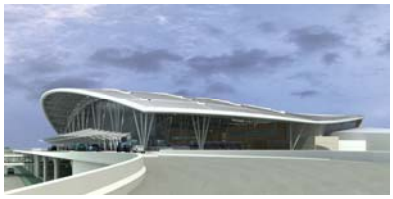
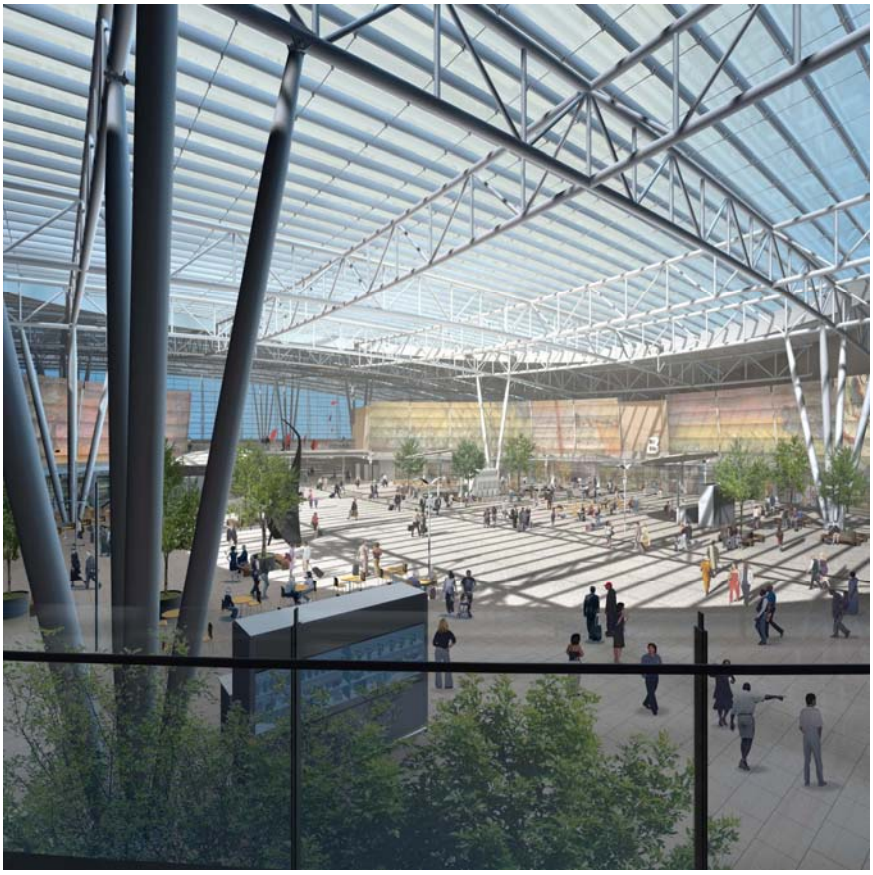


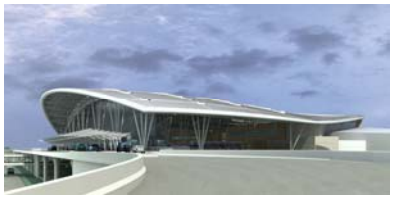
Lighting Depth Study

Civic Plaza

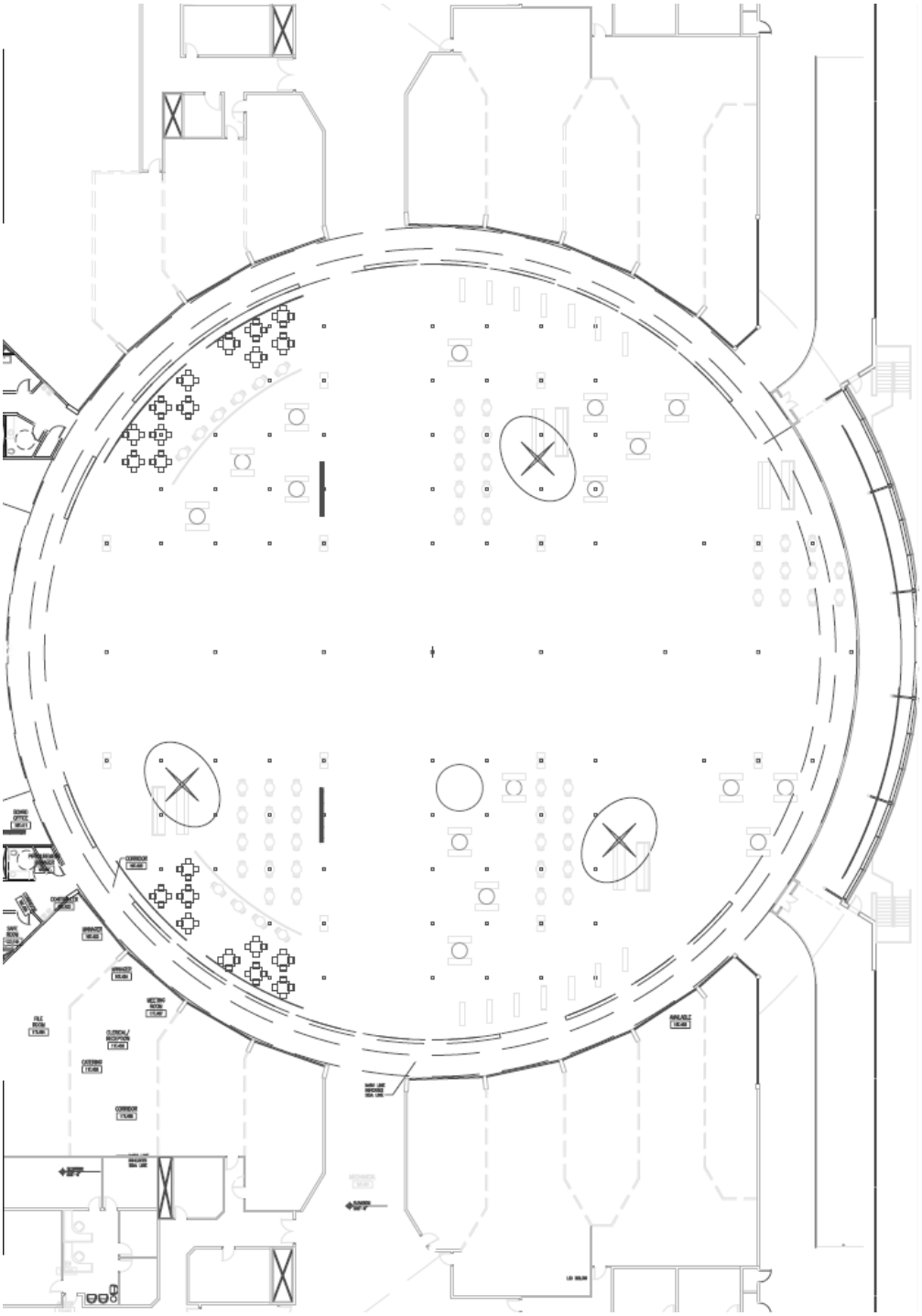


Overview

The heart of the terminal is a circular glass enclosed space – reminiscent of Indianapolis downtown's Monument Circle, which will serve the functions of circulation, security, retail and food service as well as provide space for civic activities, art gallery and public events that will breathe the character and diversity of Indianapolis and the region. Civic Plaza being the heart of the entire airport, it is the mid-point for getting from concourse to concourse, check in to concourse, concourse to arrival, departure to concourse…etc. 240 feet in diameter on ground, the Civic Plaza has featured a giant circular skylight spans a diameter of nearly 200 feet, allowing maximum daylight penetration. Branching out from the Civic Plaza, a "Connector" space which made up of security areas on the ground floor, and offices on the two floors above, is what connects the two Passenger Concourses. On the North and South side of the Civic Plaza, right in front of the office curtainwall, each side featured a giant panoramic animated screen that displays news, videos, flight announcements, and provides signage. The screens are not included as part of my study because it is not within my scope.

