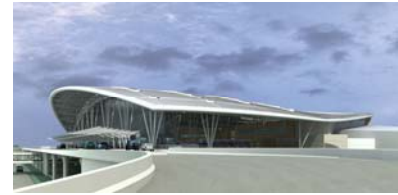
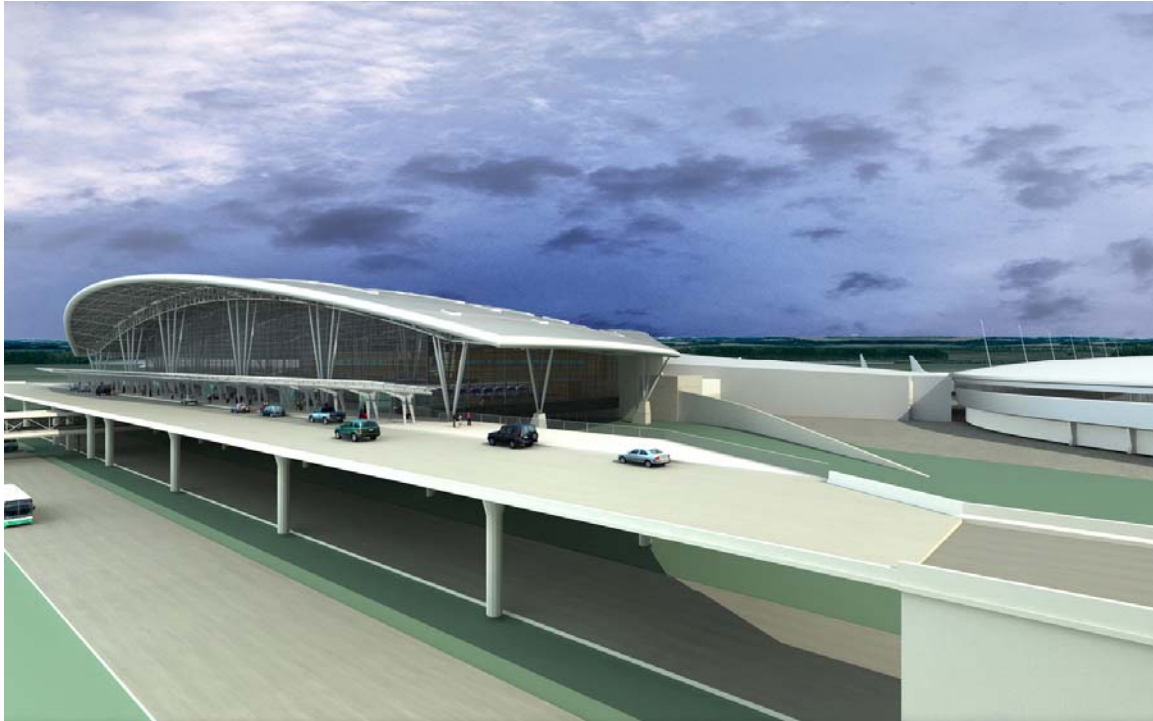


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## Lighting Depth Study

### Exterior Departure/Canopy Area



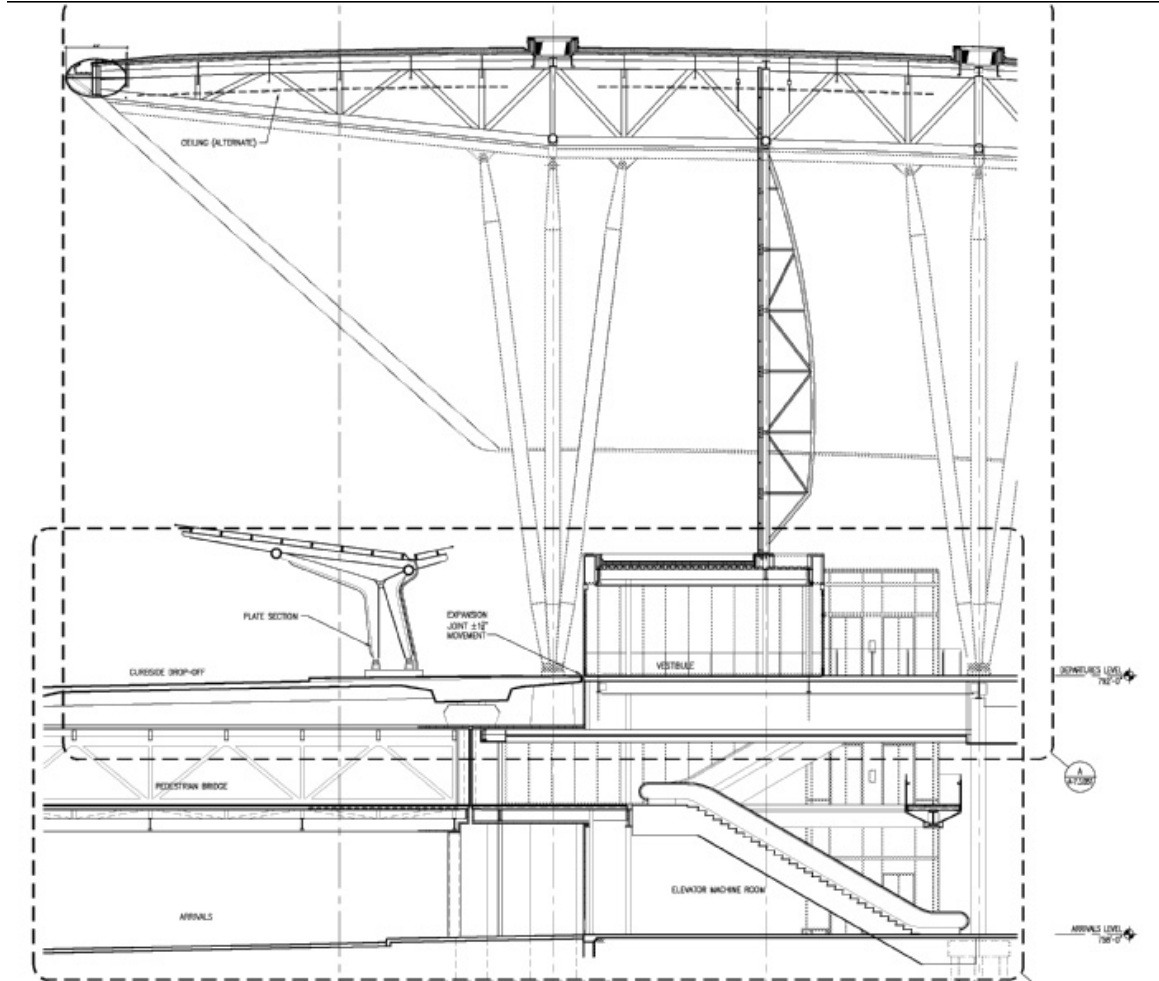
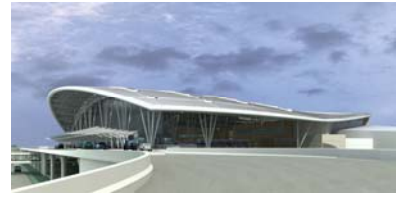
#### Overview

