



ENGINEERING



The In's & Out's of Rendering Using Lighting Software

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The In's & Out's of Rendering Using Lighting Software

- **Presentation Goal Outline**

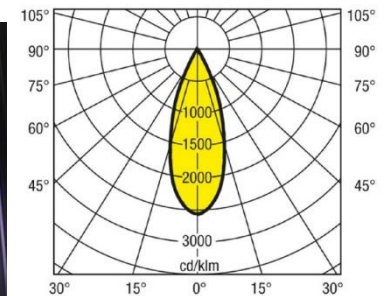
- Explain the fundamental principals of rendering software
- Review the basic formulation of modern lighting analysis software
- Understand how to differentiate between photometric software types
- Understand how rendering software depicts light and architecture
- Analyze rendering presentation examples and compare to real world project results



The In's & Out's of Rendering Using Lighting Software

■ Photometrics

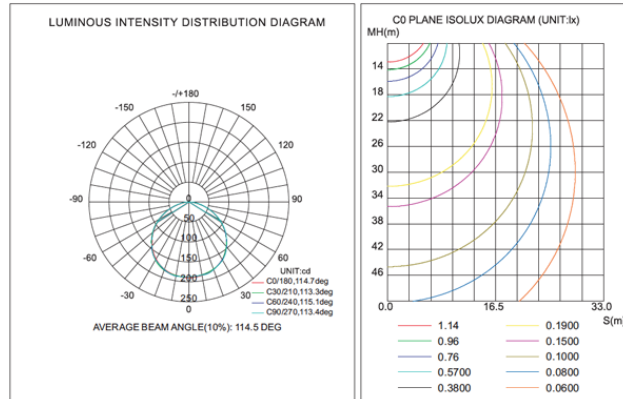
- Root word Photometry (Greek words for Light and Measure)
- Photometric Information from luminaires
 - Measurement of the amount and direction of light emitted by a luminaire
- Testing and Analysis methods
- Goniophotometer
- Manufacturer published IES files



The In's & Out's of Rendering Using Lighting Software

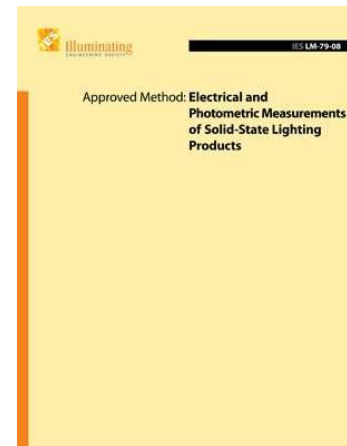
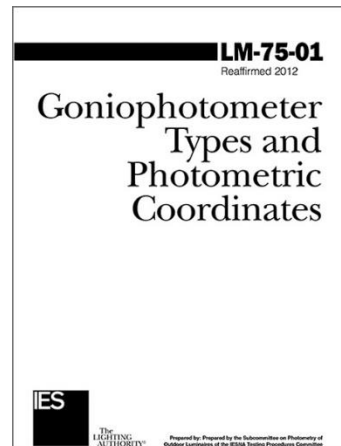
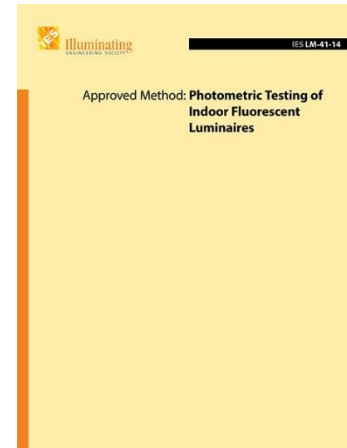
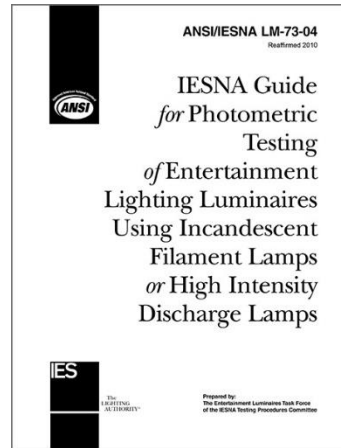
NAME: LD008AL14540	TYPE: Panel Light	WEIGHT: 0.23Kg
DIM.: # 145mm	INPUT POWER(W): 8	SUR.: 270
	CCT(K): 4000K±250	PROTECTION ANGLE:

