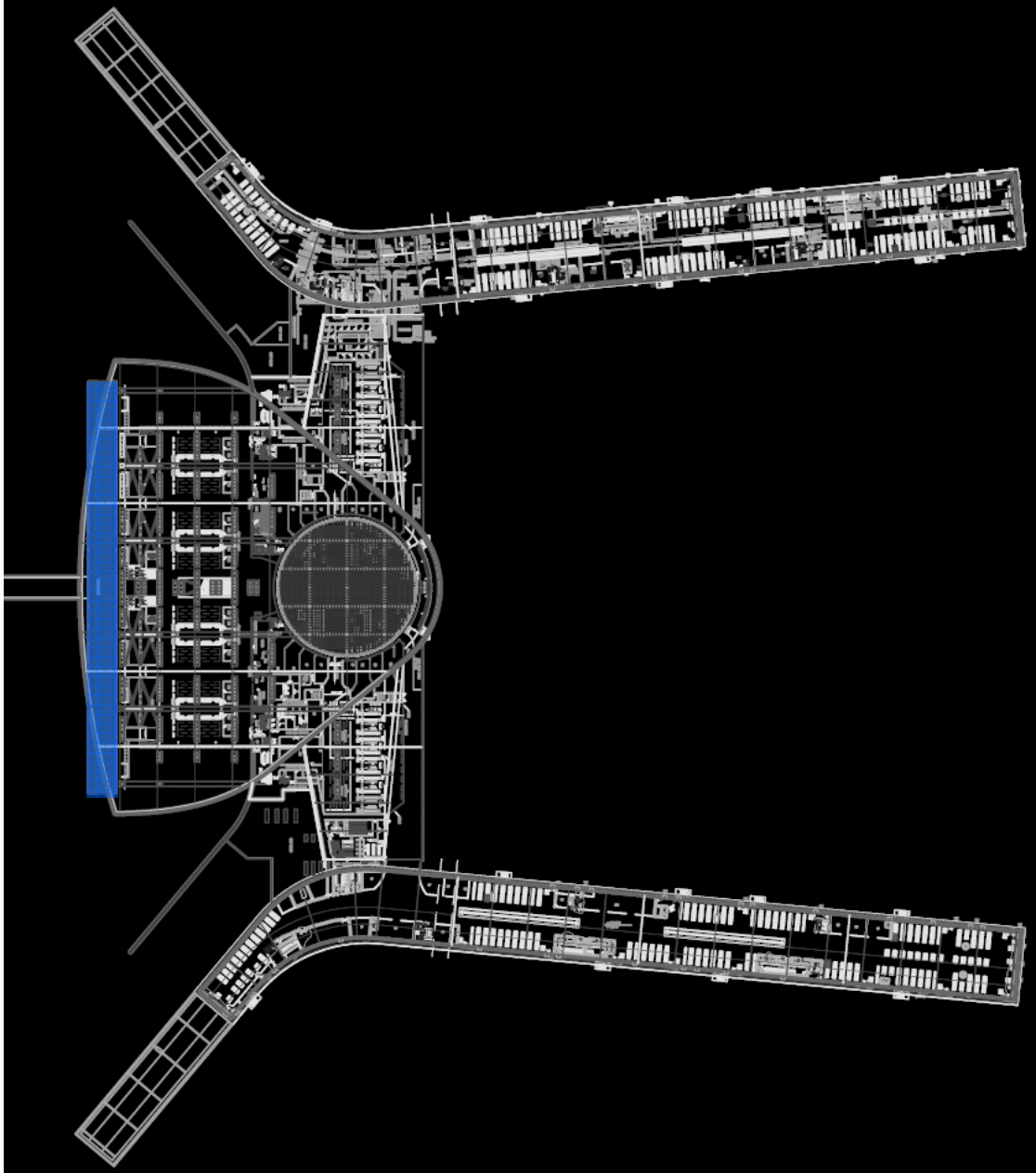
Conclusion

Acknowledgements

Overall Building Section



- Exterior Departure
- Arrival Pick-up
- Terminal Ticket Hall
- Baggage Claim
- Civic Plaza
- Passenger Concourse



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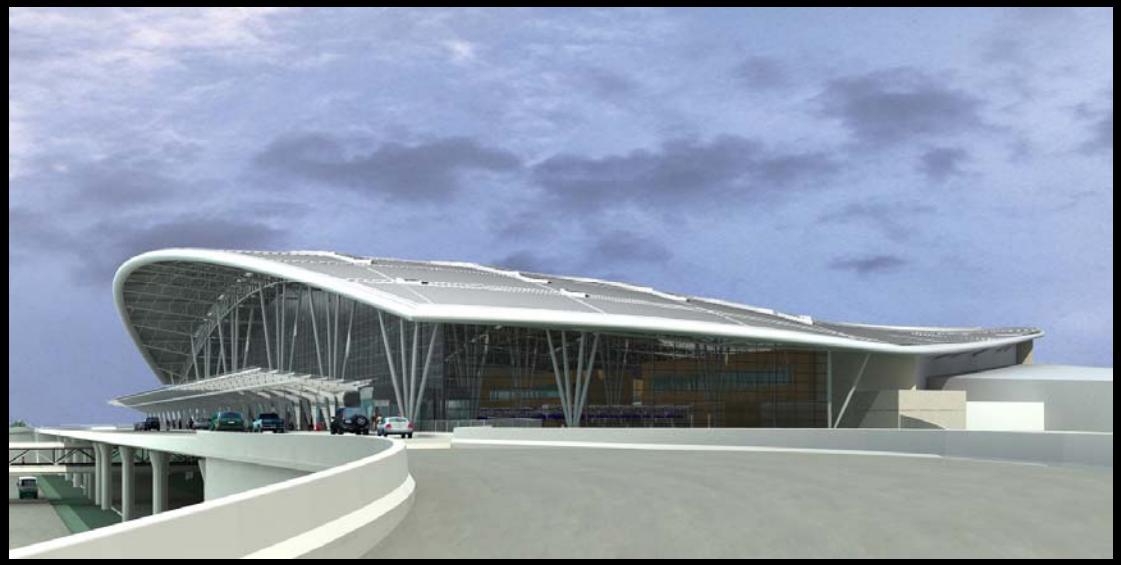
Lighting Depth: Exterior Departure/Canopy Area

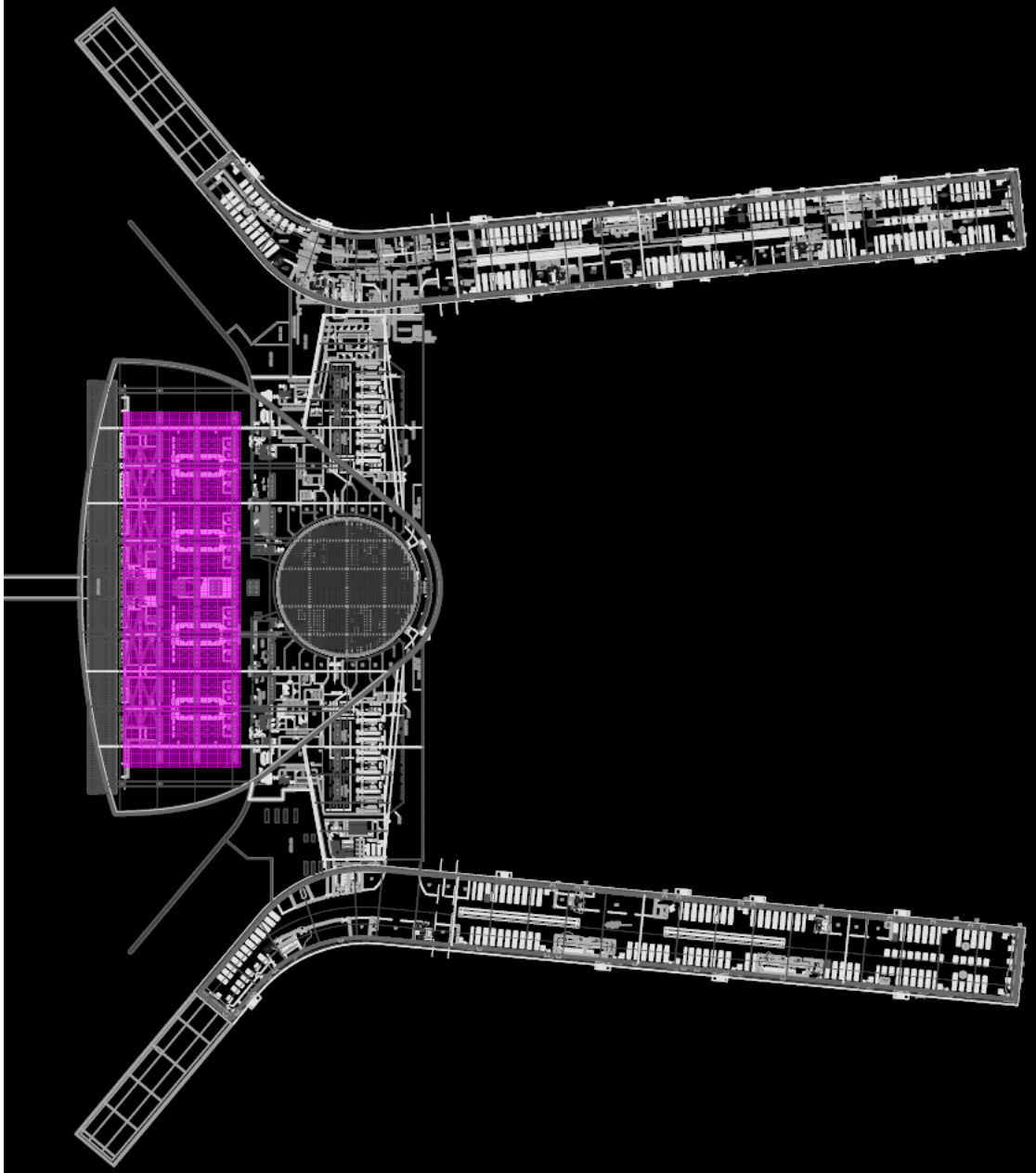


Architecture Overview

- 85 ft from Floor to Roof height
- Glass and Steel Canopy
  - 216 ft Long, 15 ft Tall
- 1 Main Entrance
- 4 Sub-entry Vestibules

Existing Condition

- Canopy-Mounted MH Roof & Façade Uplights
- Canopy-Mounted MH Pedestrian Downlights
- Semi-Recessed MH Assymetric Façade Flood Light



Outline

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Electrical Depth

Sustainable Design Breadth

Construction Management Breadth

Conclusion

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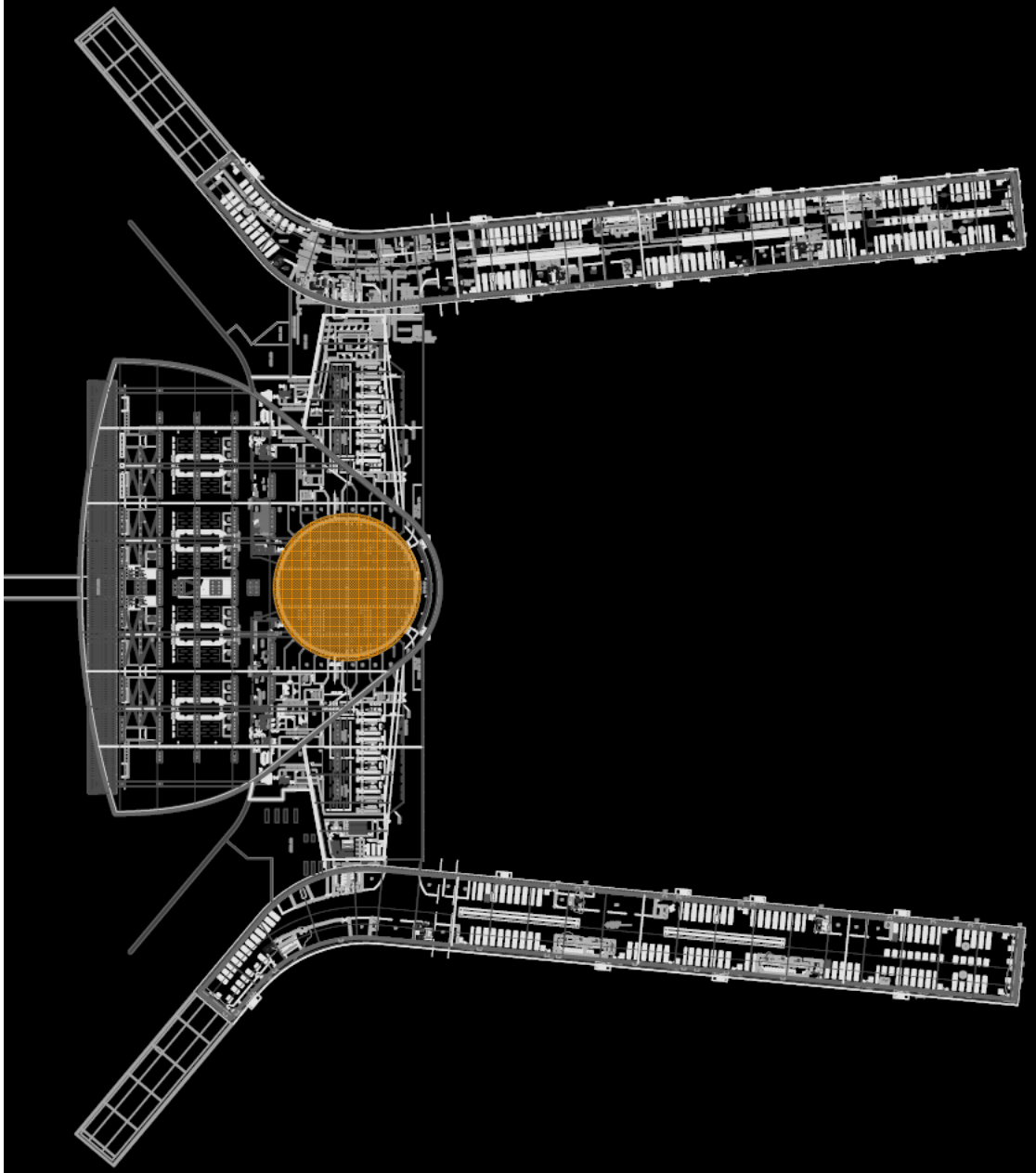
Lighting Depth: Terminal Ticket Hall