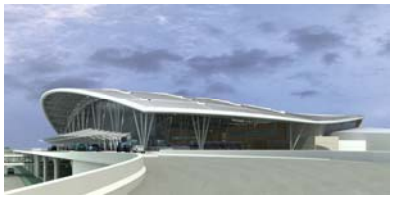


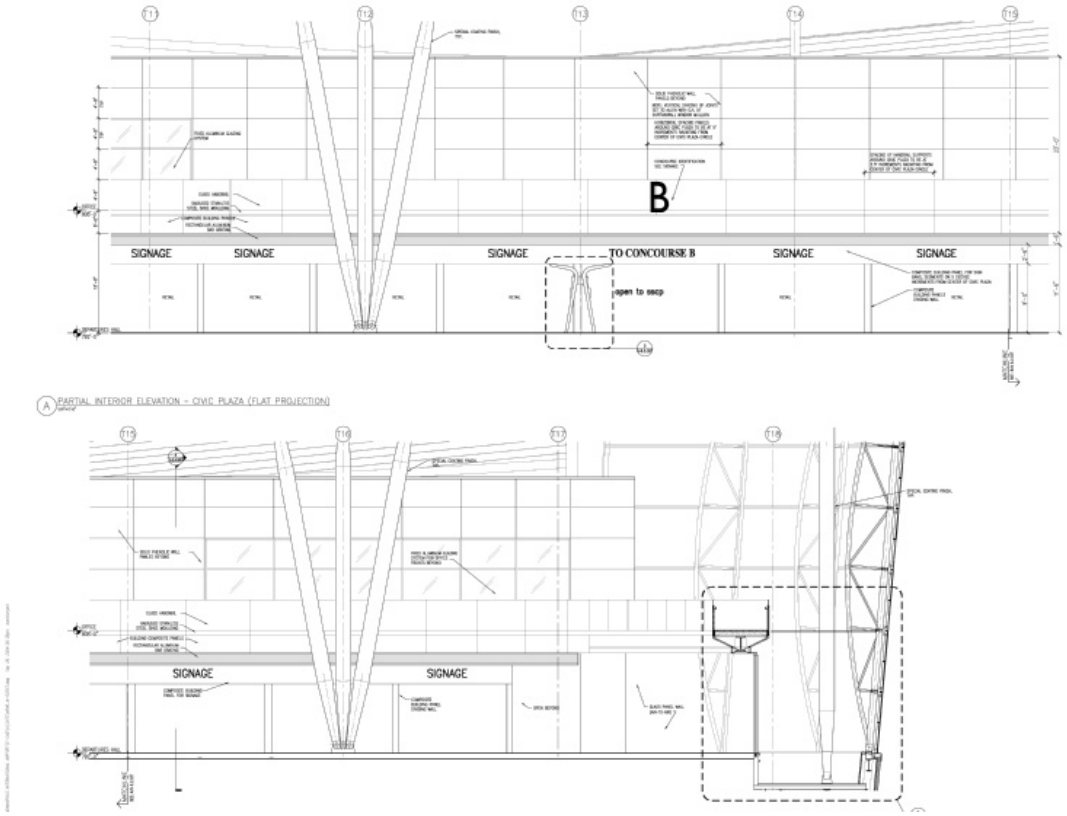
Plans and Sections below will give you a general overview of this space:



Existing Floor Plan

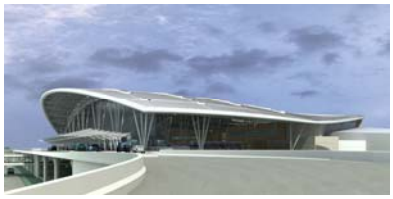
Indianapolis International Airport –
Midfield Terminal
Indianapolis, IN

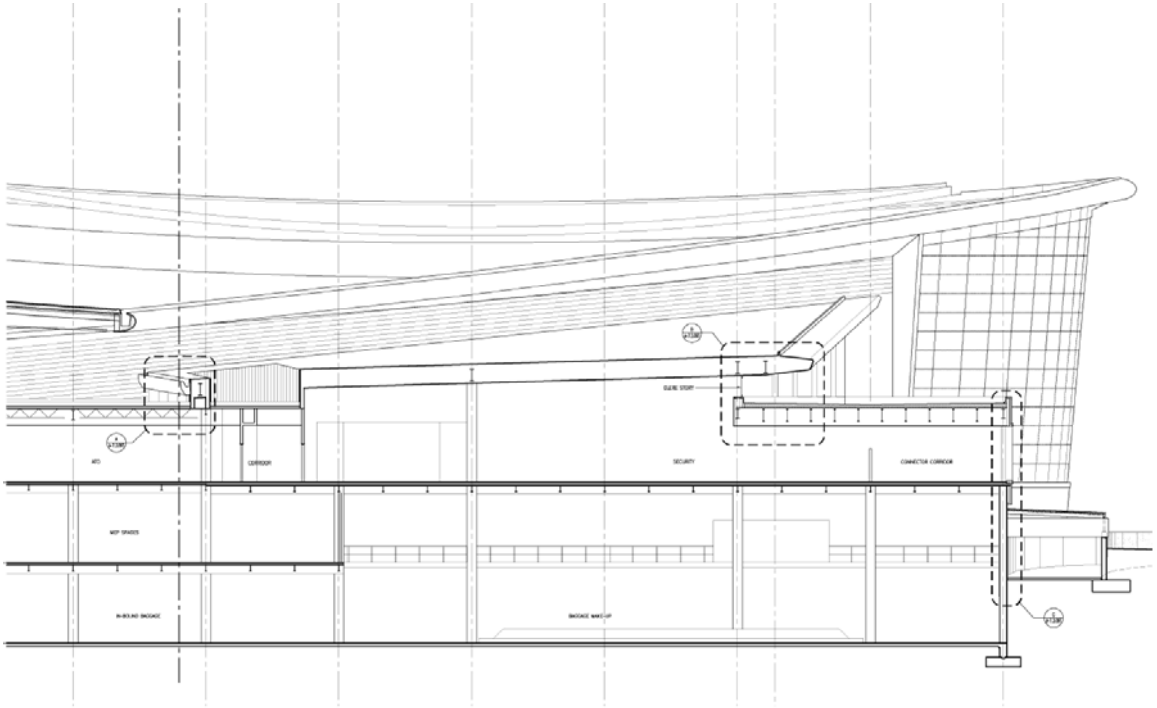




Interior Elevation of Civic Plaza

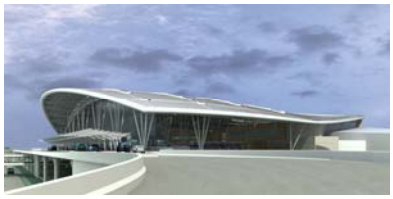
Indianapolis International Airport –
Midfield Terminal
Indianapolis, IN





Partial Enlarged Civic Plaza Section

Civic Plaza Sectional Rendering



Design Goal

To design a “Civic Garden”, minimizing solar glare discomfort from the skylight above, providing shaded thoroughfare as well as crafting out multiple arteries (heart of the flying bird) through the use of light and landscape planning. The lighting installation shall also serve the purpose of guidance to retain continuity from the previous spaces.

Design Criteria

1. Glare
    - The existing civic plaza has an extensive daylight system that utilizes both a high performance curtain wall as well as a skylight dome. During daytime, even under an overcast sky, hardly any electric lighting is required. This however, will make the space very very bright, or even causing potential glare discomfort for certain occupants.
2. Reflected Glare
    - Possible reflected glare can also occur due to the high reflectance paint of the surround architectural/structural elements.

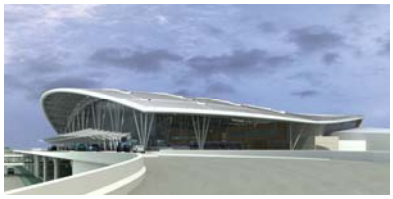
Daylighting Design Criteria

1. Quantity
    - Provide all ambient lighting needs
    - Provide a visually comfortable, glare free and uniform space for workers and travelers
    - Maintain views out for departing occupants through the glazing system to provide a connection to the outdoors
2. Integration - Minimize unwanted summertime heat gains

Design Concept

The existing civic plaza has an extensive daylight system that utilizes both a high performance curtain wall as well as a skylight dome. During daytime, even under an overcast sky, little or no electric lighting is required. Therefore, minimum amount of lighting equipment is installed in the center of the space for the purposes of night time illumination. A custom designed indirect/spot light pole is placed in for both ambient and accent lighting, accommodating the multi-purpose usage of the civic plaza. This 25-foot tall light pole consist of two indirect heads on top, and 3 levels of spotlights underneath, 2 spotlights on each level. This flexible setup is intended to draw the surroundings into a point of interest by focusing spot lights into desired locations.