DATA OF LAMP		PHOTOMETRIC DATA Eff: 67.09lm/W			
MODEL	SMD 2835	Imax(cd)	188.93	S/MH(C0°/180)	1.27
NOMINAL POWER(W)	8.16	LOR(%)	100.0	S/MH(C90°/270)	1.29
RATED VOLTAGE(V)	240	TOTAL FLUX(lm)	547.5	hUP,DN(C0-180)	1.0,49.9
NOMINAL FLUX(lm)	547.5	CIE CLASS	DIRECT	hUP,DN(C180-360)	1.0,50.1
LAMPS INSIDE	1	hup(%)	0.0	CIBSE SHR NOM	1.25
TEST VOLTAGE(V)	219.8	hdown(%)	100.0	CIBSE SHR MAX	1.35



C Range: 0 - 360DEG
 C Interval: 5.0DEG
 Test Speed: HIGH
 Temperature: 25.3DEG
 Operators: had peng fel
 Test Date: 2013-08-12

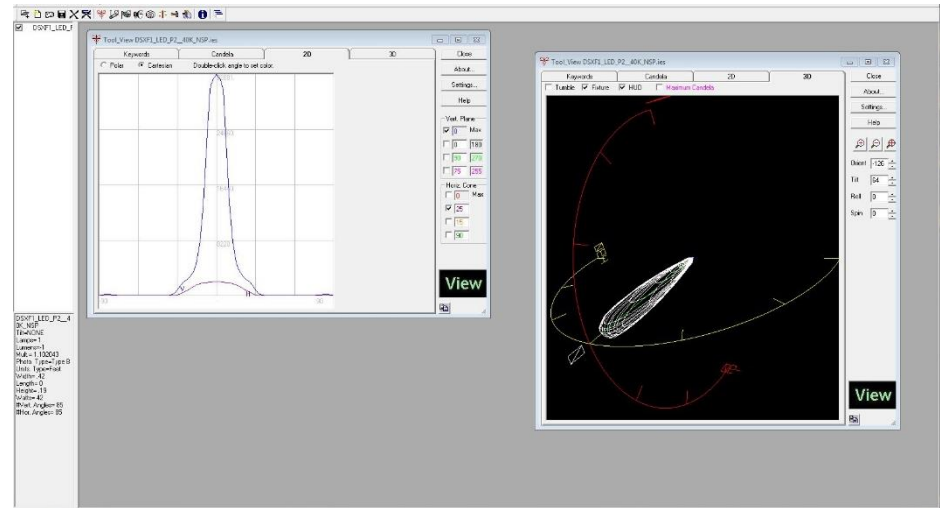
γ Range: 0 - 90DEG
 γ Interval: 0.5DEG
 Test System: EVERFINE GO-2000B_V1 SYSTEM V2.0.275
 Humidity: 65.0%
 Test Distance: 7.000m [K=1.0000]
 Remarks:



The In's & Out's of Rendering Using Lighting Software

- **Role of Science data in Lighting Design**

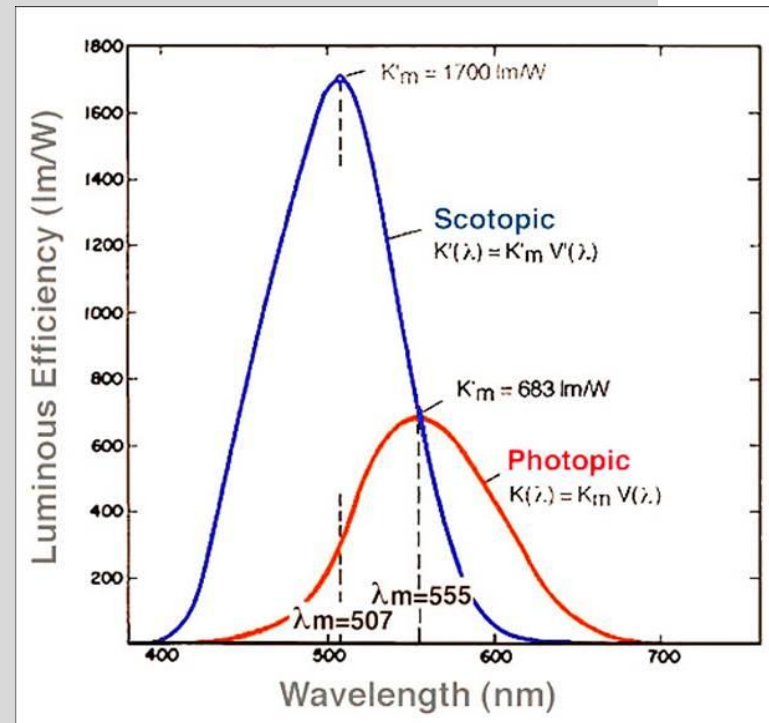
- Experiments for relationship between more-or-less (simply defined) luminous input
- Utility of the data about lighting sources acquired on that basis
- Visual performance testing
 - Measurement of speed and accuracy