Architecture Overview

- 85 ft from Floor to Roof height
- Glass and Steel Canopy
  - 120 ft Long, 15 ft Tall
- 50 Linear Stripe Skylights
- 96 Check-In Counters
- High Performance Triple Glazed Curtainwall enclosure

Existing Condition

- Canopy-Mounted MH Roof Uplights
- Linear Fluorescent Direct Pendant over Ticket Counters
- Signage Integrated Recessed Linear Fluorescent Fixture



Outline

Lighting Depth

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Electrical Depth

Sustainable Design Breadth

Construction Management Breadth

Conclusion

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Lighting Depth: Civic Plaza

Architecture Overview

- 85 ft from Floor to Roof height
- Circular Skylight
  - 240 ft in diameter
- High Performance Triple Glazed Curtain Wall enclosure
- Ventilated Floor Tiles
- Panoramic Animated Screens

Existing Condition

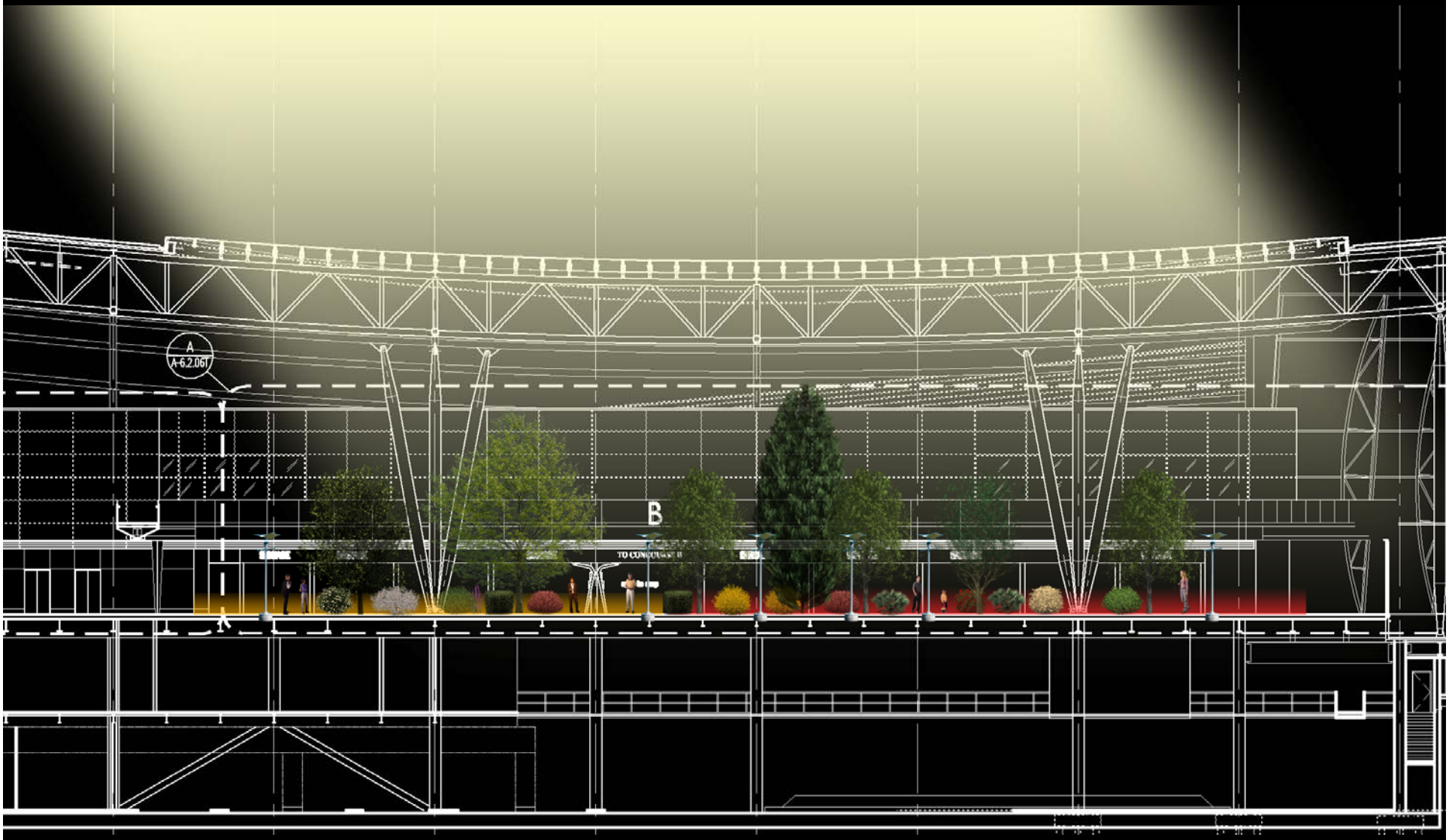
- Custom-Designed 28 ft tall Light Poles
- Mounted with 12 MH Spotlight for accent lighting
- Mounted with 4 MH Indirect Luminaire for ambient lighting

Design Goal

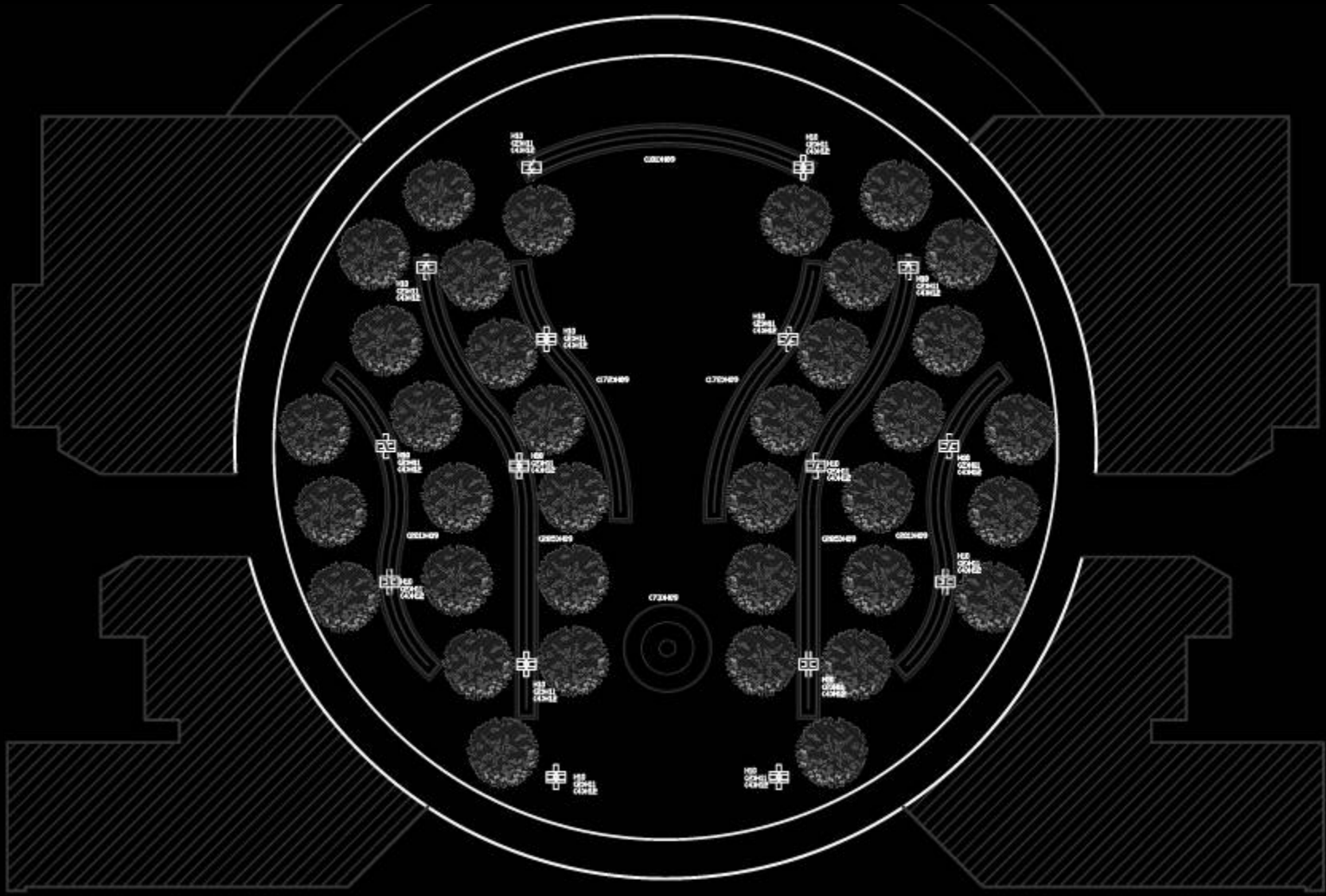
- Appearance
  - Design a "Civic Garden"
  - Arteries Landscaping for directing traffic
  - Guidance Lights from Metaphor
    - (continuity of previous space)

- Daylighting
  - Minimize Solar Glare and Discomfort
  - Provide proper shading through Massive Plantation

Schematic Design Illustration



Civic Plaza Luminaire Layout



Lighting Fixture Schedule

H09

H10

H11

H12

Civic Plaza							
Fixture #	**Luminaire**	**Lamp Type**	**Lamp Wattage (watts)**	**Lamps/Fixture**	**Quantity**	**Watts/L-ft or Watts/Fixture**	**Total Watts**
H09	**Surface Mounted Asymmetric LED**	6'/unit Warm White LED	15 w/ft	1	1570	15	23550
H10	**Custom 25' Tall Free Standing Light Poles**	Metal Halide T6	150	1	32	175	5600
H11	**Pole High Mounted Spotlight**	Metal Halide Socket G12	150	1	32	175	5600
H12	**Pole Low Mounted Spotlight**	Metal Halide Socket G12	70	1	64	85	5440

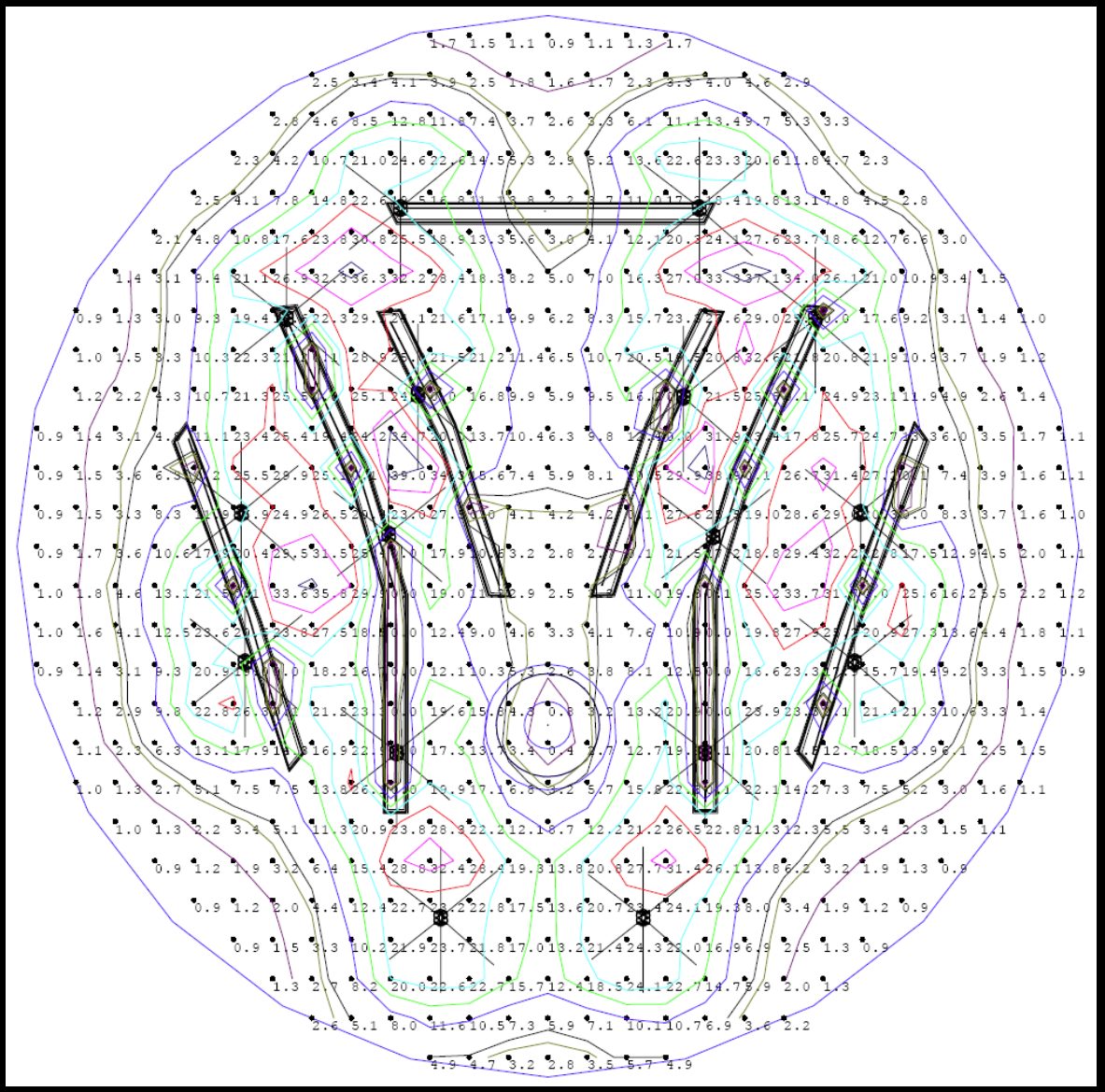
Tree Shading Study

Illuminance reading:

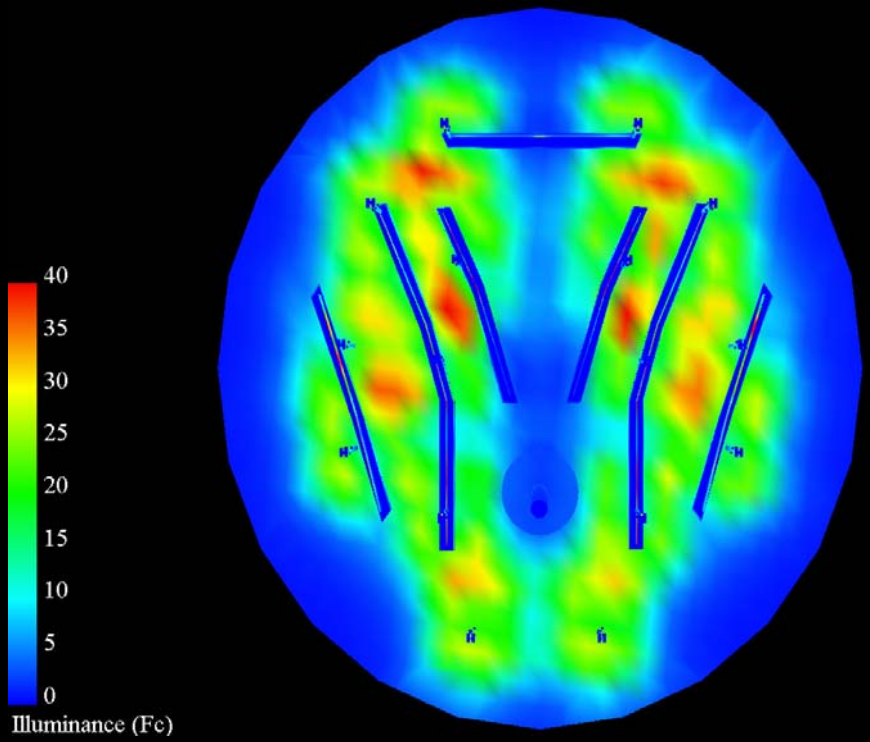
- Equinox - Clear Sky – 4:00 PM
  - Open space: 2000 fc
  - Under tree shade: 150 fc +/- 20% error
  - Remained illuminance ratio: 150/2000 x 100 = 7.5% +/- 20% error
  - Shading ratio: (2000-150)/2000 fc x 100 = 92.5% +/- 20% error
- Equinox – Clear Sky – 9:00 AM
  - Open space: 600 fc
  - Under tree shade: 30 fc +/- 20% error
  - Remained illuminance ratio: 30/600 x 100 = 5% +/- 20% error
  - Shading ratio: (600-30)/600 fc x 100 = 95% +/- 20% error

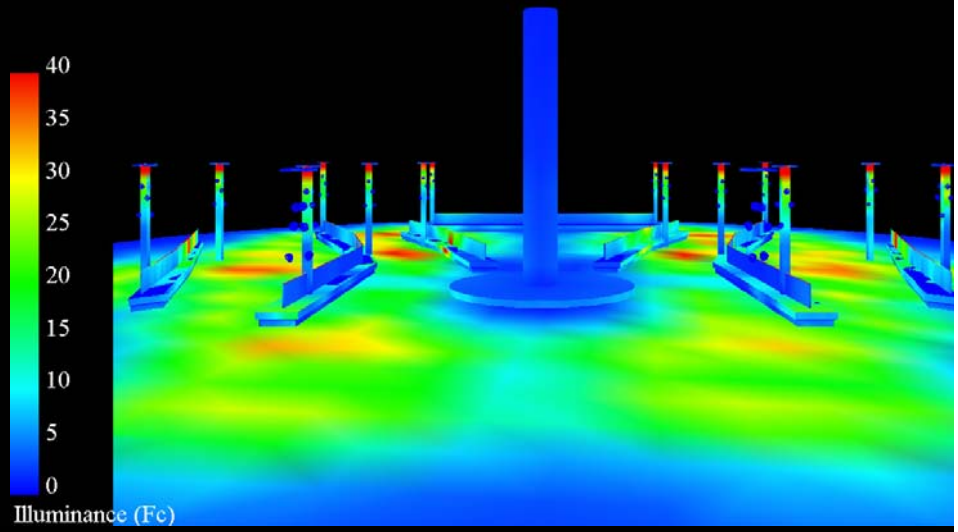
30-270 fc remain on Ground Plane if shaded with 25ft Tall Trees

Civic Plaza Illuminance Distribution



Civic Plaza Illuminance Distribution





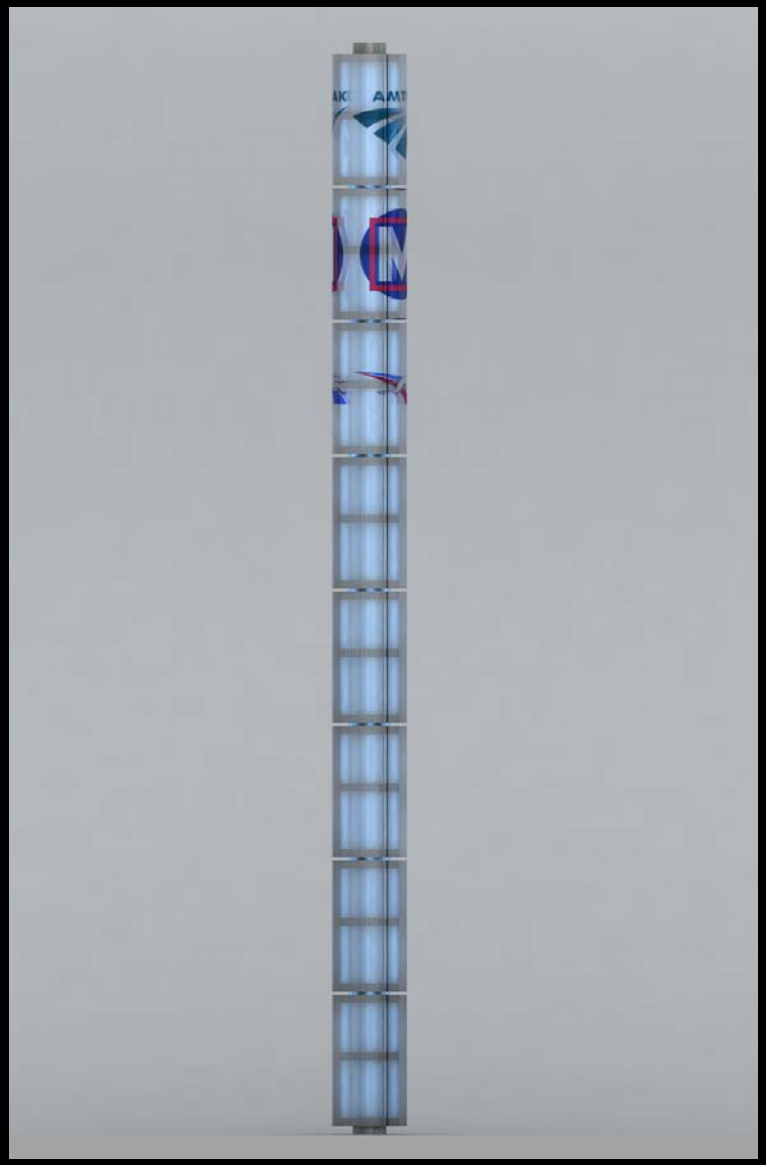
Lighting Power Density & Illuminance Summary

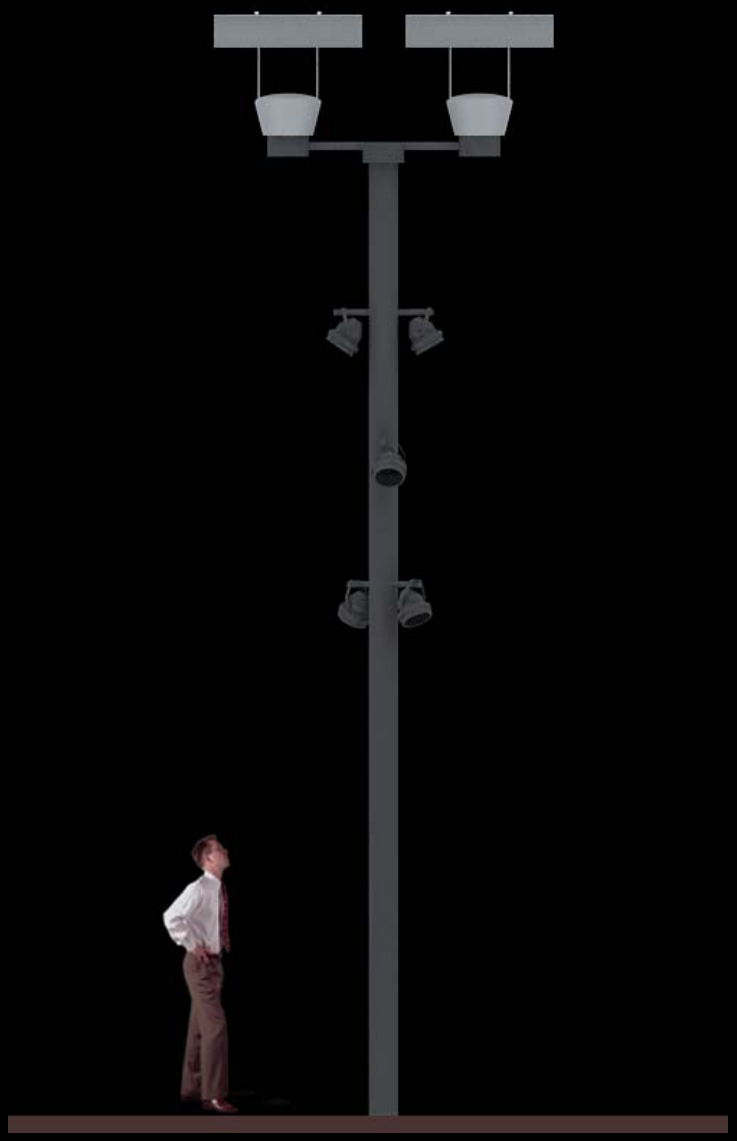
Illuminance Reading:

Average:	11.88 fc.
Maximum:	39 fc.
Minimum:	0 fc.