To counteract with the harsh direct sun light and solar head gain, I have decided to pursue a solution via landscape architecture planning approach. When people talk about “Green Building” design, I decide to perform the task, to literally bring “Green” into the Civic Plaza. I will do a massive plantation within the Civic Plaza, planting up to 40 trees that will be as tall as 30 feet, and 70+ other shrubs that will be no taller than 5 feet. A proportion study has conducted prior to drawing this conclusion, to ensure views are not obscured and that the trees can provide proper shading and enhanced ventilation effect. This operation will require up to 25% of existing flooring to be taken out, replaced with locally harvested soil in order for trees to grow. Of the trees that will be planted, all should be harvested locally from the construction site. This way, those trees that



got chopped off prior to construction will be able to recover themselves back into an indoor environment.

In addition to the massive plantation, sitting curbs and fountains that made out of locally harvested stones are crafted into the shapes of contours that will form the arteries for the Heart of the Airport. These sitting cubs will subtly forming paths that will regulate passengers traffic patterns, leading them toward either the Airside Curtainwall, or toward either one of the Passenger Concouse. In the center, the curbs are hollowed out to allow water filling in to serve as fountains. A sandblasted panels is situated and submerged into the water, acting as a visible divider. LED fixtures are installed on the bottom side of the curb, lighting the floor and creating an illuminated path at night.

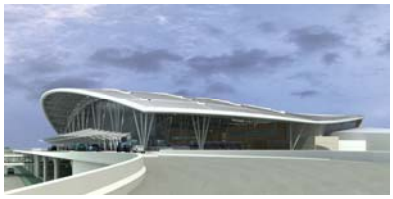
Lastly, a 45 feet tall cylindrical glass sculpture is custom designed to stand in the middle of the central fountain, back-lit with either LED or cold cathode, serving as a point of interest as well as providing signage for directions. (This design element is optional, hence lighting fixtures needed for this glass sculpture are not included or discussed within this report)

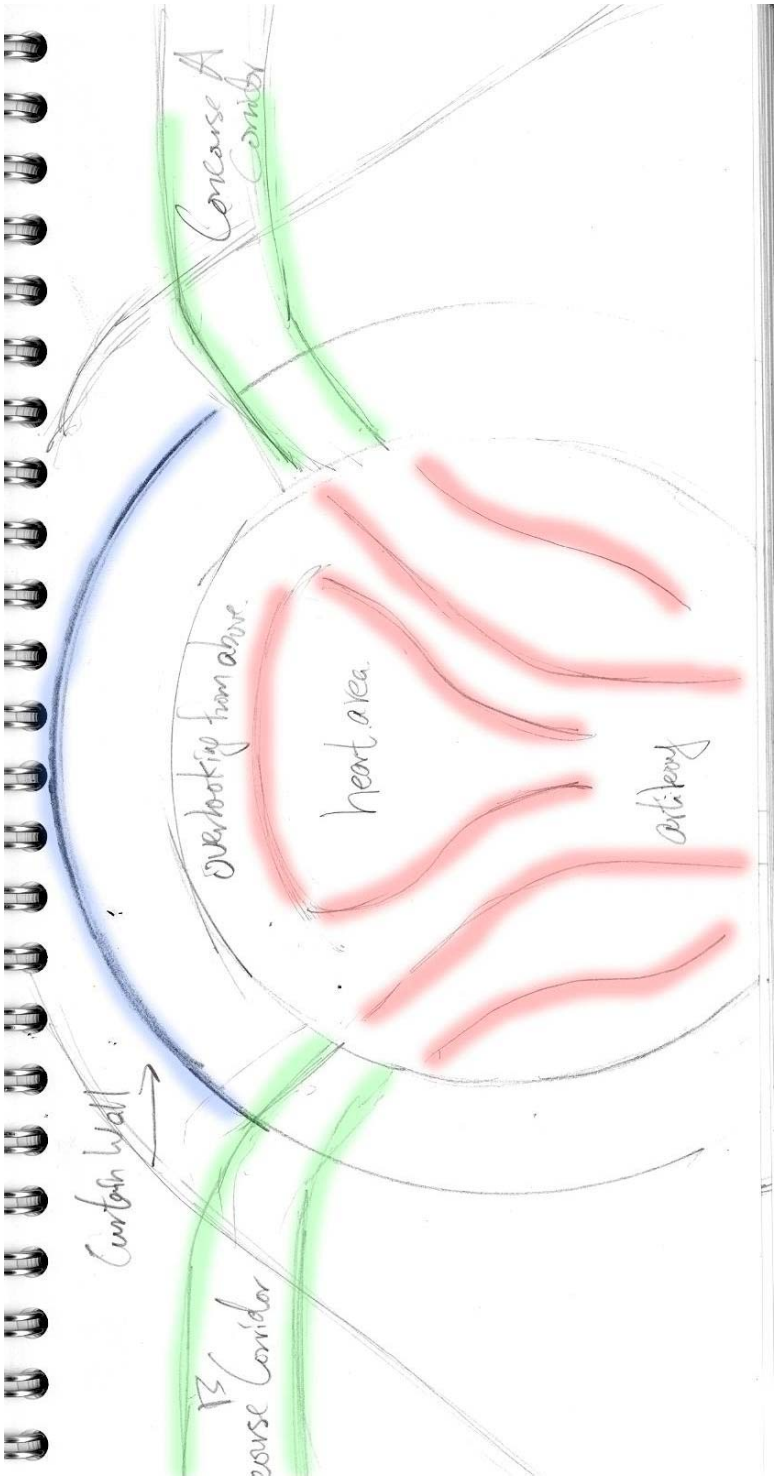
Please see Appendix B for Daylighting Study on the Civic Plaza

Please see Appendix C for Custom-Design details

Please see Appendix D for Glass Manufacturers Specification Sheets.

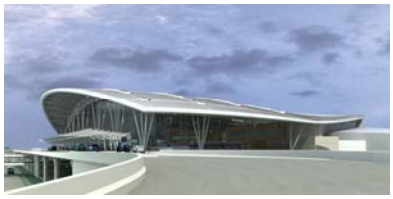
Schematic sketches and finalized design solution are illustrated below:

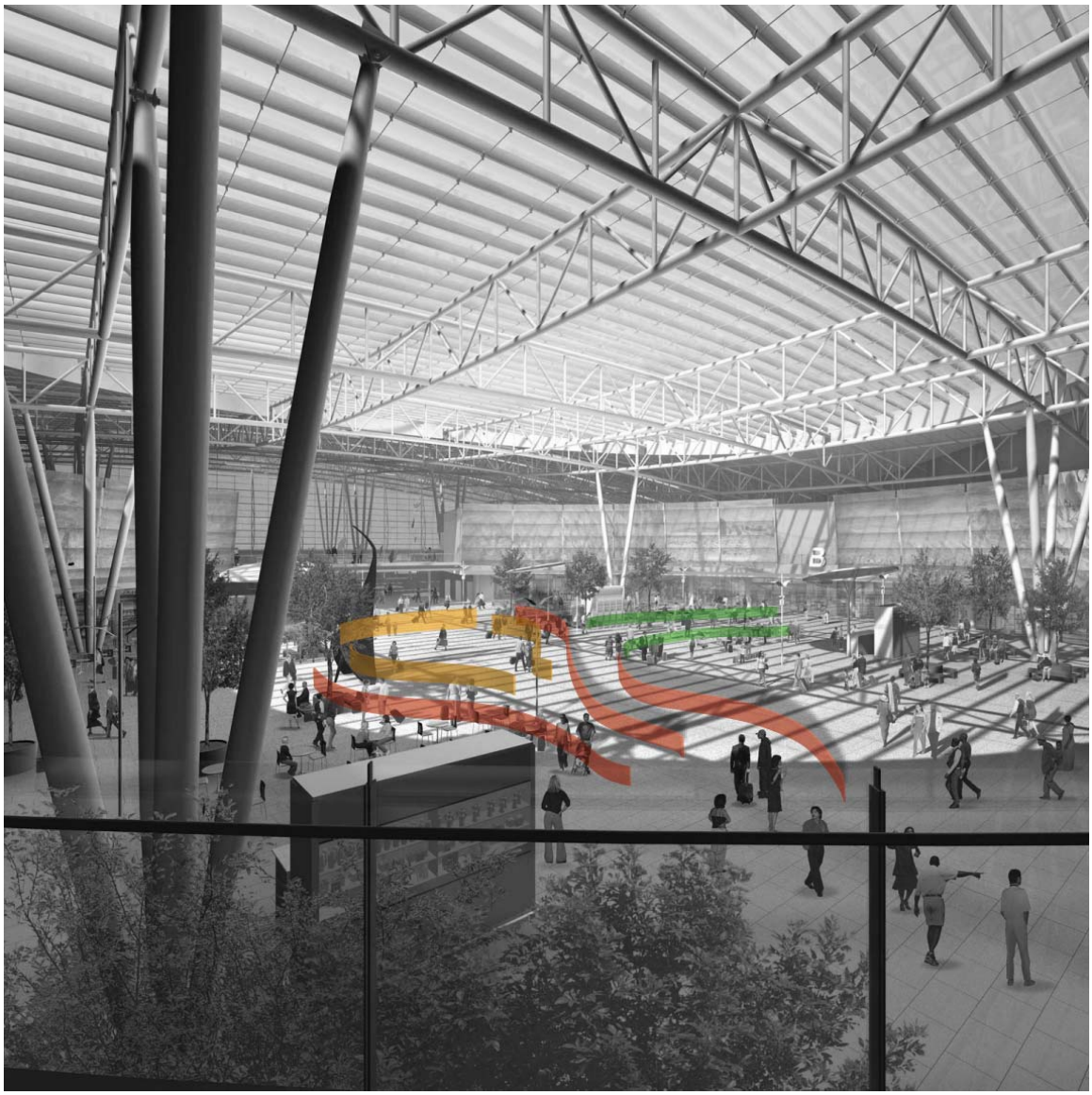




Schematic Sketch of the Ticket Hall in Plan View

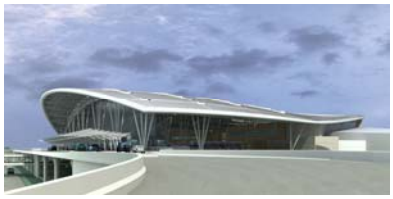
Indianapolis International Airport –
Midfield Terminal
Indianapolis, IN

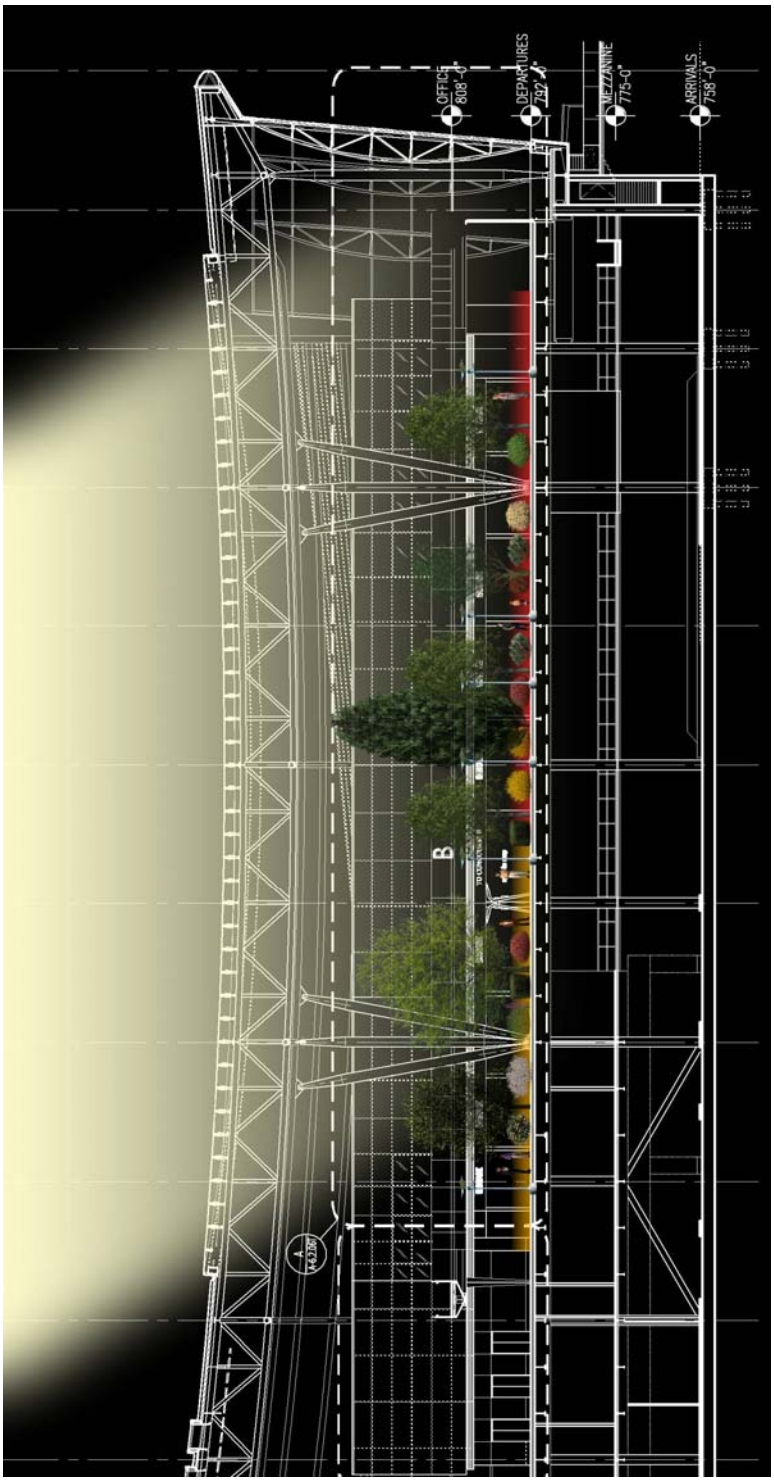




Schematic Design Proposal

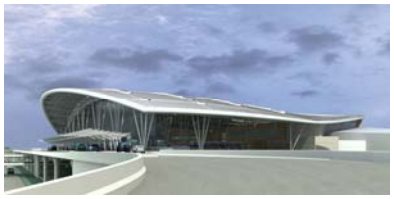
Indianapolis International Airport –
Midfield Terminal
Indianapolis, IN





Finalized Design Concept

Indianapolis International Airport –
Midfield Terminal
Indianapolis, IN



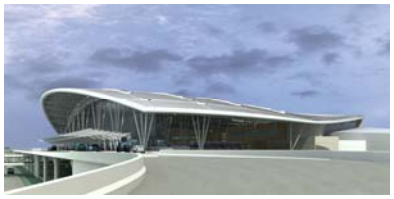
Material Reflectance

Material Reflectance Table	Exterior	Ticket Hall	Civic Plaza
Columns (aluminum)	55%	55%	55%
Curtain Wall (Glazing)	10%	15%	15%
Skylight (Glazing)	N/A	15%	15%
Concrete	20%	N/A	N/A
Flooring (Marble)	N/A	30%	30%
Ceiling (aluminum)	75%	75%	75%
Furniture Fabric	N/A	20%	N/A
Sandblasted Panels (Glass)	N/A	N/A	35%
Panorama Animation Screen	N/A	N/A	60%