The In's & Out's of Rendering Using Lighting Software

- **Relevance of Photopic, Mesopic and Scotopic**

- Range of Human vision adaptation level
- Human eye study
- Photopic – adaptation level to overall brightness (3cd/m²)
- Mesopic - adaptation level to overall brightness spectrum (.01cd/m²)
- Scotopic - adaptation level blue-green spectrum (.001cd/m²)



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- **Understanding Light**

- One of the Visual Stimuli
- Interaction of surfaces and color, texture
- Potential and comparison levels
- Meaningful definition to light



The In's & Out's of Rendering Using Lighting Software

■ Software Defines Light

- Radian watts of source is measured in small wavelength bands
- Each wavelength is weighted (multiplied) by the luminous efficiency
- Photopic vision CIE 1978, broad bands of light

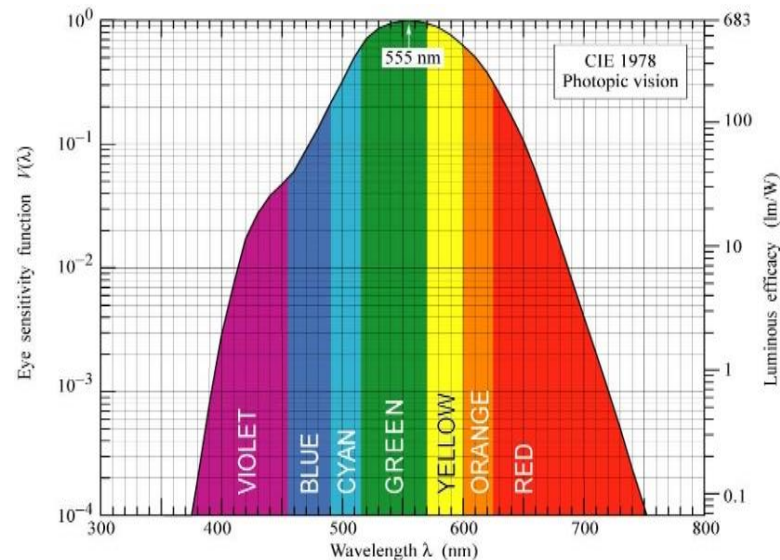
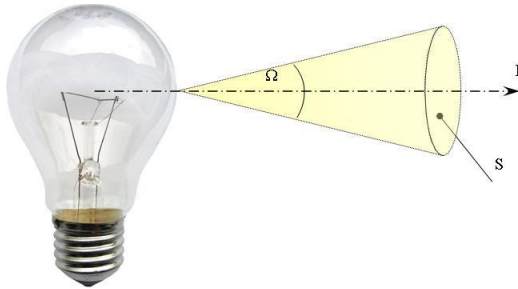


Fig. 16.7. Eye sensitivity function, $V(\lambda)$, (left ordinate) and luminous efficacy, measured in lumens per Watt of optical power (right ordinate). $V(\lambda)$ is greatest at 555 nm. Also given is a polynomial approximation for $V(\lambda)$ (after 1978 CIE data).

E. F. Schubert
Light-Emitting Diodes (Cambridge Univ. Press)
www.LightEmittingDiodes.org

The In's & Out's of Rendering Using Lighting Software

▪ Luminous Flux

- Defined as “Visually evaluated” radiant power
- Strength of all photo metrics depends on how “Visually evaluated” is defined
- Radiant powers ability to provoke the perception of brightness
- Development of luminous power
- Luminous strength of one wavelength compared to another