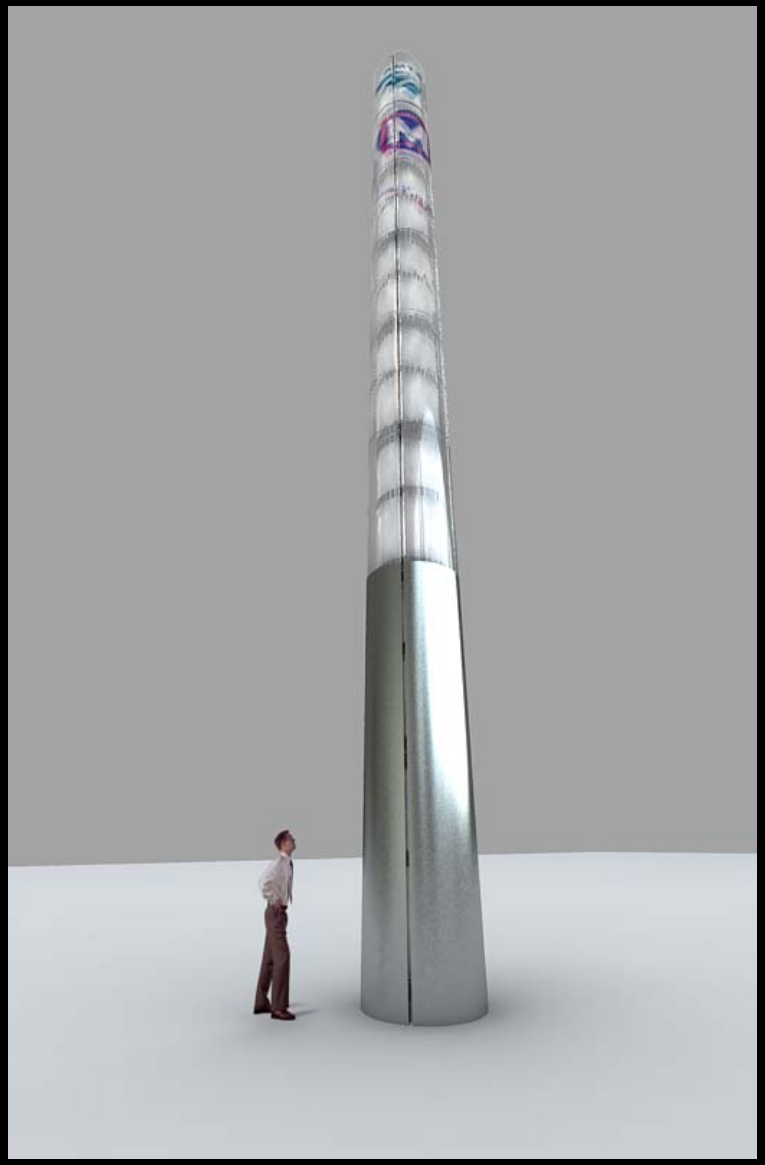
Lighting Power Density (watts/sq.ft)		Area (sq.ft)	Obtained LPD (watts/sq.ft)	Illuminance Category	Recommended Illuminance Level (fc)	Obtained Illuminance (fc)
Civic Plaza						
Lobby	1.32 W/sq.ft	45240	0.89	B	10	11.88

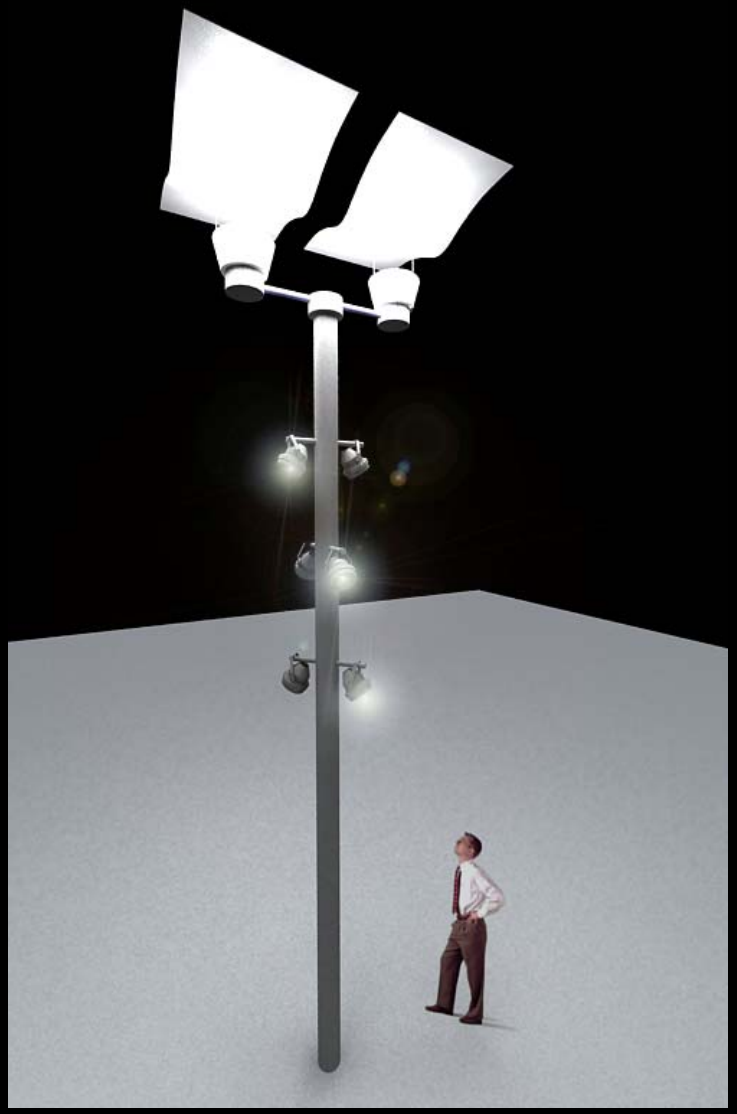
Custom Design Elevation





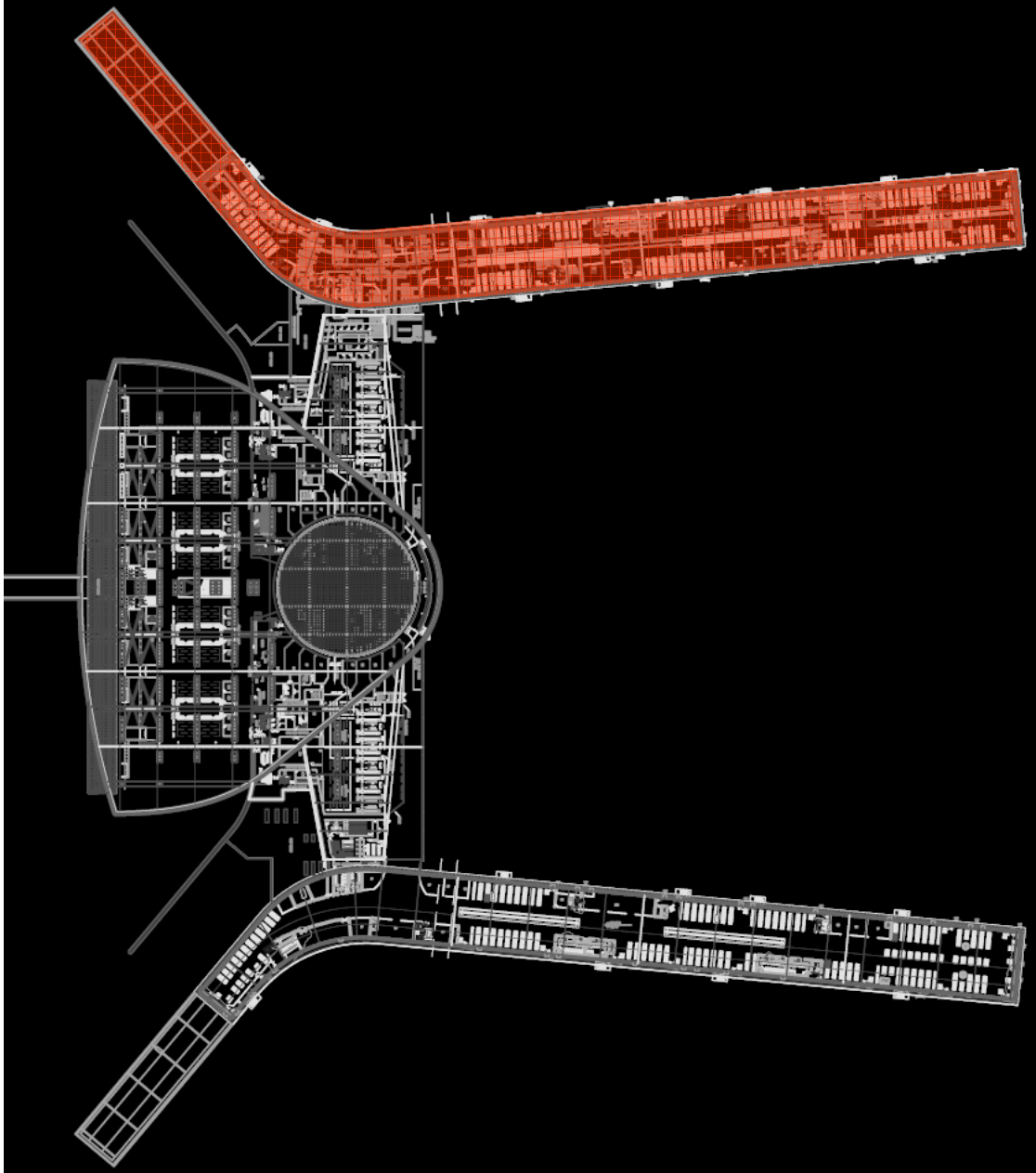
Custom Design Rendering





Civic Garden Rendering

Final Rendering



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- Exterior Departure
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Electrical Depth

Sustainable Design Breadth

Construction Management Breadth

Conclusion

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Lighting Depth: Passenger Concourse (B)

Architecture Overview

- High & Low-side Ceiling Height
- Long & Short-side Concourse
  - 1200 ft in length
- High Performance Triple Glazed Curtain Wall enclosure
- 20 Boarding Gates
- 4 Identical Modules/Quadrant

Existing Condition

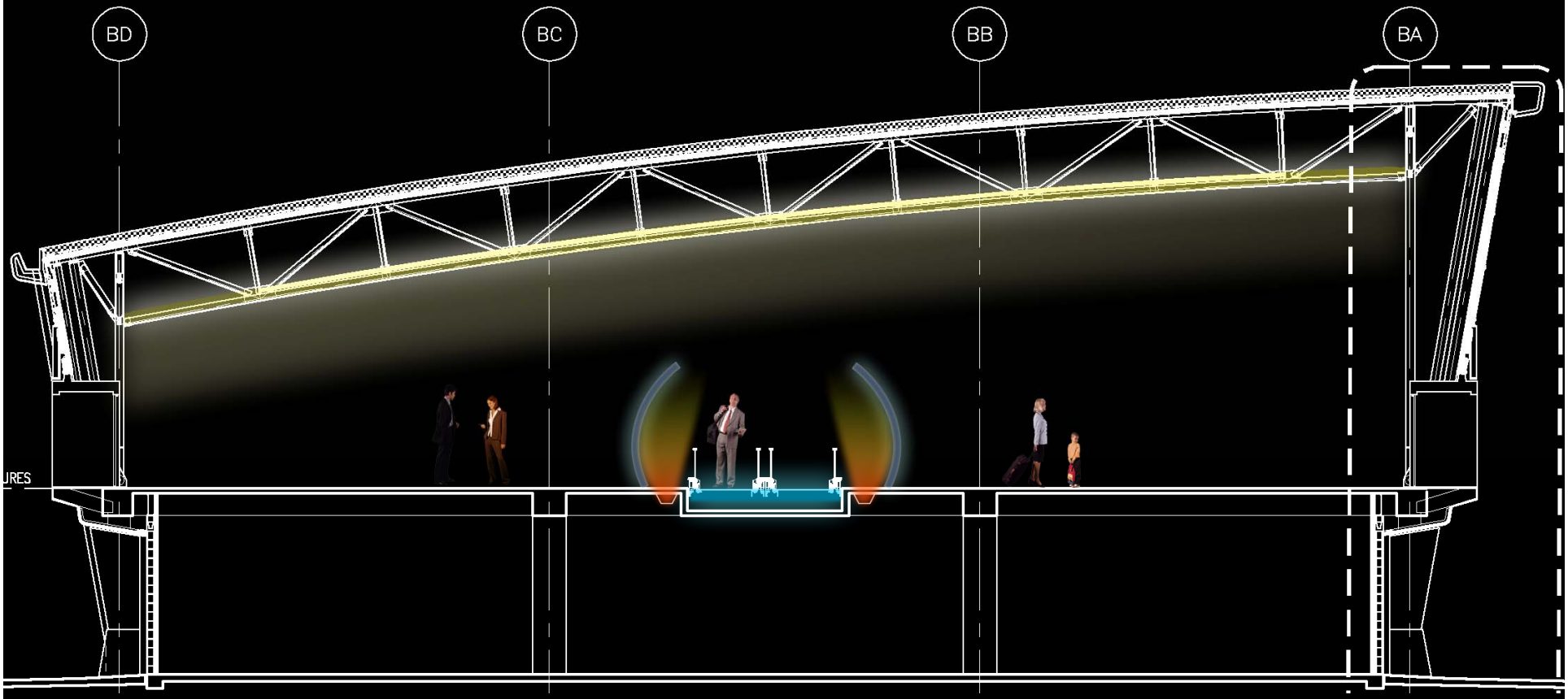
- Adjustable MH Downlight
- Recessed Linear Fluorescent Direct Fixture
- Recessed Linear Suspended Direct Fixture

Design Goal

- Appearance
  - Design a Comfortable Ambient for stressed Passengers
  - Create Visual Interest through implementing Artificial Tunnel
  - Guidance LED Lights for Metaphor
    - (continuity of previous space)