The Exterior of the Indianapolis International Airport is consisted of 2 levels of traffic circulation. The lower level is the Arrival pick up area where the upper level is the Departure drop off area. The Departure level features a 600 feet long glass and steel canopy that not only serves as an architectural element for aesthetic purposes, but it also provides shading for passengers from different weather conditions. Over the Canopy is a great arched roof with elegant contours that cantilevers nearly 60 feet out of the Curtainwall perimeter.

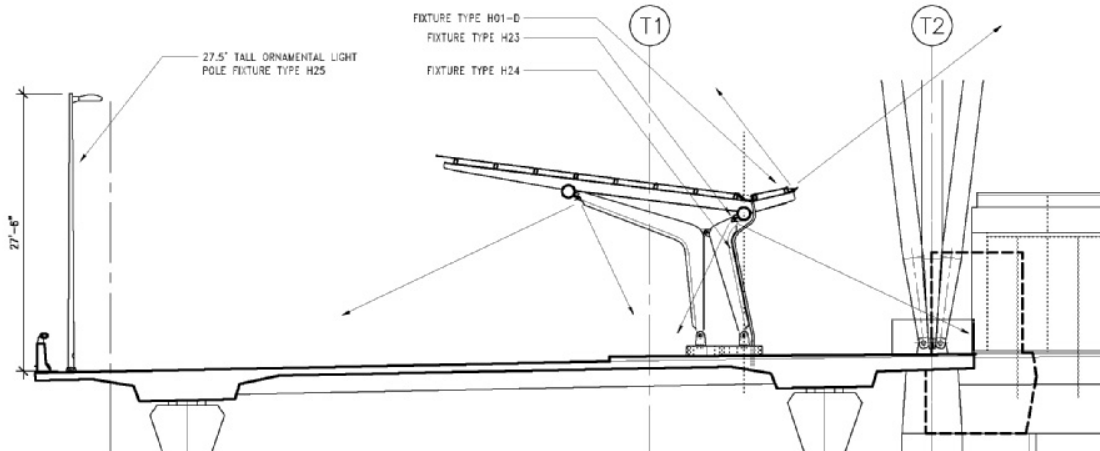
A plan and section below will illustrate the size and scales of this exterior perimeter.



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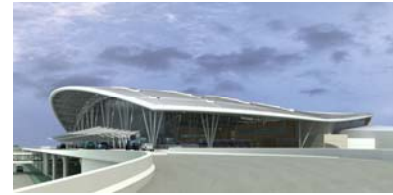


**Exterior Canopy Section**



**Exterior Canopy Detail**

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### Design Goal

To design an visually stunning exterior space with little or no upward light pollution to the night sky environment in order to achieve a LEED Lighting Pollution credit. Secondly, appearance of this exterior space is very important, since it is the first view contacting point from spectator's eye, the lighting design must announce a civic presence and lasting impression via great lighting solution.

### Design Criteria

1. Color Appearance
  - Color appearance and color contrast is very important because the lighting of this space must be well balanced for pleasing appearance as well as visibility to roadway drivers
2. Glare
  - Direct glare must be avoided for oncoming traffic approaching from the road access since the glare might affect the drivers' visibility to the signage at the departure/arrival area.
3. Light Distribution
  - Light distribution on surface is important because by ensuring an evenly distributed surface would enhance the overall appearance of the space as well as maintaining uniform illuminance for pedestrian conveyance.
4. Light Pollution/Light Trespass
  - Light pollution/trespass is important, since the departure canopy is made all out of glass, improper uplighting would project unwanted glare to sky and possibly affect pilot's flight visibility. Secondly, in accordance to the LEED guideline, all light trespass issue ought to be resolved in order to achieve the credit. Hence, all lighting candle distribution must fall within the building property and no lights can be spilled outward into the sky.
5. Points of interest
  - Via Roof uplighting, giving the structure a monumental appearance can easily make the architecture itself a point of interest for tourist to visit.
6. Reflected Glare
  - Reflected glare ought to be avoided from the curtainwall façade and glass canopy due to the same reason as direct glare, to maintain visual comfort and visibility to signage at the departure/arrival area for drivers and departing passengers.