Lumens per Watt
Conversion Factor for
CIE V_λ Curve

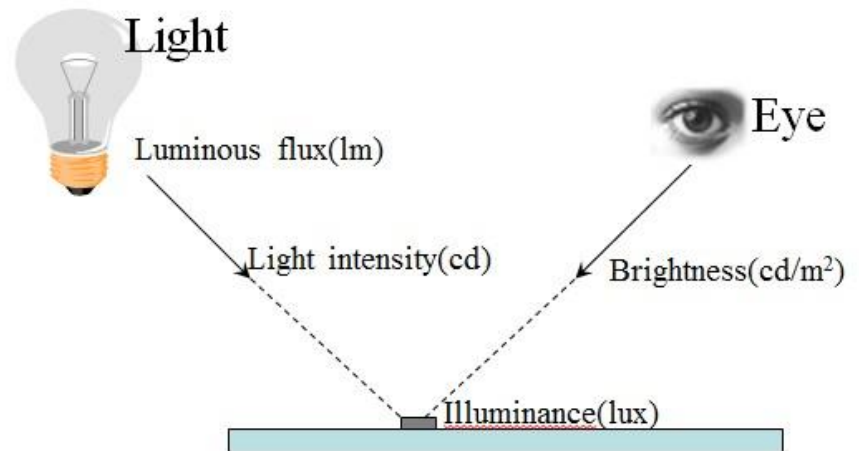
Radiant Energy
in Watts

Wavelength
Sampling
Increment

$$\text{Lumens} = 683 \int_{380}^{730} \Phi_{e,\lambda} V(\lambda) d\lambda$$

Integrate over
Visible Spectrum

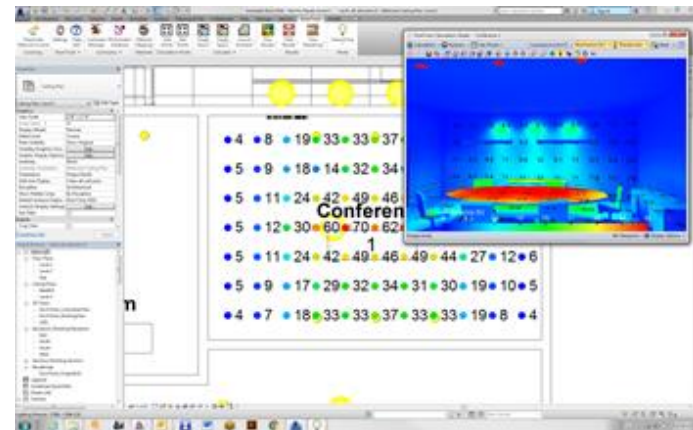
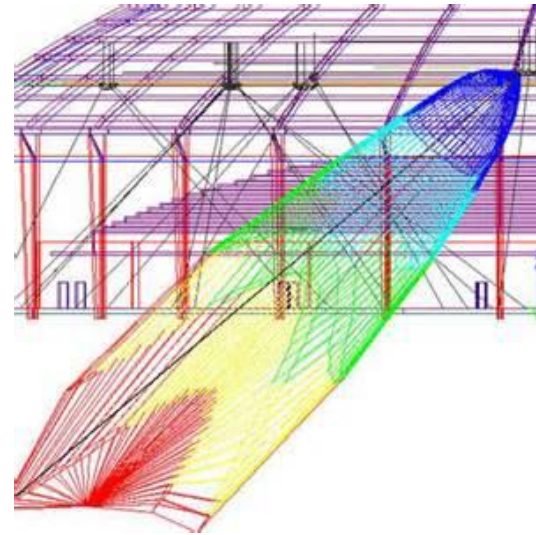
CIE
Spectral Luminosity
Function



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▪ Luminous Flux

- "Ray of Light" very small cone
- Represented by a single arrow then collected into bundles
- Bundles then form densities
 - Surface (lumens/area)
 - Spatial
 - Light forms density



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Specular and Diffuse Reflection