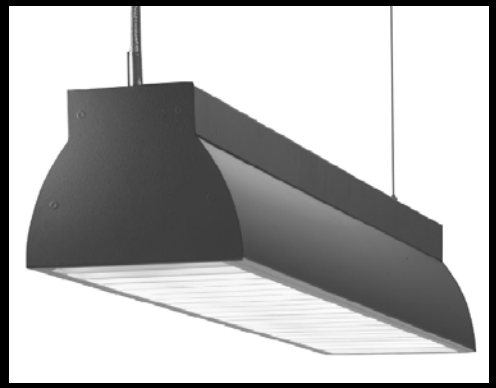
- Daylighting
  - Minimize Solar Glare and Discomfort
  - Provide proper shading through Operable Blinds

Schematic Design Illustration

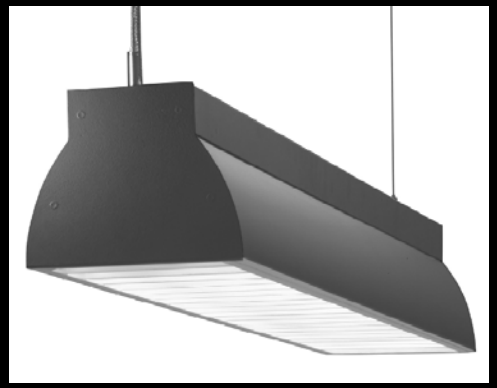


Concourse Luminaire Layout

Lighting Fixture Schedule



H13



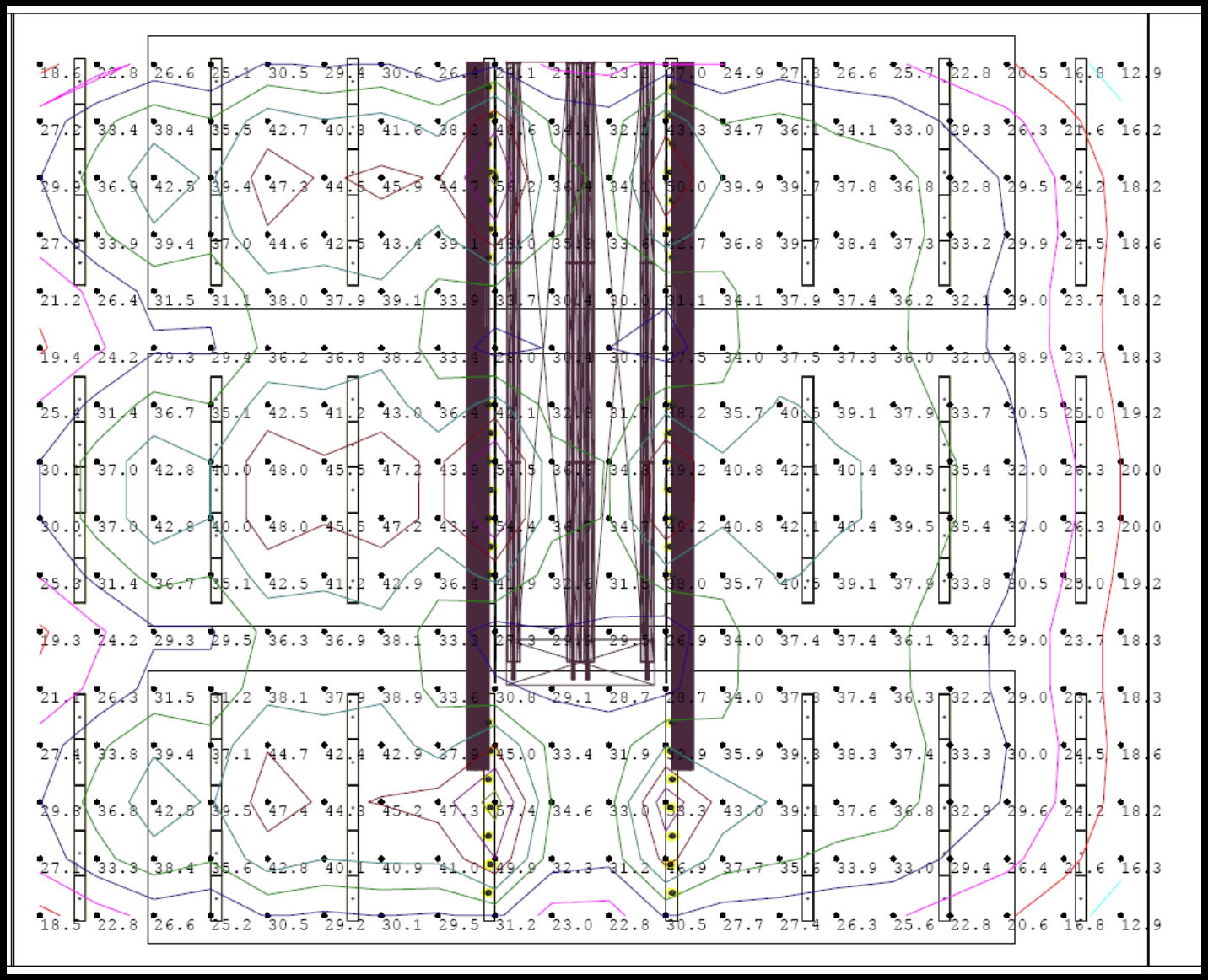
H14

H15

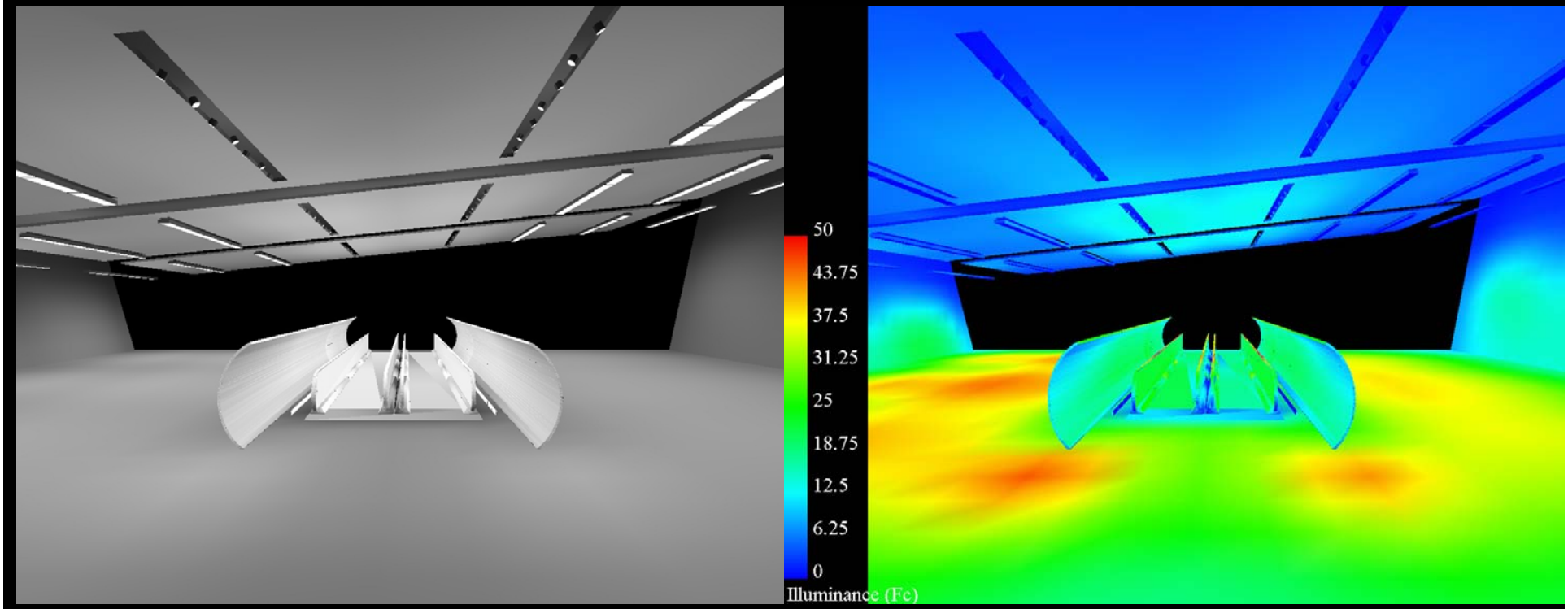
H16

Concourse							
Fixture #	**Luminaire**	**Lamp Type**	**Lamp Wattage (watts)**	**Lamps/Fixture**	**Quantity**	**Watts/L-ft or Watts/Fixture**	**Total Watts**
H13	**Linear Recessed Slot**	Flourescent T5HO	24	2 X-sect	800	17	13866.66667
H14	**Linear Pendant Direct**	Flourescent T8	32	2 X-sect	832	20	16362.66667
H15	**Adjustable Downlight**	Metal Halide T6	70	1	924	85	78540
H16	**Ingrade LED Coves**	1'/unit RGB LED	12	1	720	12	8640

Concourse Illuminance Distribution



Concourse Illuminance Distribution



Lighting Power Density & Illuminance Summary

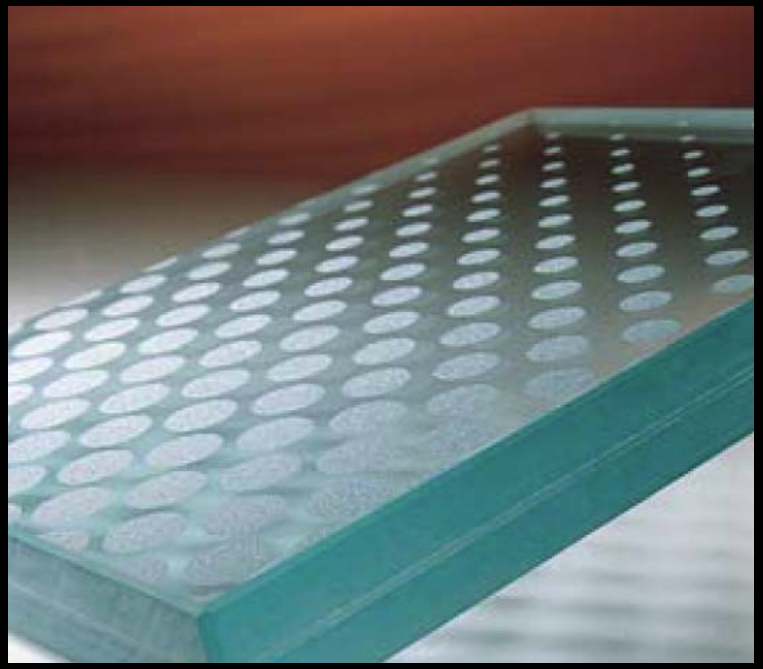
Illuminance Reading:

Average: 34.05 fc.
Maximum: 57.7 fc.
Minimum: 13 fc.

Lighting Power Density (watts/sq.ft)		Area (sq.ft)	Obtained LPD (watts/sq.ft)	Illuminance Category	Recommended Illuminance Level (fc)	Obtained Illuminance (fc)
Concourse						
Airport Concourse	0.62 W/sq.ft	275300	0.43	C	10	34.05
Reception/Waiting	0.54 W/sq.ft	91767	0.33	A	30	34.05