### Design Concept

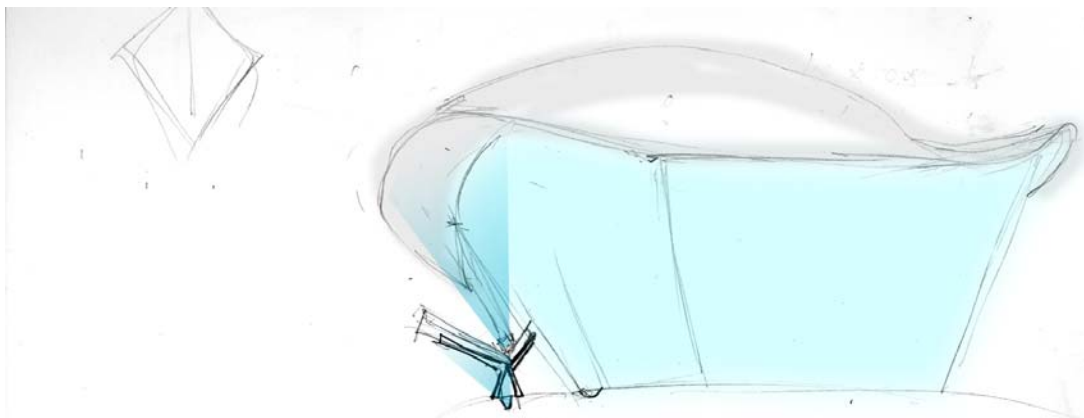
To reference the airport runway's in-grade guidance lights for air crafts' landing or take off, I have pursued the same kind of continuity. However, for the exterior case, in addition to the roadway lighting (which are not included as part of my exterior study), I have specified a series of light columns which runs along the back of the Canopy, act as a guiding features for the drivers approaching from the highway into the airport for take off(departure) or landing(arrival). As the great arched roof goes, more than half of the existing uplight fixtures (as of Design Development Phase), are taken out for energy and light pollution reduction purposes. Half of the downlight fixtures originally mounted from the Canopies are taken out as well. All perimeter semi-recessed asymmetric uplight fixtures are taken out to prevent light spilling into the night sky. All new and

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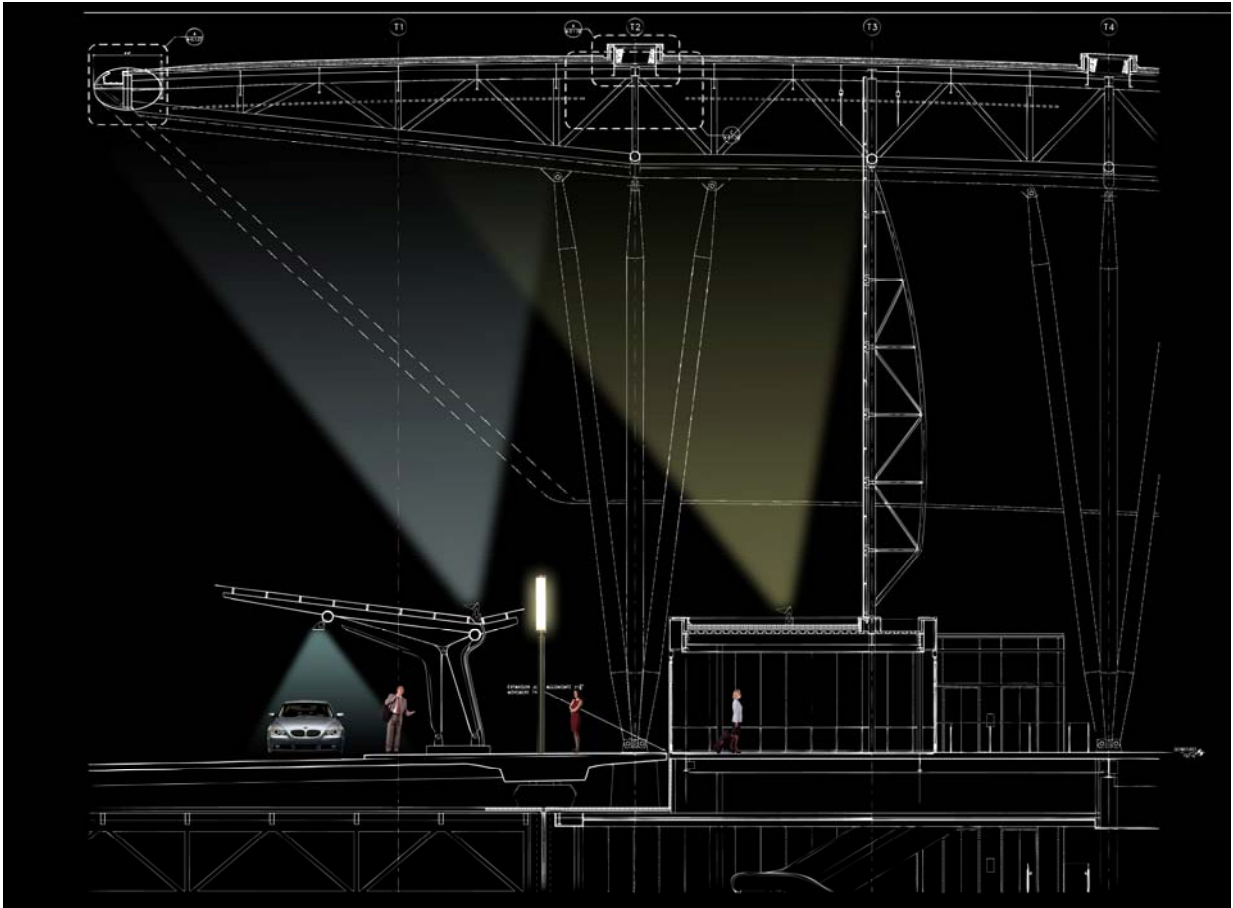
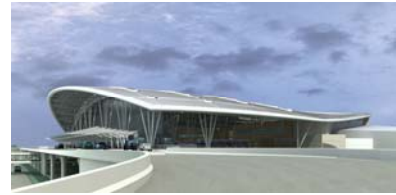
remaining fixtures are re-aimed in a way so that all of the lights will fall-off within the roof, and thus without causing light pollution. I personally submits to Helmut Jahn’s philosophy of light, which says, “A building is luminous, not illuminated”, is a very important statement that governs my design. I also believe that façades need not any artificially lights blasting onto its surface to generate illumination, in addition to all the reflected glares or light pollutions and such, it simply is not efficient and is out of date design strategy. Hence, my approach to make this terminal luminous, is to generate illuminations from within. Utilizing interior uplights aimed at the arched roof structure, when viewed from far away, one will get the impression of a glowing bird taking flight.