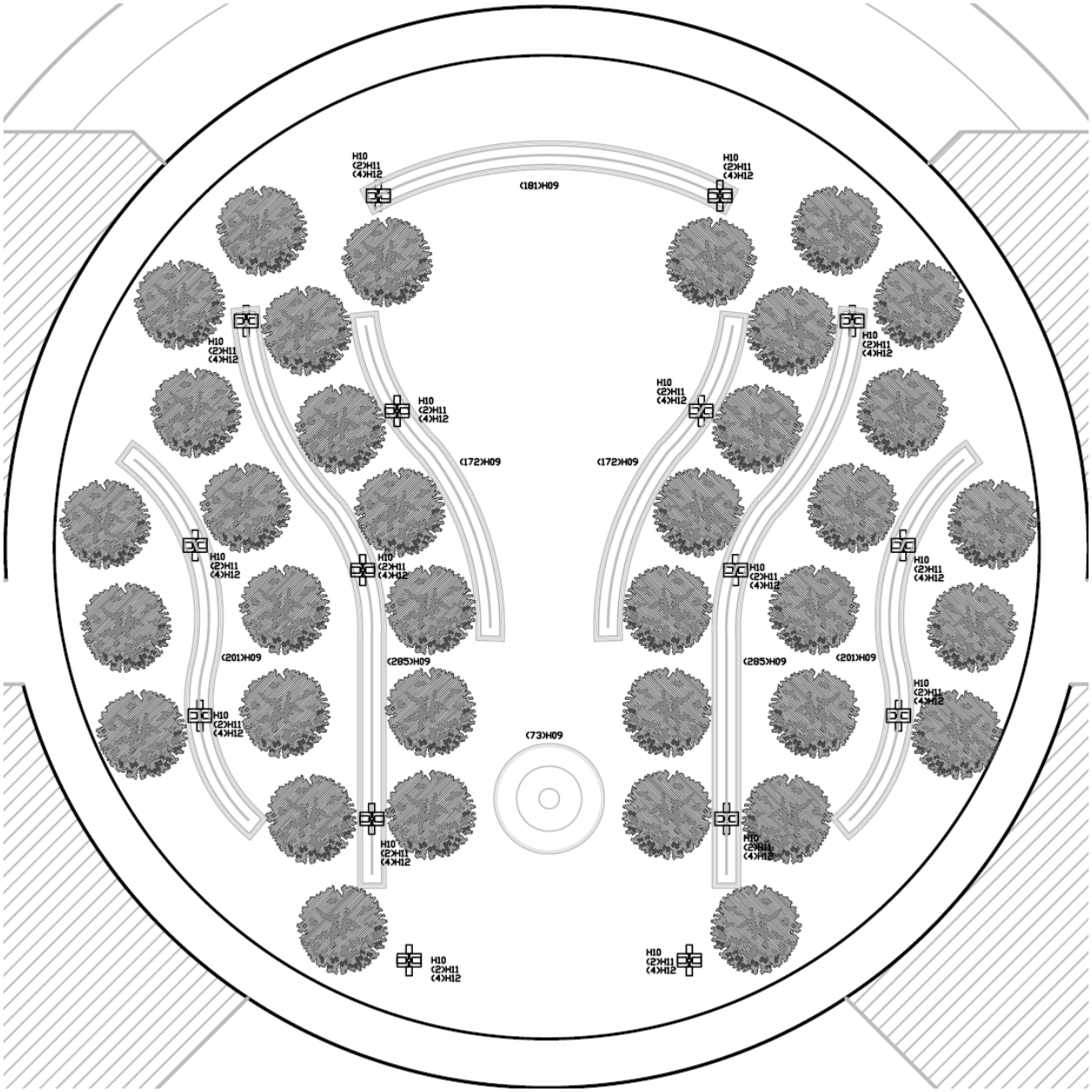
Glazing Specification

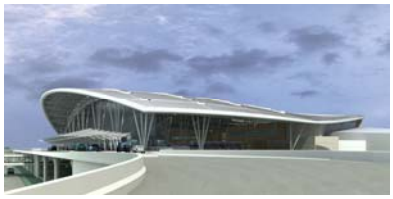
Glazing Spec		
Location	**Curtain Wall**	**Skylight Glazing**
Brand	Pilkington Solar E	Visionwall 3-element Glazing System
Type	Insulated	Insulated
Total Thickness	1"	1"
	24 mm	24 mm
Space Filler	Argon-Filled	
Outboard Lite	1/4" Pilkington Solar E™	Low E Coating (optional)
Inboard Lite	1/4" Pilkington Optifloat™	Low E Coating (optional)
Reflective Surface	2nd	n/a
Low-E Surface	2nd	n/a
Visible Light Transmittance (%)	53%	66%
Visible Lite Exterior Reflectance (%)	10%	n/a
Visible Lite Interior Reflectance (%)	15%	n/a
Total Solar Energy Transmittance (%)	33%	n/a
Total Solar Energy Reflectance (%)	9%	n/a
U-V Transmittance (%)	31%	n/a
U-Value - Summer	0.27	0.21
U-Value - Winter	0.28	0.22
Solar Heat Gain Coefficient	0.43	0.18
Shading Coefficient	0.49	0.19

Indianapolis International Airport –
Midfield Terminal
Indianapolis, IN



Luminaire Layout





Lighting Fixture Schedule

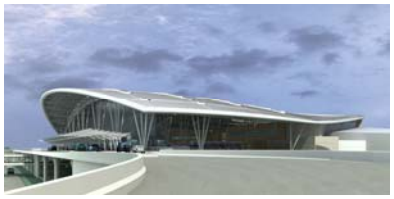
Civic Plaza								
Fixture #	Brand	Luminaire	Lamp Type	Lamp Wattage (watts)	Lamps/Fixture	Quantity	Watts/L-ft or Watts/Fixture	Total Watts
H09	IO Line 20HO	Surface Mounted Asymmetric LED	6'/unit Warm White LED	15 w/ft	1	1570	15	23550
H10	Lumec-Shreder Hermes Series	Custom 25' Tall Free Standing Light Poles	Metal Halide T6	150	1	32	175	5600
H11	Martini Sax 130 Spot	Pole High Mounted Spotlight	Metal Halide Socket G12	150	1	32	175	5600
H12	Martini Sax 130 Spot	Pole Low Mounted Spotlight	Metal Halide Socket G12	70	1	64	85	5440
							Total Watts	40190
							Total Area	45240
							Overall LPD	0.89

H09 H10 H11 H12

For Ballast and Lamp Schedule, please see Appendix A.

Light Loss Factor

Civic Plaza								
Fixture #	Maintenance Category	Dirt Condition	Cleaning Interval	Ballast Factor	RSDD	LLD	LDD	Total LLF
H09	VI	Very Clean	6 Months	1	0.9	0.8	0.82	0.59
H10	I	Very Clean	6 Months	0.8	0.9	0.8	0.92	0.53
H11	IV	Very Clean	6 Months	0.8	0.9	0.8	0.88	0.51
H12	IV	Very Clean	6 Months	0.8	0.9	0.8	0.88	0.51



Lighting Power Density

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

Tree Shading Effect

		Clear Sky			Cloudy Sky		
		Avg	Max	Min	Avg	Max	Min
Equinox	8:00AM	275	932	45	107	141	31
	10:00AM	901	3912	104	259	343	68
	12:00PM	1570	3021	125	344	465	87
	2:00PM	1385	3630	127	336	447	88
	4:00PM	588	2170	99	241	320	61
	Average	**944**	**2733**	**100**	**257**	**343**	**67**

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

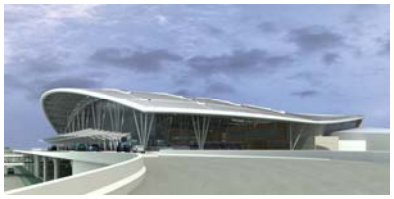
Equinox – Clear Sky – 9:00 AM

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

The above numbers are measured from an illuminance meter during a clear sky afternoon, standing on a open concrete ground plane (in Nittany Crossing residence) as well as under a tree that is roughly 25-ft tall. The concrete ground plane has an estimated 30% reflectance, which is very similar to the marble floor material that is currently installed in the Civic Plaza.