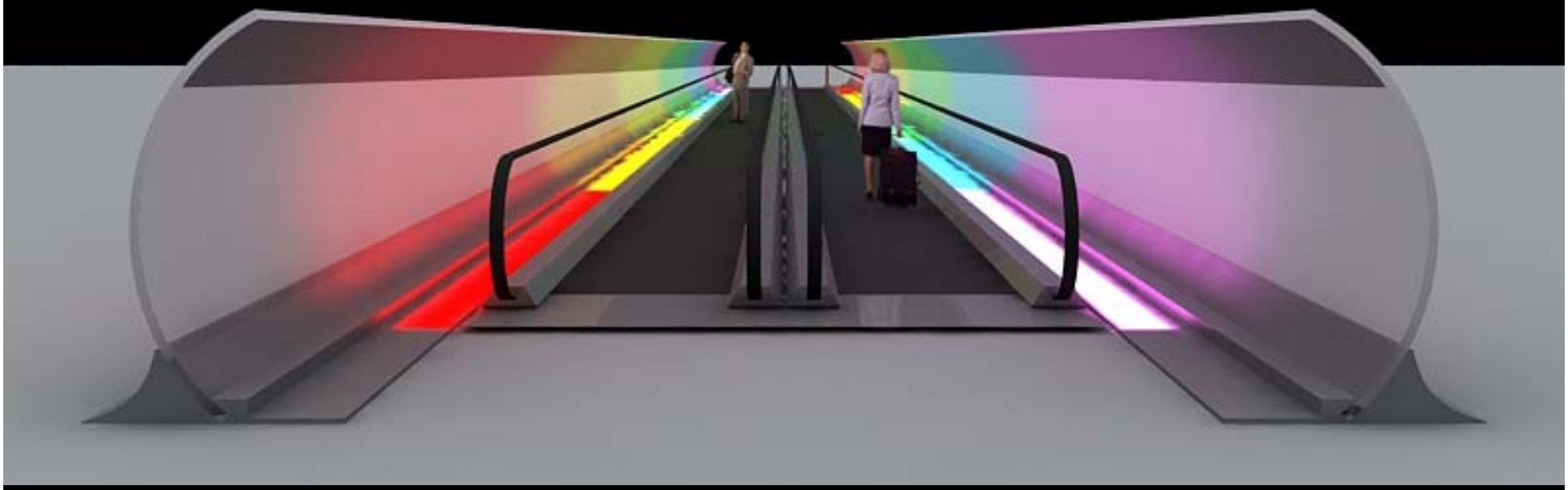
Product Specified

Mecho Shade Euroveil 6000 series

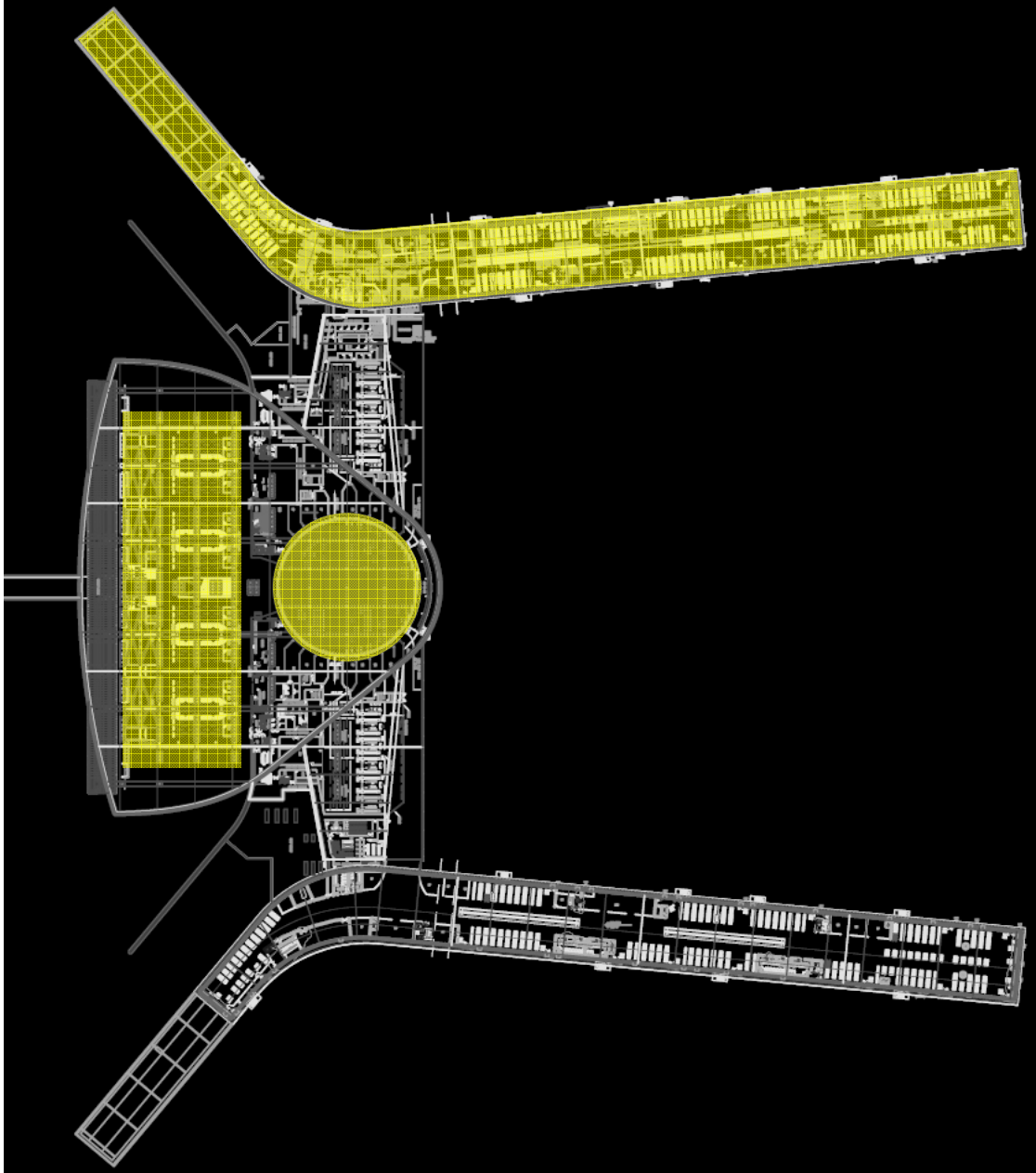


Cricursa Deformable Sandblasted Glass Panels

Tunnel Rendering



Concourse Rendering



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Electrical Depth

Sustainable Design Breadth

Construction Management Breadth

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Electrical Depth

Design Goal:

- Re-design panelboard layout to acommodate of new lighting system
- Re-size feeders to load demand
- Perform voltage drop study
- Specify new required electrical equipment
  - panelboards and step down transformers.

Concourse Lighting Distribution Panelboard

Concourse Lighting Panelboard

Panel LA / L **Voltage** 208/120V 3P, 4W Eaton Cutler-Hammer PRL-1a
Breaker 40
Location Concourse **Bus** 100

Ckt	Equipment	Demand	kVA	Amp	Bkr	Pole	A	B	C	Pole	Bkr	Amp	kVA	Demand	Equipment	Ckt
1	LED 1-1	1.25	2.113	17.59	20	1	4.225			1	20	17.59	2.113	1.25	LED 2-1	2
3	LED 3-1	1.25	2.113	17.59	20	1		4.225		1	20	17.59	2.113	1.25	LED 4-1	4
5	LED 1-2	1.25	2.113	17.59	20	1			4.225	1	20	17.59	2.113	1.25	LED 2-2	6
7	LED 3-2	1.25	2.113	17.59	20	1	4.225			1	20	17.59	2.113	1.25	LED 4-2	8
9	LED 1-3	1.25	2.113	17.59	20	1		4.225		1	20	17.59	2.113	1.25	LED 2-3	10
11	LED 3-3	1.25	2.113	17.59	20	1			4.225	1	20	17.59	2.113	1.25	LED 4-3	12
13	LED 1-4	1.25	2.113	17.59	20	1	4.225			1	20	17.59	2.113	1.25	LED 2-4	14
15	LED 3-4	1.25	2.113	17.59	20	1		4.225		1	20	17.59	2.113	1.25	LED 4-4	16
17	SPARE	1	0	0	20	1			0	1	20	0	0	1	SPARE	18
19	SPARE	1	0	0	20	1	0			1	20	0	0	1	SPARE	20
21	SPACE	1	0	0	-	1		0		1	-	0	0	1	SPACE	22
23	SPACE	1	0	0	-	1			0	1	-	0	0	1	SPACE	24
25	SPACE	1	0	0	-	1	0			1	-	0	0	1	SPACE	26
27	SPACE	1	0	0	-	1		0		1	-	0	0	1	SPACE	28
29	SPACE	1	0	0	-	1			0	1	-	0	0	1	SPACE	30
31	SPACE	1	0	0	-	1	0			1	-	0	0	1	SPACE	32
33	SPACE	1	0	0	-	1		0		1	-	0	0	1	SPACE	34
35	SPACE	1	0	0	-	1			0	1	-	0	0	1	SPACE	36
37	SPACE	1	0	0	-	1	0			1	-	0	0	1	SPACE	38
39	SPACE	1	0	0	-	1		0		1	-	0	0	1	SPACE	40
41	SPACE	1	0	0	-	1			0	1	-	0	0	1	SPACE	42
						Total Load per phase	12.68	12.68	8.45							
						Total Load	33.8	KVA								
						Total Amps	93.8	A								

Concourse Lighting Panelboard

Concourse Lighting Panelboard

Panel HA / L
Location Concourse
Voltage 480/277V 3P, 4W
Breaker 250
Bus 400
Eaton Culter-Hammer PRL-2a

Ckt	Equipment	Demand	kVA	Amp	Bkr	Pole	A	B	C	Pole	Bkr	Amp	kVA	Demand	Equipment	Ckt
1	MH Lighting Zone 1-1	1.25	4.25	15.34	20	1	8.5			1	20	15.34	4.25	1.25	Fluor. Lighting Zone 1-1	2
3	Fluor. Lighting Zone 2-1	1.25	4.25	15.34	20	1		8.5		1	20	15.34	4.25	1.25	Fluor. Lighting Zone 2-1	4
5	Fluor. Lighting Zone 2-1	1.25	4.25	15.34	20	1			8.5	1	20	15.34	4.25	1.25	Fluor. Lighting Zone 2-1	6
7	MH Lighting Zone 3-1	1.25	3.75	13.53	20	1	7.5			1	20	13.53	3.75	1.25	MH Lighting Zone 3-1	8
9	Fluor. Lighting Zone 1-2	1.25	3.75	13.53	20	1		7.5		1	20	13.53	3.75	1.25	MH Lighting Zone 3-1	10
11	Fluor. Lighting Zone 2-2	1.25	4.25	15.34	20	1			8.5	1	20	15.34	4.25	1.25	Fluor. Lighting Zone 1-2	12
13	Fluor. Lighting Zone 2-2	1.25	4.25	15.34	20	1	8.5			1	20	15.34	4.25	1.25	Fluor. Lighting Zone 2-2	14
15	MH Lighting Zone 3-2	1.25	4.25	15.34	20	1		8.5		1	20	15.34	4.25	1.25	Fluor. Lighting Zone 2-2	16
17	Fluor. Lighting Zone 1-3	1.25	3.75	13.53	20	1			7.5	1	20	13.53	3.75	1.25	MH Lighting Zone 3-2	18
19	Fluor. Lighting Zone 2-3	1.25	3.75	13.53	20	1	7.5			1	20	13.53	3.75	1.25	MH Lighting Zone 3-2	20
21	Fluor. Lighting Zone 2-3	1.25	4.25	15.34	20	1		8.5		1	20	15.34	4.25	1.25	Fluor. Lighting Zone 1-3	22
23	MH Lighting Zone 3-3	1.25	4.25	15.34	20	1			8.5	1	20	15.34	4.25	1.25	Fluor. Lighting Zone 2-3	24
25	Fluor. Lighting Zone 1-4	1.25	4.25	15.34	20	1	8.5			1	20	15.34	4.25	1.25	Fluor. Lighting Zone 2-3	26
27	Fluor. Lighting Zone 2-4	1.25	3.75	13.53	20	1		7.5		1	20	13.53	3.75	1.25	MH Lighting Zone 3-3	28
29	Fluor. Lighting Zone 2-4	1.25	3.75	13.53	20	1			7.5	1	20	13.53	3.75	1.25	MH Lighting Zone 3-3	30
31	MH Lighting Zone 3-4	1.25	4.25	15.34	20	1	8.5			1	20	15.34	4.25	1.25	Fluor. Lighting Zone 1-4	32
33	SPARE	1	0	0	-	-		4.25		1	20	15.34	4.25	1.25	Fluor. Lighting Zone 2-4	34
35	SPARE	1	0	0	-	-			4.25	1	20	15.34	4.25	1.25	Fluor. Lighting Zone 2-4	36
37	LA / L	1	33.8	40.66	50	3	37.55			1	20	13.53	3.75	1.25	MH Lighting Zone 3-4	38
39	LA / L	1						3.75		1	20	13.53	3.75	1.25	MH Lighting Zone 3-4	40
41	LA / L	1							0	-	-		0	1	SPARE	42
					Total Load per phase		86.55	48.5	44.75							
					Total Load		179.8	KVA								
					Total Amps		216.3	A								

Civic Plaza/Ticket Hall Lighting Distribution Panelboard

Civic Plaza & Ticket Hall Lighting Panelboard

Panel HB / L **Voltage** 480/277V 3P, 4W Eaton Culter-Hammer PRL-2a
Breaker 250
Location Civic Plaza + Ticket Hall **Bus** 400

							A	B	C							
Ckt	Equipment	Demand	kVA	Amp	Bkr	Pole				Pole	Bkr	Amp	kVA	Demand	Equipment	Ckt
1	MH Lighting Zone 1-1	1.25	3	10.83	20	1	4.5			1	20	5.413	1.5	1.25	MH Lighting Zone 1-1	2
3	MH Lighting Zone 2-1	1.25	3	10.83	20	1		6		1	20	10.83	3	1.25	MH Lighting Zone 2-1	4
5	MH Lighting Zone 3-1	1.25	3	10.83	20	1			6	1	20	10.83	3	1.25	MH Lighting Zone 3-1	6
7	Fluor. Lighting Zone 1-1,2	1.25	1.75	6.315	20	1	3.5			1	20	6.315	1.75	1.25	Fluor. Lighting Zone 1-2,4	8
9	Fluor. Lighting Zone 2-1,2	1.25	1.75	6.315	20	1		3.5		1	20	6.315	1.75	1.25	Fluor. Lighting Zone 2-3,4	10
11	MH Lighting Zone 3-1	1.25	5.25	18.94	20	1			10.5	1	20	18.94	5.25	1.25	MH Lighting Zone 3-3	12
13	MH Lighting Zone 3-1	1.25	5.25	18.94	20	1	10.5			1	20	18.94	5.25	1.25	MH Lighting Zone 3-3	14
15	MH Lighting Zone 3-2	1.25	5.25	18.94	20	1		10.5		1	20	18.94	5.25	1.25	MH Lighting Zone 3-4	16
17	MH Lighting Zone 3-2	1.25	5.25	18.94	20	1			10.5	1	20	18.94	5.25	1.25	MH Lighting Zone 3-4	18
19	SPARE	1	0	0	-	-	4.375			1	20	15.79	4.375	1.25	MH Lighting Zone 4-1	20
21	SPARE	1	0	0	-	-		4.375		1	20	15.79	4.375	1.25	MH Lighting Zone 4-2	22
23	SPARE	1	0	0	-	-			0	-	-	0	0	1	SPARE	24
25	SPARE	1	0	0	-	-	0			-	-	0	0	1	SPARE	26
27	SPARE	1	0	0	-	-		0		-	-	0	0	1	SPARE	28
29	SPARE	1	0	0	-	-			0	-	-	0	0	1	SPARE	30
31	SPARE	1	0	0	-	-	0			-	-	0	0	1	SPARE	32
33	SPARE	1	0	0	-	-		0		-	-	0	0	1	SPARE	34
35	SPARE	1	0	0	-	-			0	-	-	0	0	1	SPARE	36
37	LB / L	1	47.08	56.62	50	3	47.075			-	-	0	0	1	SPARE	38
39	LB / L	1						0		-	-	0	0	1	SPARE	40
41	LB / L	1							0	-	-	0	0	1	SPARE	42
				Total Load per phase			69.95	24.375	27							
				Total Load			69.95	KVA								
				Total Amps			84.1	A								