Schematic sketches and finalized design solution are illustrated below:



**Schematic Sketch**

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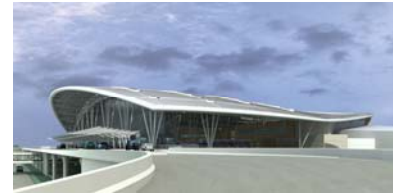


**Finalized Design Concept**

**Material Reflectance:**

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

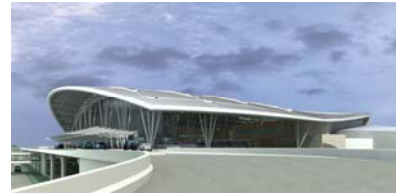
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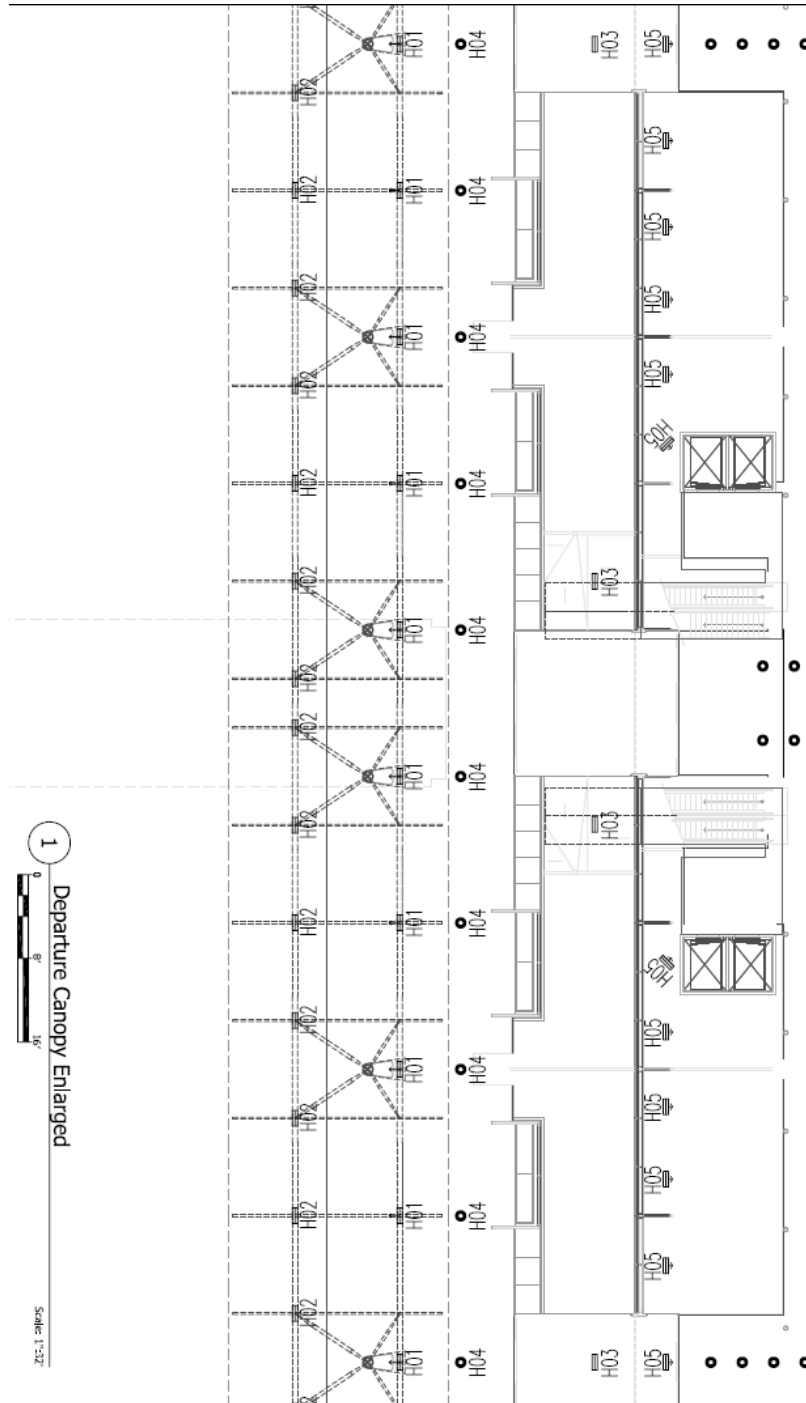
**Glazing Specification**