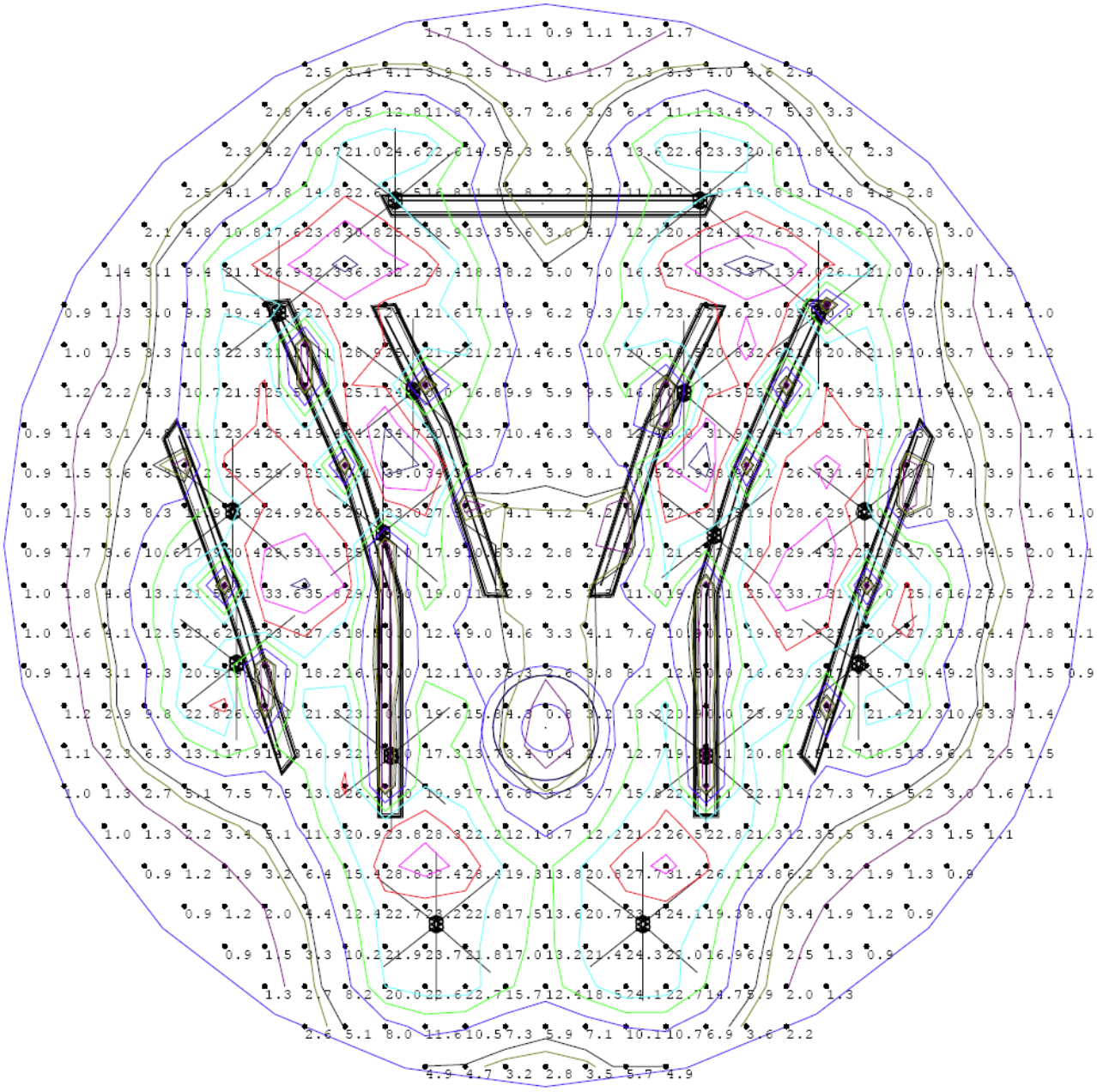
The measured ratio is a very practical method of determining how much light a tree can actually shaded off. With this errors taken into account for the ratio, we can confidently predict that by performing massive plantation, during the brightest hour at the brightest location, we can obtain a more comfortable environment that consist of illuminance that ranges from 30 fc to 270 fc on the



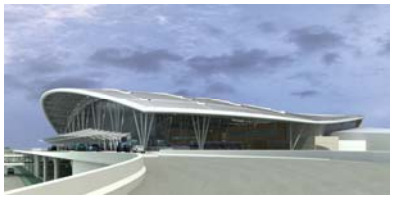
ground plane. This kind of shading can make the Civic Plaza a serene oasis under the bright hot skylight, creating a more visually and thermally comfortable ambient.

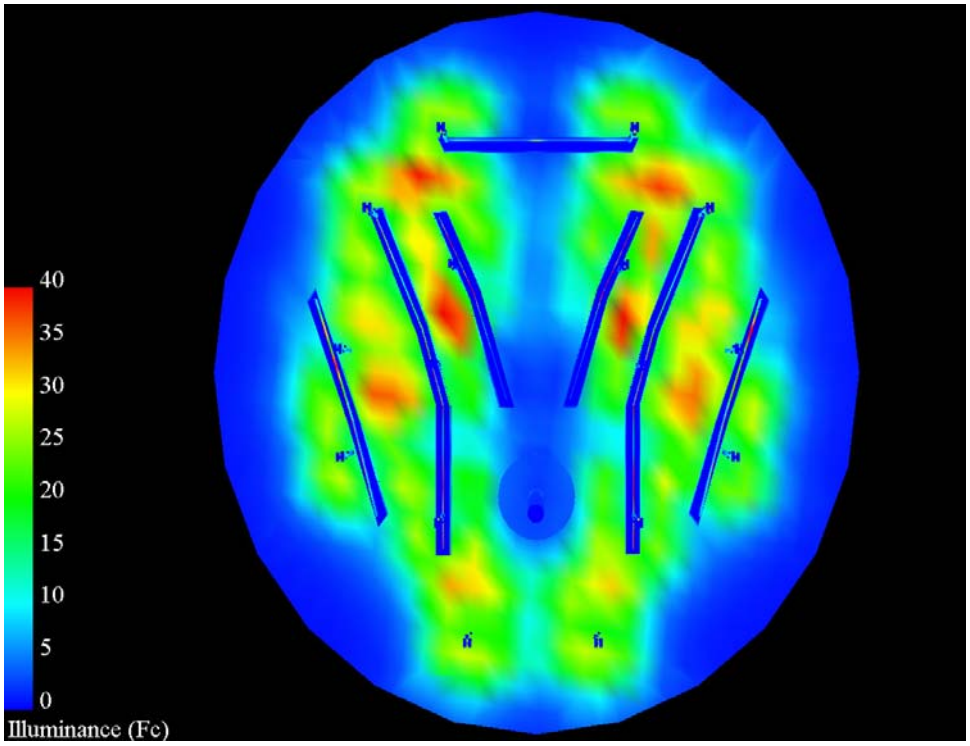
For more daylight readings, please see Appendix B.