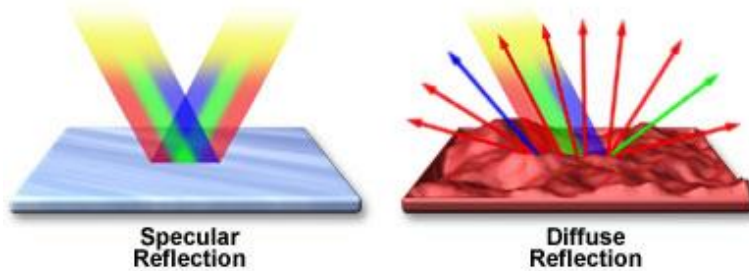
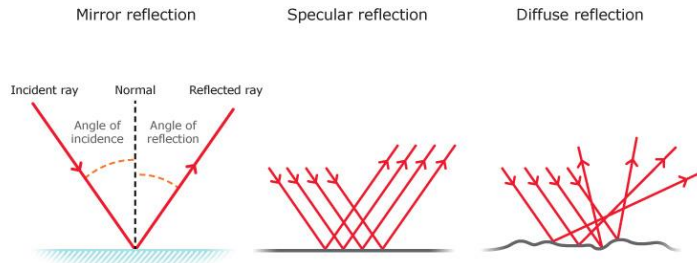
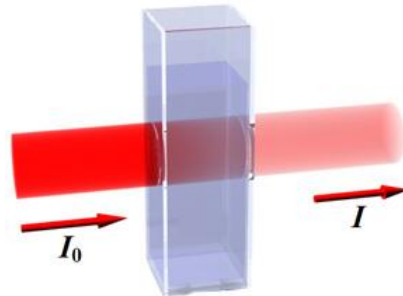


Figure 1



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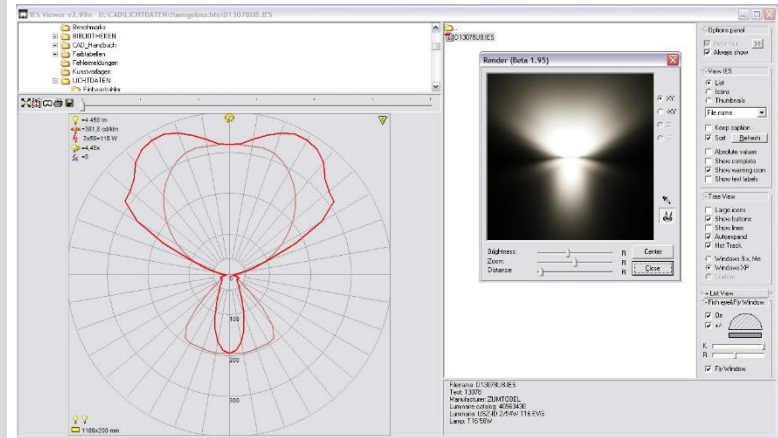
■ Inter-reflection of light

- Balance between the generation and absorption of light
- Luminous potential of surfaces
 - Glass
 - Wood
 - Ice
 - metal
- Reflectance
 - Diffuse
 - Directional
- Transmittance
 - Diffusing
 - Directional

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Photometric Data Files and Their Format

- IES LM-63
 - IESNA Standard 1986
 - LM-63-1986
- CIBSE TM-14
 - British TM-14
- CIE 102-1993
 - International (not used)
- EULUMDAT
 - European standard