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

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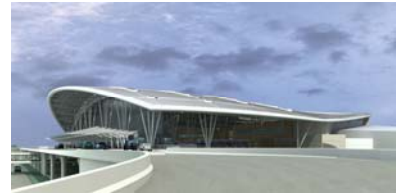


Luminaire Layout





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**Lighting Fixture Schedule**

Exterior								
Fixture #	Brand	Luminaire	Lamp Type	Lamp Wattage (watts)	Lamps/Fixture	Quantity	Watts/L-ft or Watts/Fixture	Total Watts
H01	Elliptipar Style 152	Canopy Mount Asymmetric Uplight	Metal Halide T6	70	1	34	85	2890
H02	Elliptipar Style 151	Canopy Mount Asymmetric Downlight	Metal Halide T6	150	2	22	350	7700
H03	Elliptipar Style 152	Roof Mount Asymmetric Uplight	Metal Halide ED28	250	1	6	292	1752
H04	Lumec-Shreder Nemo Series	16' Tall Free Standing Light Pole	Metal Halide T6	150	1	34	85	2890
							<b>Total Watts</b>	<b>12342</b>
							<b>Total Area</b>	<b>20700</b>
							<b>Overall LPD</b>	<b>0.60</b>

H01



H02



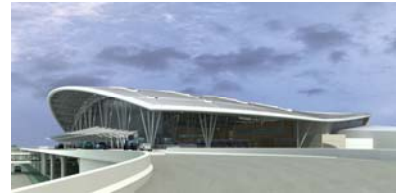
H03



H04



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For Ballast and Lamp Schedule, please see Appendix A.

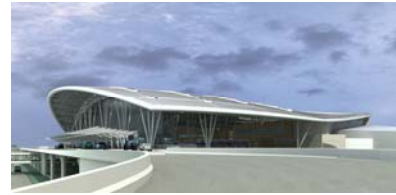
**Light Loss Factor**

Exterior								
Fixture #	Maintenance Category	Dirt Condition	Cleaning Interval	Ballast Factor	RSDD	LLD	LDD	Total LLF
H01	VI	Medium	6 Months	0.8	0.9	0.8	0.6	0.35
H02	IV	Medium	6 Months	0.8	0.9	0.8	0.65	0.37
H03	VI	Medium	6 Months	0.8	0.9	0.8	0.6	0.35
H04	I	Medium	6 Months	0.8	0.9	0.8	0.8	0.46