Civic Plaza

Civic Plaza/Ticket Hall Lighting Panelboard

Civic Plaza & Ticket Hall Lighting Panelboard

Panel LB / L **Voltage** 208/120V 3P, 4W Eaton Cutler-Hammer PRL-1a
Breaker 40
Location Civic Plaza + Ticket Hall **Bus** 100

							A	B	C							
Ckt	Equipment	Demand	kVA	Amp	Bkr	Pole				Pole	Bkr	Amp	kVA	Demand	Equipment	Ckt
1	LED Zone 4 (78ft)	1.25	2.288	19.05	20	1	4.575			1	20	19.05	2.288	1.25	LED Zone 4 (78ft)	2
3	LED Zone 4 (78ft)	1.25	2.288	19.05	20	1		4.575		1	20	19.05	2.288	1.25	LED Zone 4 (78ft)	4
5	LED Zone 4 (78ft)	1.25	2.288	19.05	20	1			4.575	1	20	19.05	2.288	1.25	LED Zone 4 (78ft)	6
7	LED Zone 4 (78ft)	1.25	2.288	19.05	20	1	4.575			1	20	19.05	2.288	1.25	LED Zone 4 (78ft)	8
9	LED Zone 4 (78ft)	1.25	2.288	19.05	20	1		4.575		1	20	19.05	2.288	1.25	LED Zone 4 (78ft)	10
11	LED Zone 4 (78ft)	1.25	2.288	19.05	20	1			4.575	1	20	19.05	2.288	1.25	LED Zone 4 (78ft)	12
13	LED Zone 4 (78ft)	1.25	2.288	19.05	20	1	4.575			1	20	19.05	2.288	1.25	LED Zone 4 (78ft)	14
15	LED Zone 4 (78ft)	1.25	2.288	19.05	20	1		4.575		1	20	19.05	2.288	1.25	LED Zone 4 (78ft)	16
17	LED Zone 4 (78ft)	1.25	2.288	19.05	20	1			4.575	1	20	19.05	2.288	1.25	LED Zone 4 (78ft)	18
19	LED Zone 4 (78ft)	1.25	2.288	19.05	20	1	4.575			1	20	19.05	2.288	1.25	LED Zone 4 (78ft)	20
21	SPARE	1	0	0	-	1		1.325		1	20	4.781	1.325	1.25	LED Zone 5 (Ticket Hall)	22
23	SPARE	1	0	0	-	1			0	1	-	0	0	1	SPARE	24
25	SPACE	1	0	0	-	1	0			1	-	0	0	1	SPACE	26
27	SPACE	1	0	0	-	1		0		1	-	0	0	1	SPACE	28
29	SPACE	1	0	0	-	1			0	1	-	0	0	1	SPACE	30
31	SPACE	1	0	0	-	1	0			1	-	0	0	1	SPACE	32
33	SPACE	1	0	0	-	1		0		1	-	0	0	1	SPACE	34
35	SPACE	1	0	0	-	1			0	1	-	0	0	1	SPACE	36
37	SPACE	1	0	0	-	1	0			1	-	0	0	1	SPACE	38
39	SPACE	1	0	0	-	1		0		1	-	0	0	1	SPACE	40
41	SPACE	1	0	0	-	1			0	1	-	0	0	1	SPACE	42

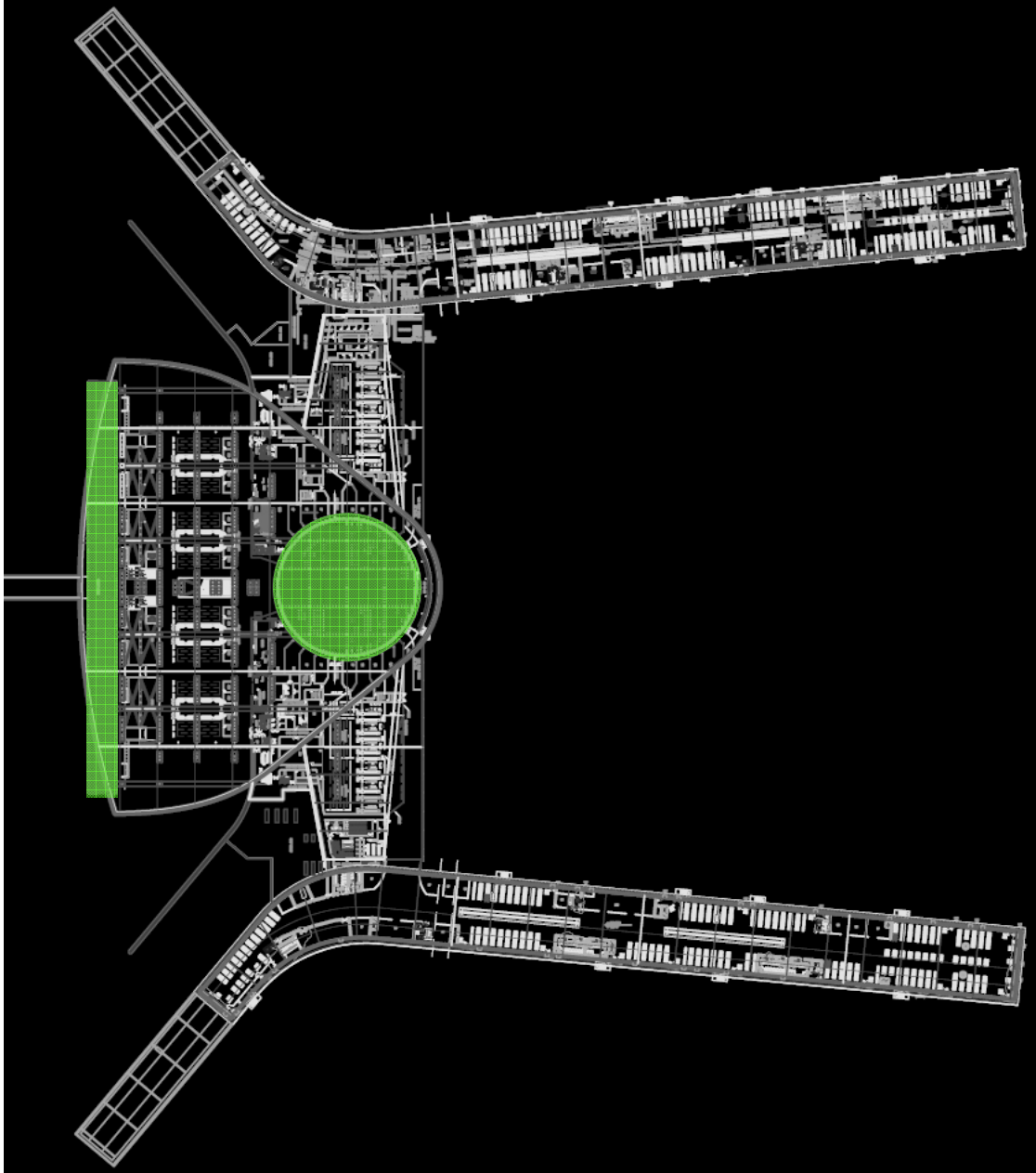
Total Load per phase 18.3 15.05 13.725

Total Load 47.075 KVA
Total Amps 130.7 A

Civic Plaza

Feeder Size/Voltage Drop/Equipment Summary

Panelboard Designation	Panelboard Location	Equipment	Step Down Transformer	Feeder Size	Voltage Drop
HA/L	Concourse Distribution	Eaton Cutler- Hammer PRL1a	Eaton 45 KVA K-factor Dry Type, 480 Δ-280Y/120V	(3) #300	2.50%
LA/L	Concourse Lighting	Eaton Cutler- Hammer PRL2a		(3) #2/0	4.60%
HB/L	Civic Plaza/Ticket Hall Distribution	Eaton Cutler- Hammer PRL1a	Eaton 45 KVA K-factor Dry Type, 480 Δ-280Y/120V	(3) #1	2.80%
LB/L	Civic Plaza/Ticket Hall Lighting	Eaton Cutler- Hammer PRL2a		(3) #2/0	2.60%



Outline

Lighting Depth

- Exterior Departure
- Terminal Ticket Hall
- Civic Plaza
- Passenger Concourse

Electrical Depth

Sustainable Design Breadth

Construction Management Breadth

Conclusion

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Sustainable Design Breadth

Current Status

Expecting a LEED Silver Certification with 34 credits

Design Goals

- To obtain a LEED Gold rating status through achieving the following LEED credits:
  - Lighting Pollution Reduction *(Sustainable Site)*
  - Rapidly Renewable Materials *(Materials & Resources)*
  - Innovation in Design *(Innovation & Design Process)*

Design Criteria

- To follow and meet with all the guidelines established by the United States Green Building Council (USGBC).

Design Solution

- **Lighting Pollution solution**
  - Removal of exterior flood light fixtures
  - Re-aim of uplight fixtures, all falls within perimeter of building

    - earning ONE credit in the **Sustainable Site Category**.

- **Rapidly Renewable Materials solution**
  - Massive Plantation
  - Harvest at least 10% of all trees that were removed prior to the construction

    - earning ONE credit in **Materials & Resources Category**.

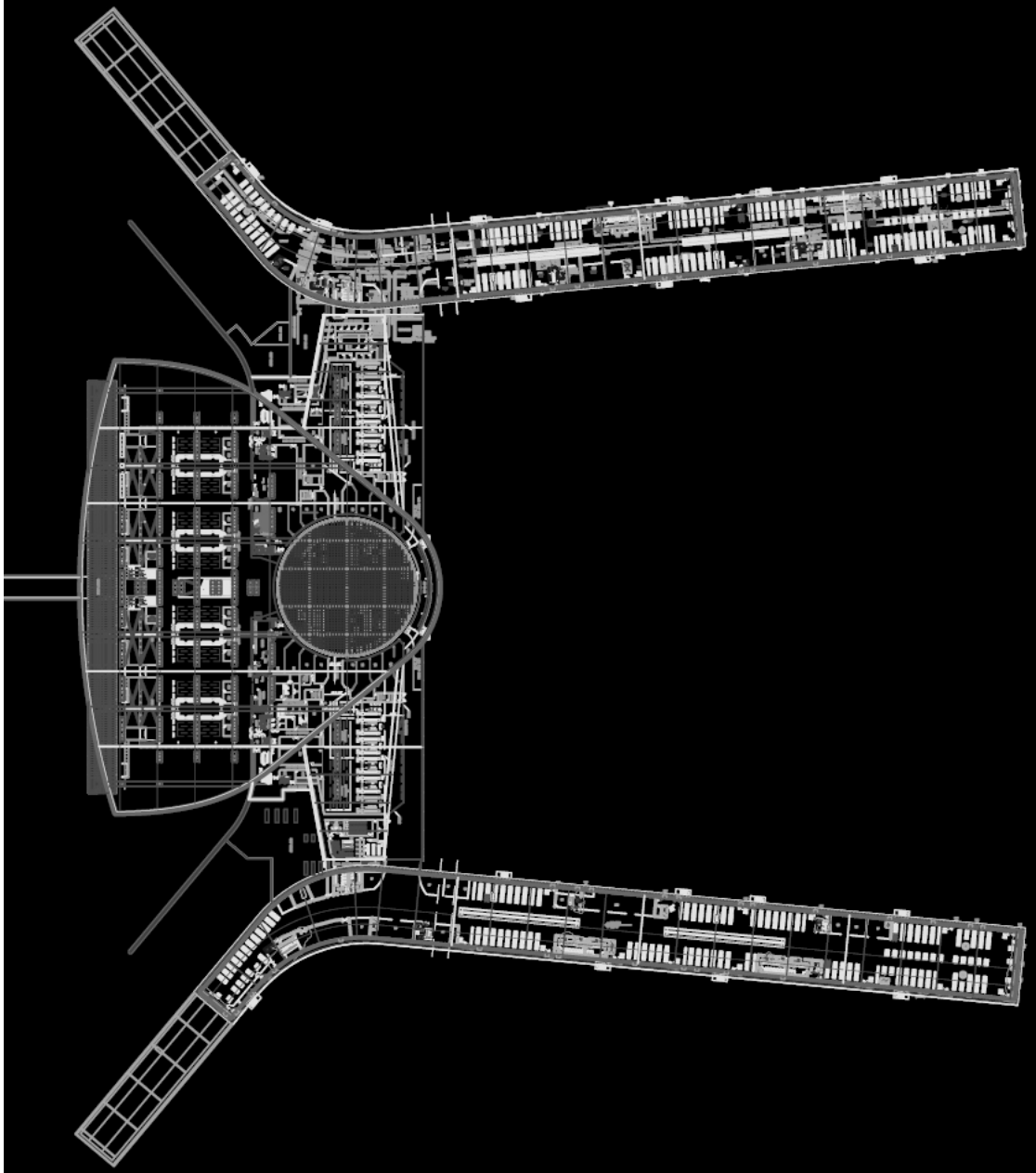
Design Solution

- Innovation in Design solution
  - Massive Plantation with soil replacement
  - Harvest at least 10% of all trees that were removed prior to the construction
  - Dematerialization of 25% of existing flooring
  - Lower Indoor Carbon Dioxide level
  - Provides Temperature Barrier
  - Reduced Cooling Load during Summer Months
  - Reduced Glare and Thermal Discomfort

    - Pursuing ONE credit in **Construction Waste Management**.
    - Pursuing ONE credit in **Resource Reuse**
    - Pursuing ONE credit in **Regional Materials**

Conclusion:

Proper attempt, but insufficient credits to attain a **LEED Gold Certification.**



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Construction Management Breadth

Design Goals

- To perform Cost Analysis, and analyze if the retrofitted

  - Electrical system &
  - Massive Plantation (foliage cost)

can be paid off by the

  - reduction of luminaires
  - by replacing ventilated floor tiles with soil.