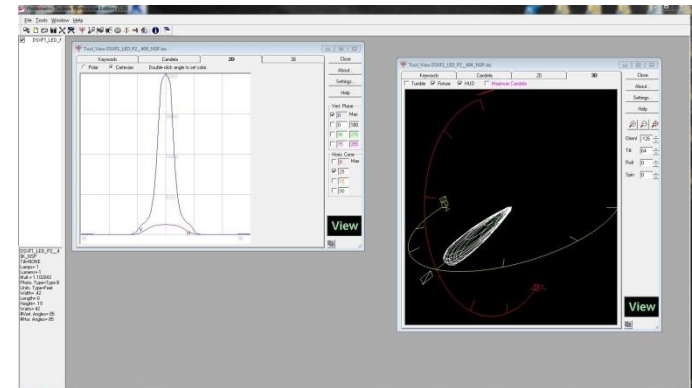
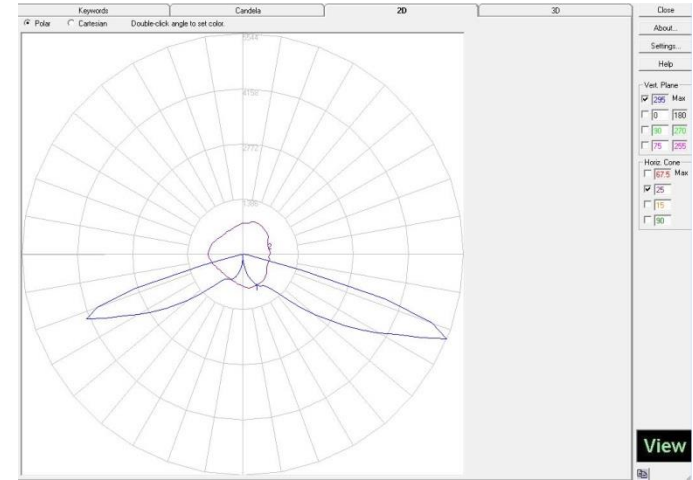


```
1 IESNA:LM-63-2002
2 [TEST] 1
3 [TESTLAB]
4 [TESTDATE] 2014-11-21
5 [ISSUEDATE] 2014-11-21 14:52:20
6 [NEARFIELD]
7 [LAMPPOSITION] 0,0
8 [OTHER] EVERFINE GO-2000A_V1_SYSTEM
9 [MANUFAC]
10 [LUMINAIRE] HiCloud 150W 5000K
11 [LAMP] 120DEGREE 5000K CR173
12 TILT=NONE
13 1 18434.4 1 37 181 2 2 -0.230 -0.230 0.22
14 1.000 1 155.3
15 -90.0 -85.0 -80.0 -75.0 -70.0 -65.0 -60.0 -55.0 -50.0 -45.0
16 -40.0 -35.0 -30.0 -25.0 -20.0 -15.0 -10.0 -5.0 0.0 5.0
17 10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0 55.0
18 60.0 65.0 70.0 75.0 80.0 85.0 90.0
19 -90.0 -89.0 -88.0 -87.0 -86.0 -85.0 -84.0 -83.0 -82.0 -81.0