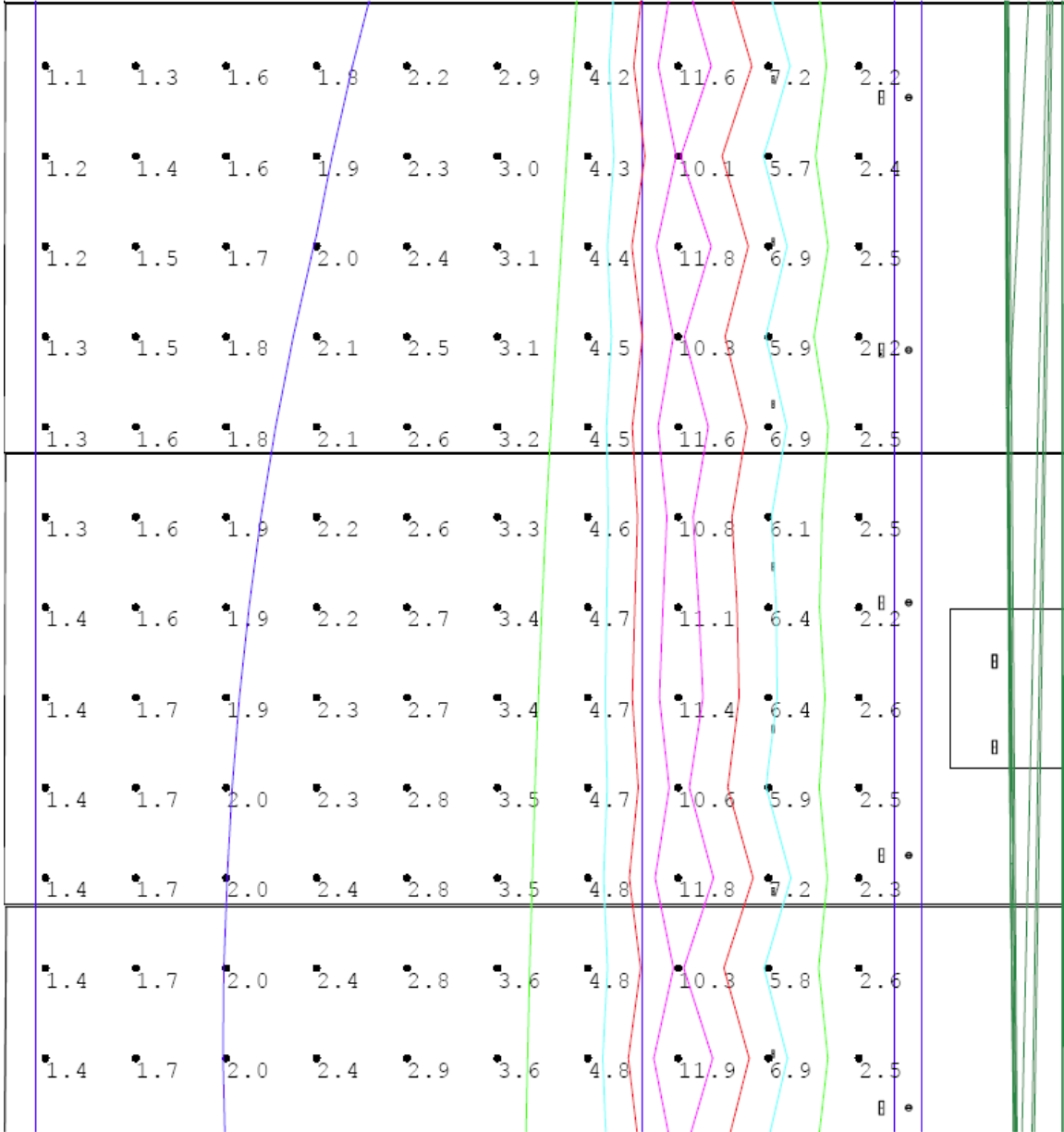
**Lighting Power Density**

Exterior							
Building entrance with canopy or free standing canopy (Departure)	3 W/sq.ft. of canopied area*	6900	1.53	B	10*	10.3	
Building entrance without canopy (Arrival)	33 W/linear ft of door width*	4092	12 w/l-ft	B	10*	N/A	
Building Facades	0.25 W/sq.ft. of illuminated façade area*	61400	0**	B	3*	-	
Air/Train/Bus Baggage Area	1.03 W/sq.ft	N/A	N/A	B	30	N/A	
Corridor/Transition Area	0.46 W/sq.ft	13800	0.21	C	10	10.3	
Ticket Hall							

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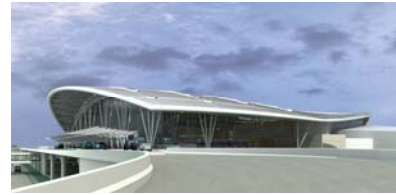


**Illuminance Value**

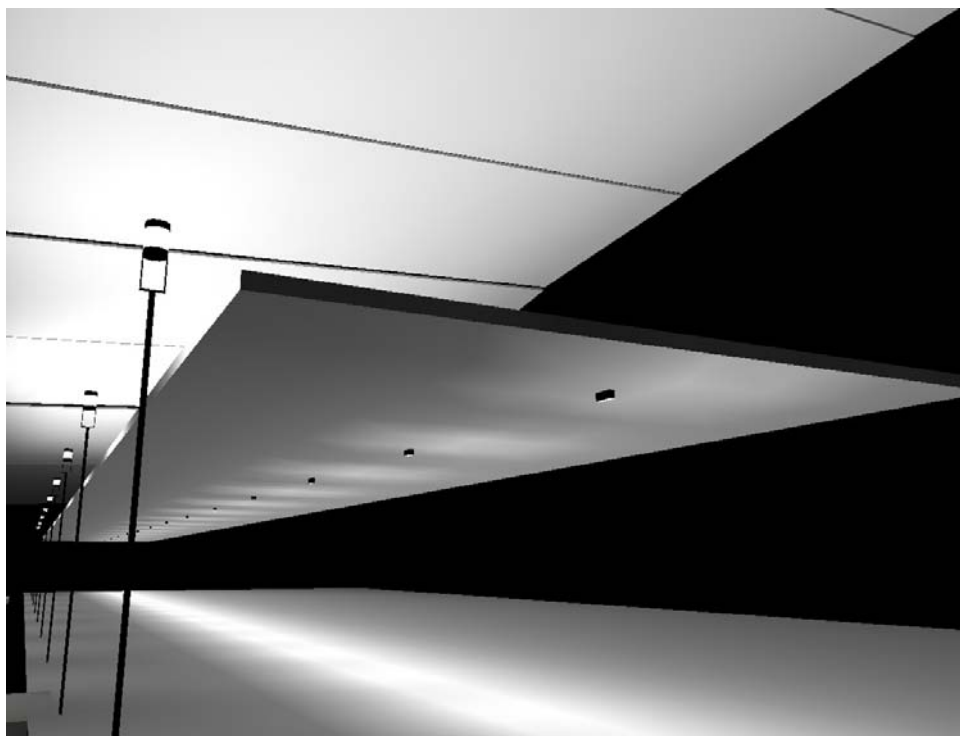
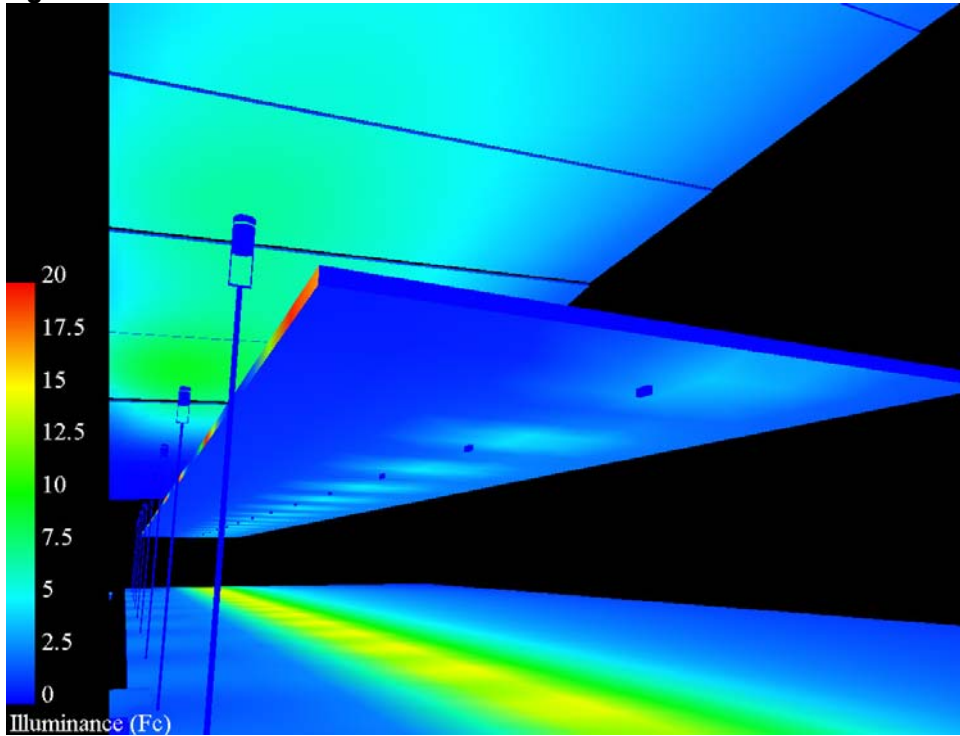