Additional Cost

Equipment Type	Location	Quantity	Equipment cost	Manufacturers Retrofit cost	Total Cost
Distribution Panel	Civic Plaza	1	$7,280	-$4,040	$3,240
Distribution Panel	Concouse	1	$7,280	-$4,040	$3,240
Lighting Panel	Civic Plaza	1	$7,280	-$4,040	$3,240
Lighting Panel	Concouse	1	$7,280	-$4,040	$3,240
Step-down Transformer	Civic Plaza	1	$6,480	$0	$6,480
Step-down Transformer	Concouse	1	$6,480	$0	$6,480
#300 Wire	Concourse	1200	$57	$0	$68,400
#2/0 Wire	Civic Plaza/Concourse	1520	$35	$0	$53,200
#1 Wire	Civic Plaza	320	$27	$0	$8,640
				Total Cost	**$156,160**

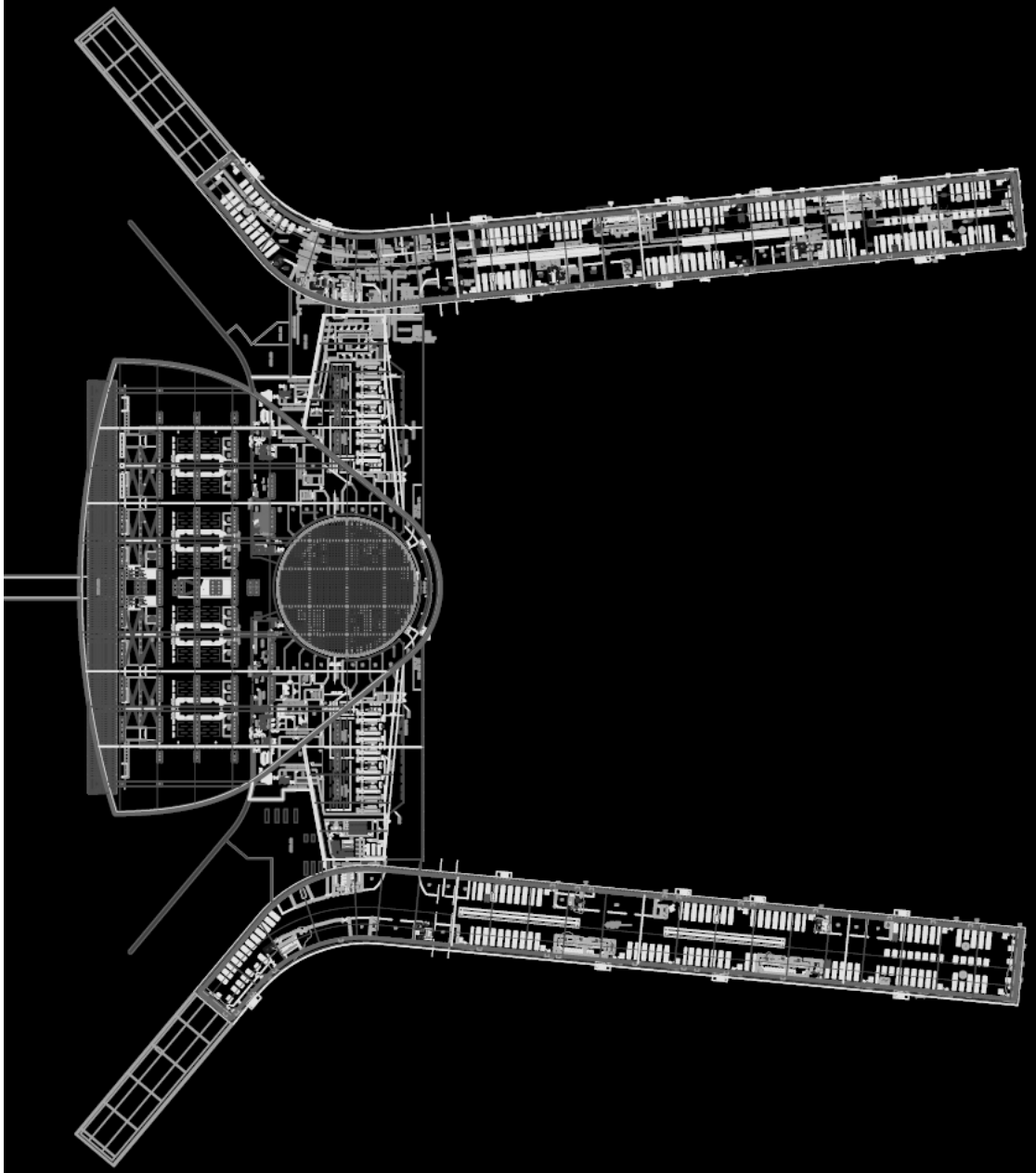
Tree Type	Location	Quantity	Cost Per Tree (Harvest + Labor Installation)	Total Cost
Oak	Civic Plaza	18	$275	$4,950
Red Oak	Civic Plaza	9	$175	$1,575
Honey Locust	Civic Plaza	9	$175	$1,575
Juniper	Civic Plaza	1	$190	$190
Barberry	Civic Plaza	18	$80	$1,440
Pearl Bush	Civic Plaza	18	$45	$810
Forsythia	Civic Plaza	18	$64	$1,152
Boxwood	Civic Plaza	18	$46	$828
			Total Cost	**$12,520**

Reduction Savings

Fixture Type	Location	Quantity	Cost per Fixture	Reduction Saving	Additional Cost
Asymmetric Uplight	Outdoor	104	$1,200	$124,800	----
Asymmetric Downlight	Outdoor	22	$830	$18,260	----
Semi-Recessed Uplight	Outdoor	78	$800	$62,400	----
Asymmetric Uplight	Indoor	20	$1,200	$24,000	----
Compact Florescent Decorative Glowing Fixture	Civic Plaza	16	$650	$10,400	----
20' Proposed Custom Light Pole	Civic Plaza	32	$7,200	230400	----
26' Existing Custom Light Pole	Civic Plaza	16	$10,000	----	$160,000
LED Fixtures	Civic Plaza	1570	$118	----	$185,260
LED Fixtures	Concouse	720	$132	----	$95,040
LED Fixtures	Ticket Hall	170	$162	----	$27,540
			Total Reduction Savings	**$470,260**	
			Total Additional Cost	**$467,840**	
			Total Difference	**$2,420**	

Flooring	Ventilated Floor Tile
Total Area	45240 sq-ft
Area Removed	11310 sq-ft
Area Removed %	25%
Cost per Sq-ft (+ labor & installation	$155/sq-ft
Total Saving	**$1,753,050**

Electrical System Cost ($156,150) – Fixture Reduction Saving ($2,420) = $153,740.
Flooring Removal Saving = $1,753,050 - $12,520 - $153,740 = $1,586,790



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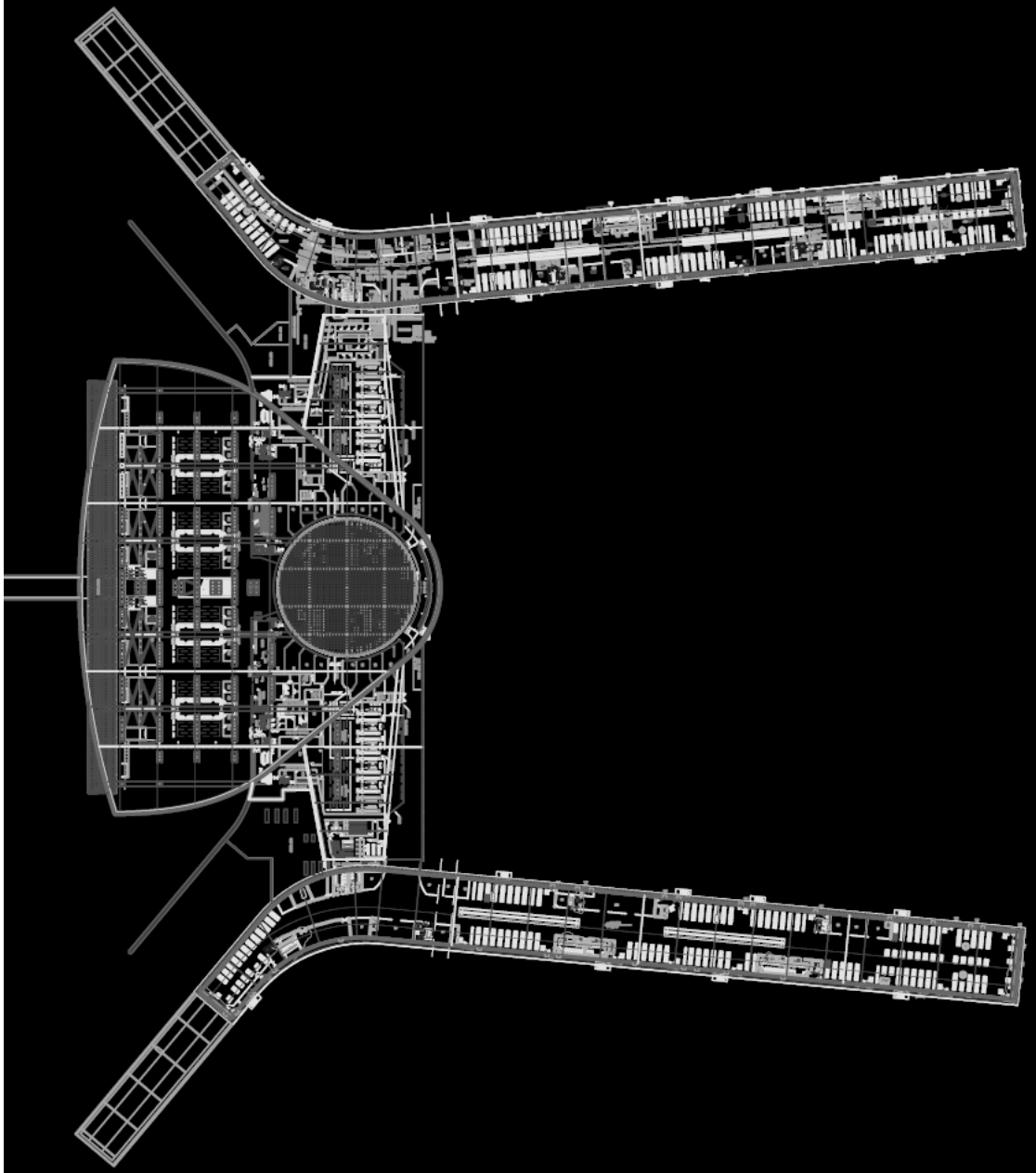
Final Conclusions

- The Exterior Departure Canopy area lighting redesign
  - acquire the LEED's Lighting Pollution credit.
  - resulted in energy as well as budget savings.
- Ticket Hall redesign
  - addition of in-grade LED luminaires has realized the desired design metaphor
- Civic Plaza redesign
  - effectively created a "Civic Garden".
  - potentially earn 2 to 4 extra LEED credits in the Innovation in Design category.
- Concourse redesign
  - artificial tunnel utilizing in-grade LED uplights provided visual interest to the space without exceeding ASHRAE's lighting power densities requirement.
- Electrical Depth
  - Resize of panelboard without causing additional cost
- Sustainable Design Breadth
  - Potentially Obtained 2 extra LEED credit
  - Insufficient overall credits needed for LEED Gold certification
- Construction Management Breadth
  - Massive Plantation with soil replacement yield tremendous savings



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Questions?