Illuminance Value

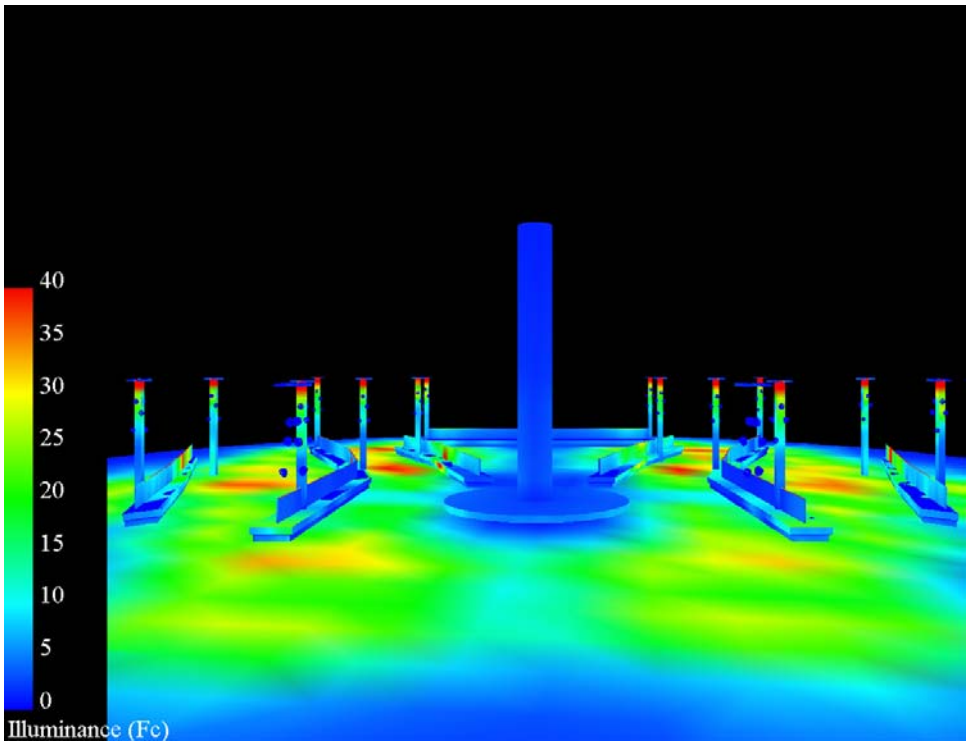


Civic Plaza illumination/light distribution without daylight





Pseudo Color Rendering Top View



Pseudo Color Rendering Front View

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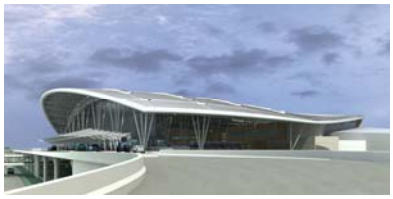
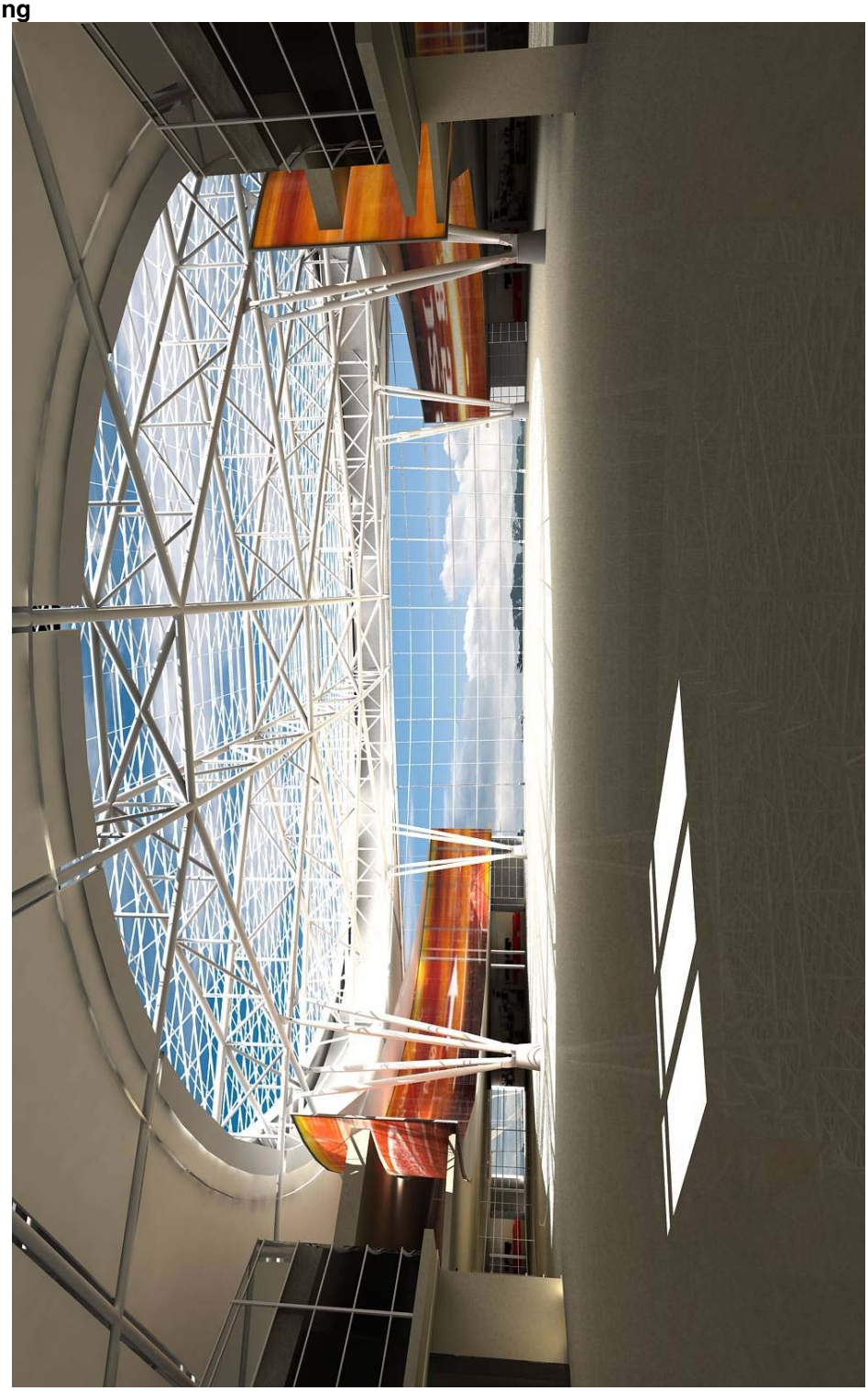
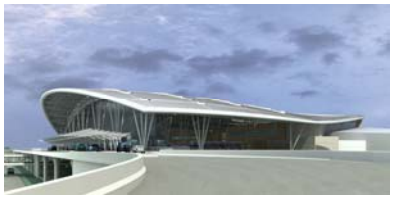


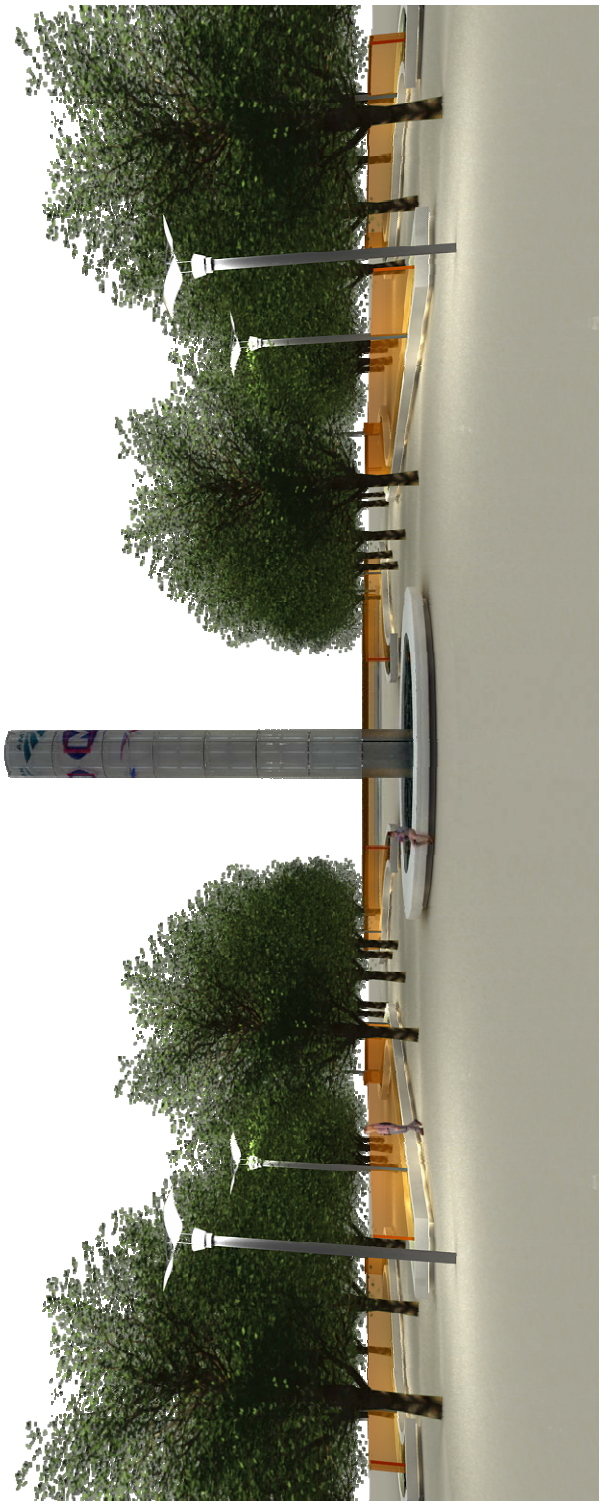
Rendering



Civic Plaza Rendering

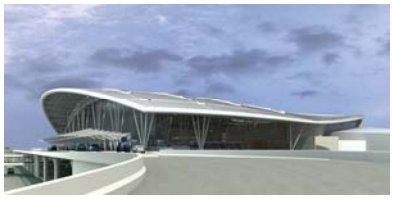
Indianapolis International Airport –
Midfield Terminal
Indianapolis, IN