**Illuminance for a section of the canopied area.**

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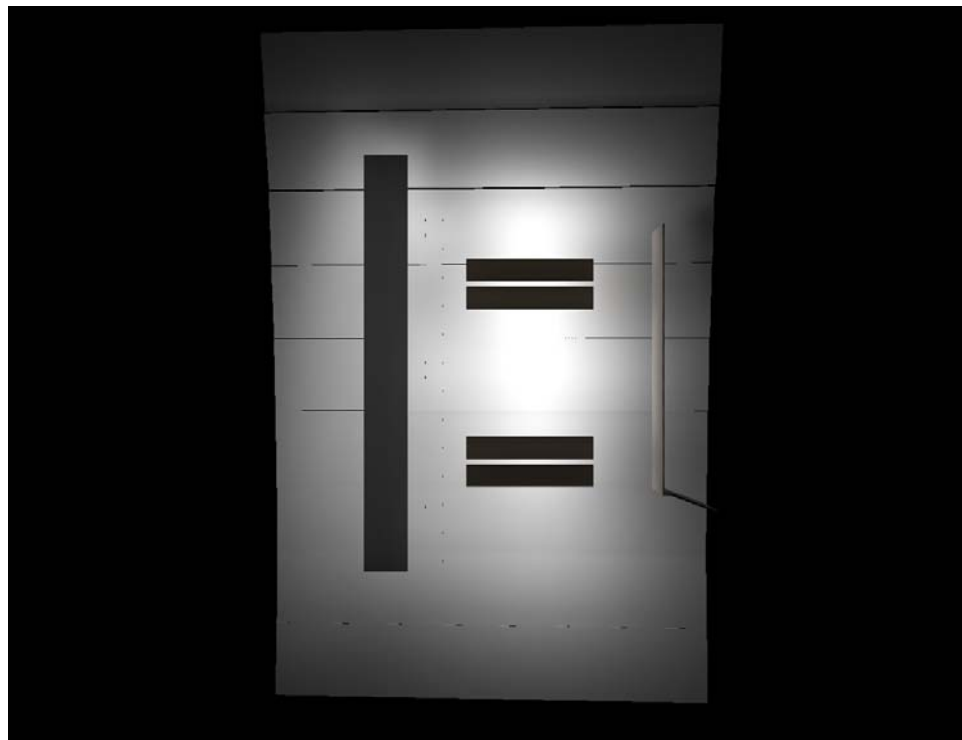
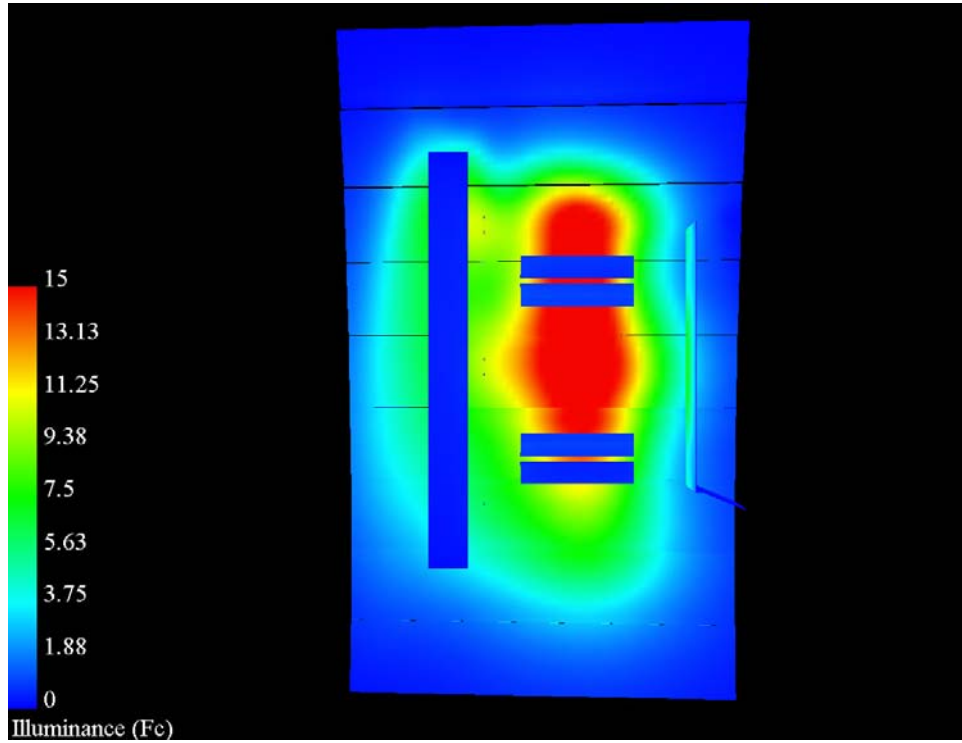
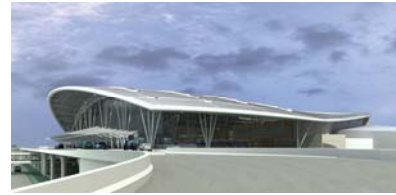