20 -80.0 -79.0 -78.0 -77.0 -76.0 -75.0 -74.0 -73.0 -72.0 -71.0
21 -70.0 -69.0 -68.0 -67.0 -66.0 -65.0 -64.0 -63.0 -62.0 -61.0
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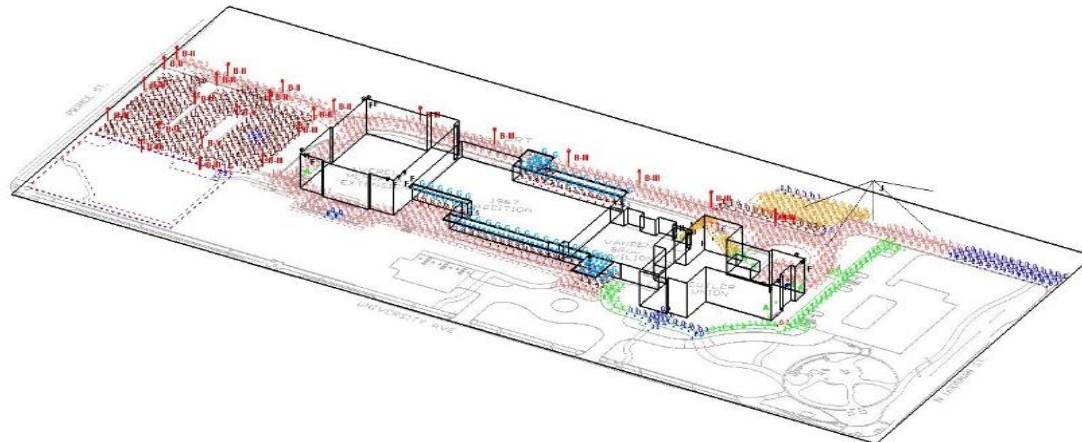
■ IES File Viewer

- Evaluate IES matrix file
- Distribution analyzation
- Orientation of file for REVIT
- Compare manufacturers data
- Evaluate “equal” products
- Quick check of BUG ratings

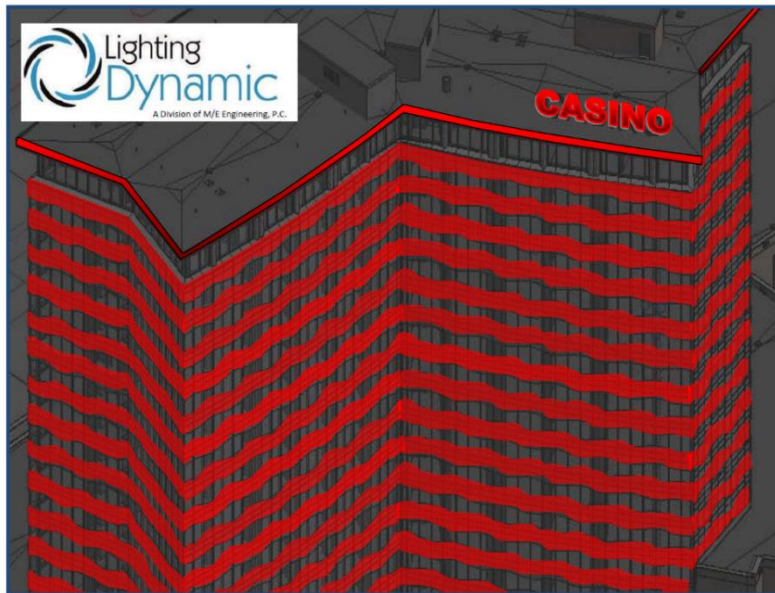


The In's & Out's of Rendering Using Lighting Software

- **Rendering Role for Lighting Design not Architecture**
 - Predict the lighting potential
 - Amounts Ratios and Gradients
 - Architectural Space definition and Potential Glare
 - Predict the movement of the Sun
 - Reflection of light