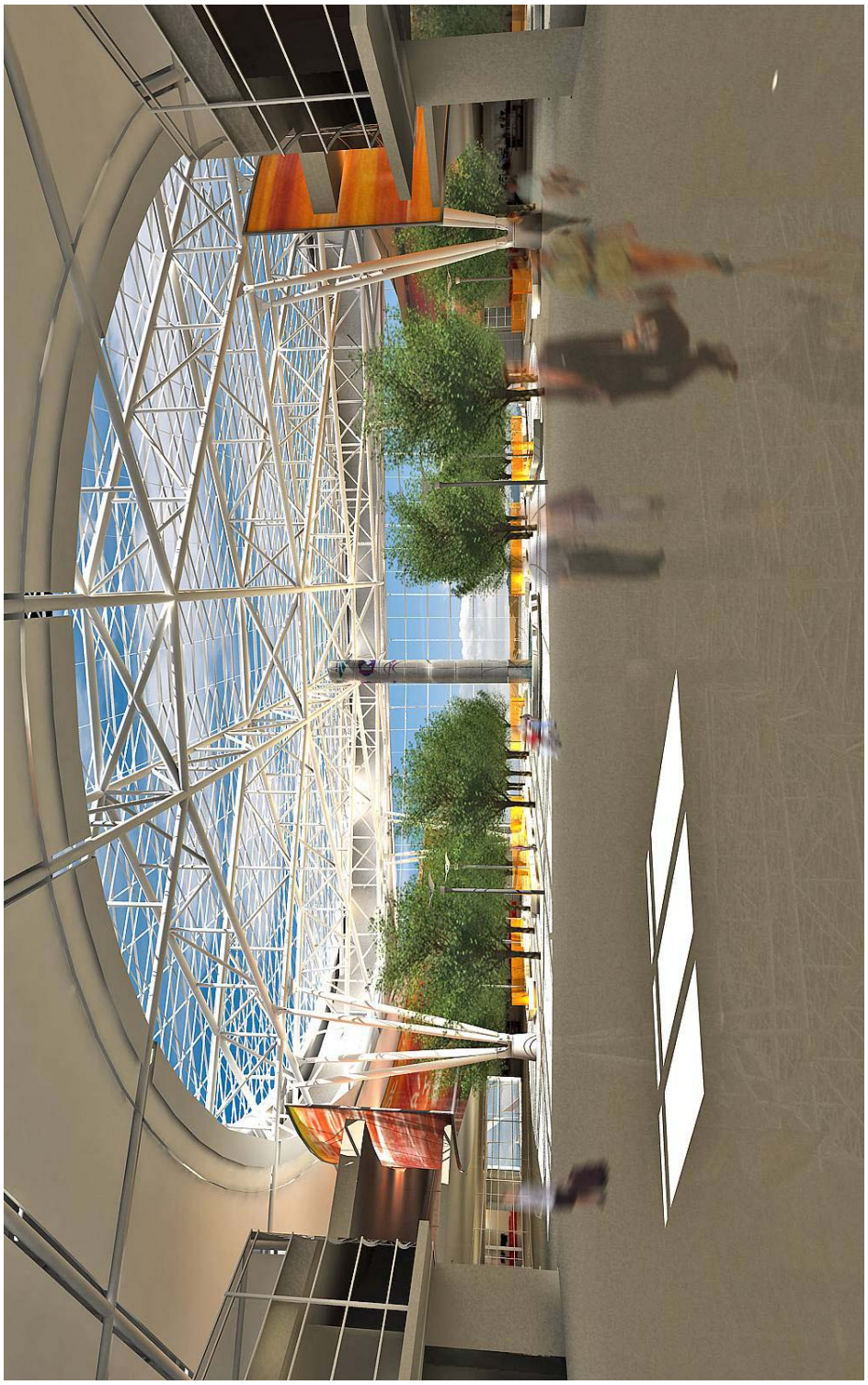




Civic Garden Rendering

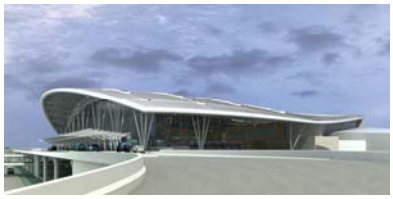
Indianapolis International Airport –
Midfield Terminal
Indianapolis, IN





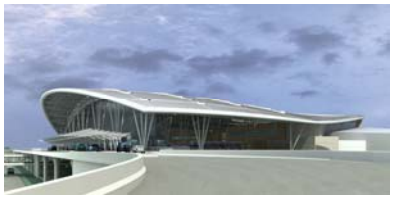
Civic Plaza + Civic Garden Rendering

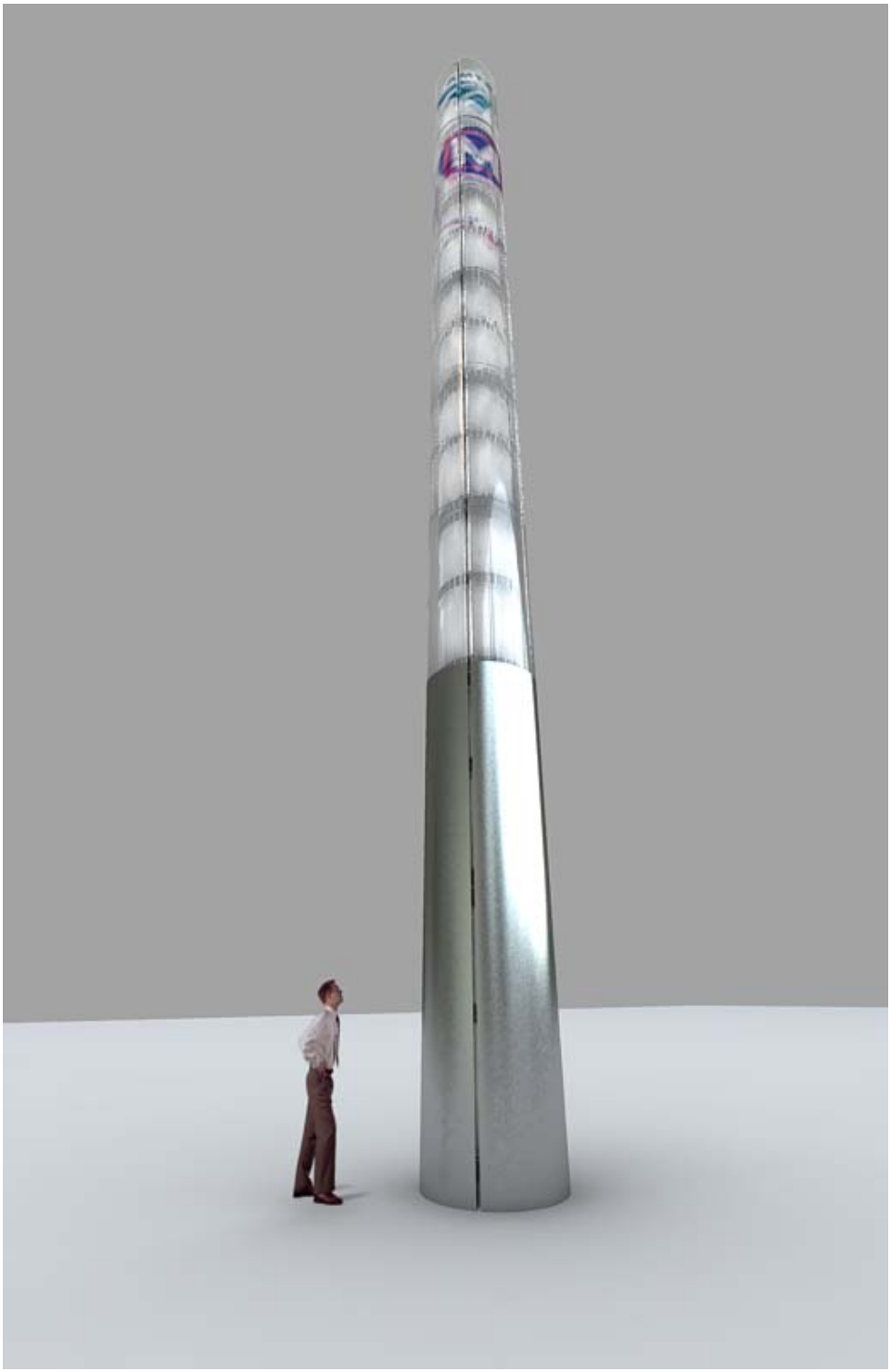
Indianapolis International Airport –
Midfield Terminal
Indianapolis, IN



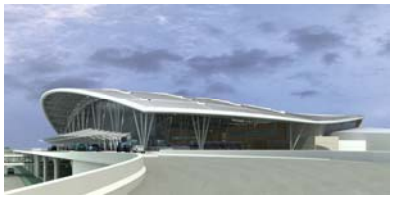
Custom Designed Fixture

Indianapolis International Airport –
Midfield Terminal
Indianapolis, IN





Custom Designed Light Sculpture



Conclusion

By utilizing massive plantation in the Civic Plaza, we are creating an artificial nature within a confined boundary, as I would like to call it an Urban Jungle or a Civic Garden rather than a Civic Plaza. This area of greenery provides a breath of fresh air, lowers indoor carbon dioxides level, provides a very organic way of shielding end-users from the harsh sunlight and glares from the giant skylight above them. The trees can also serve as a temperature barrier, provides cooling during summer months when direct heat gain from the skylight above and cause thermal comfort issues. Afterall, whenever a solution is proposed, there are never only advantages, there are potential problems and trade offs identified. Potential bug and moisture problems can occur if the foliages are not properly maintained during humid seasons. For more details on massive plantation and its sustainability, please see my Sustainable Design Breadth Study.
The overall lighting condition at night is satisfactory both photometrically and aesthetically, this proven that my design concepts are a viable solution.