Rendering



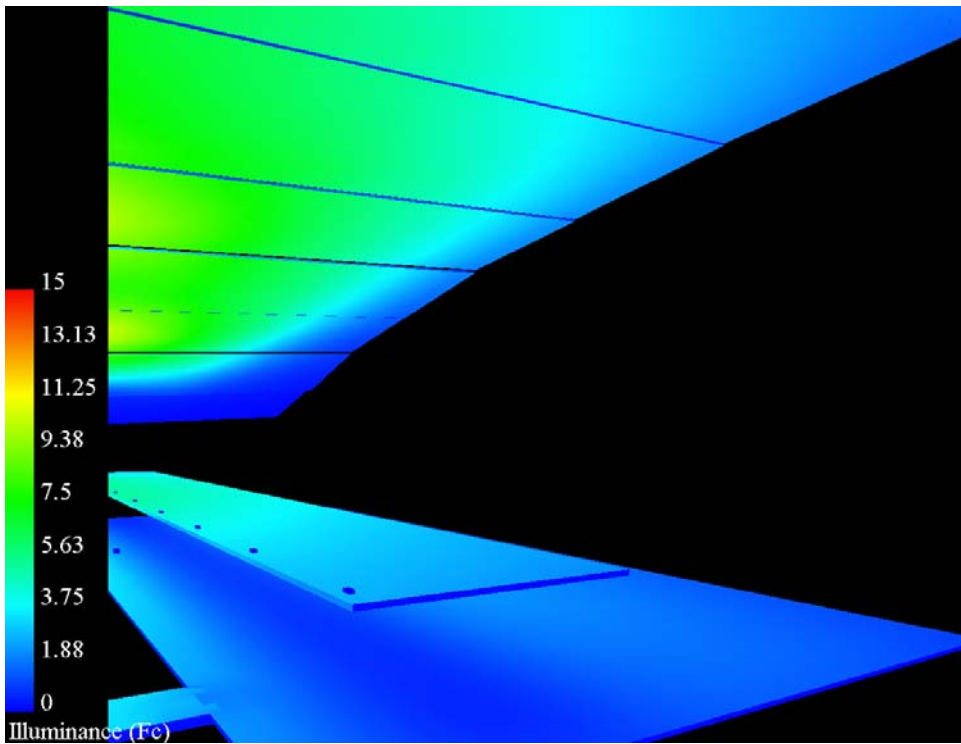
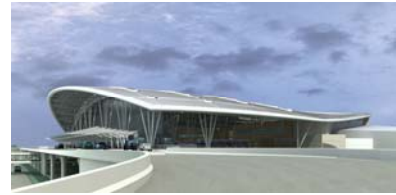
Exterior Perspective

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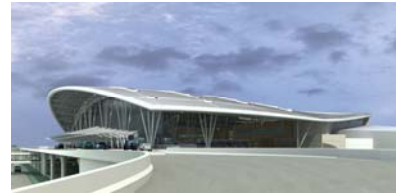
Bottom View

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Roof uplight only (all lights falls within the roof, 0 fc at edge)

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**Conclusion**

With the careful aiming and shielding of upright fixtures, no lights are spilled outside of the roof area(see pseudo color rendering for distribution) and yet able to achieve a high contrast and visually pleasing exterior. Energy saved is tremendous with the reduction of over 60% of exterior fixtures. As a result, LEED Lighting Pollution credit is achieved (see Sustainable Design Breadth Study). The result is exhilarating, a low slung structure hugging the ground, mimicked a giant glowing bird with luminous interior taking off, blending the contour of the roof into the surrounding landscape.