 - Code compliance



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■ Architectural Rendering Software

- 3D MAX Design Studio
- Archicad
- Revit
- Sketch UP
- Rhinoceros
- Photoshop

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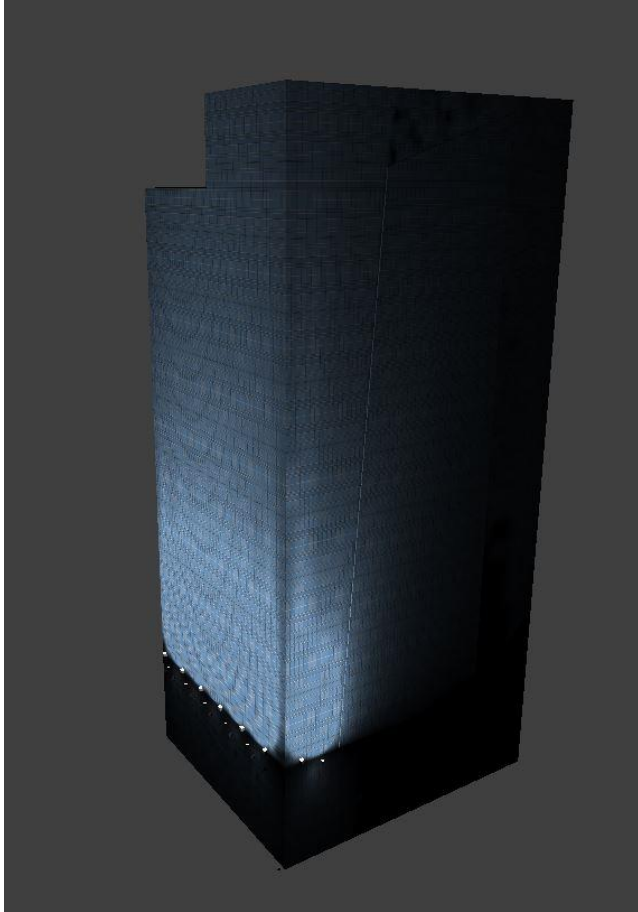
The In's & Out's of Rendering Using Lighting Software



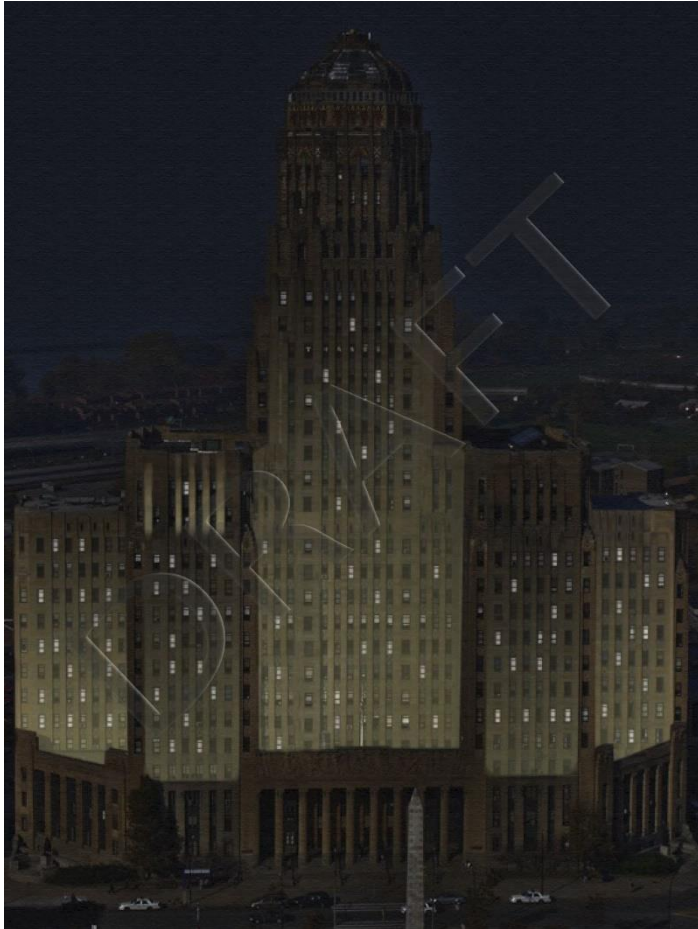
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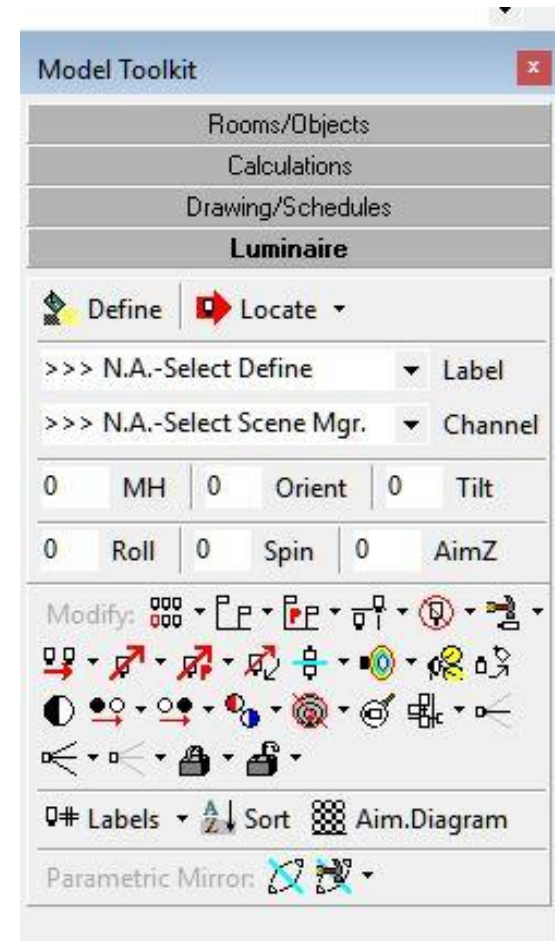


■ Lighting Rendering Software

- AGI 32
- Visual Professional
- DIA Lux
- Lumen Designer
- Radiance
- Elumtools (AGI32 REVIT)
- Lite Pro DLX

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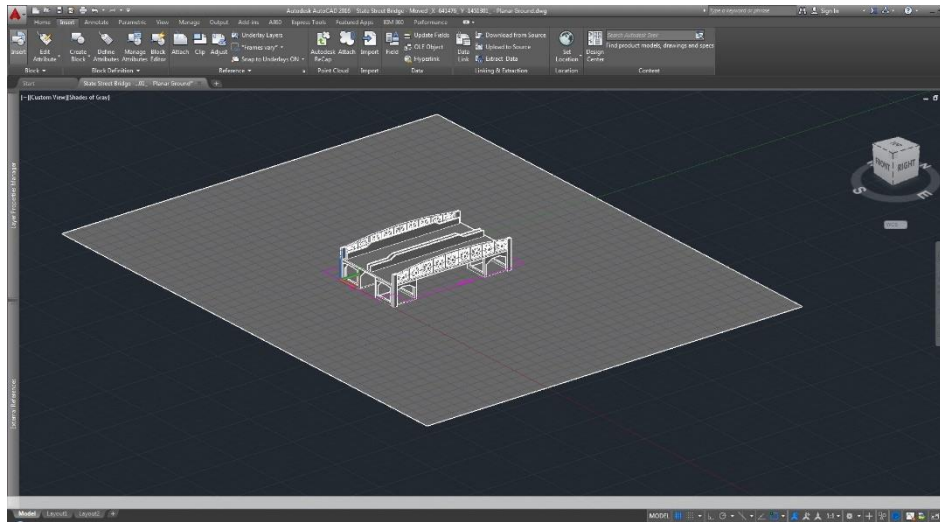
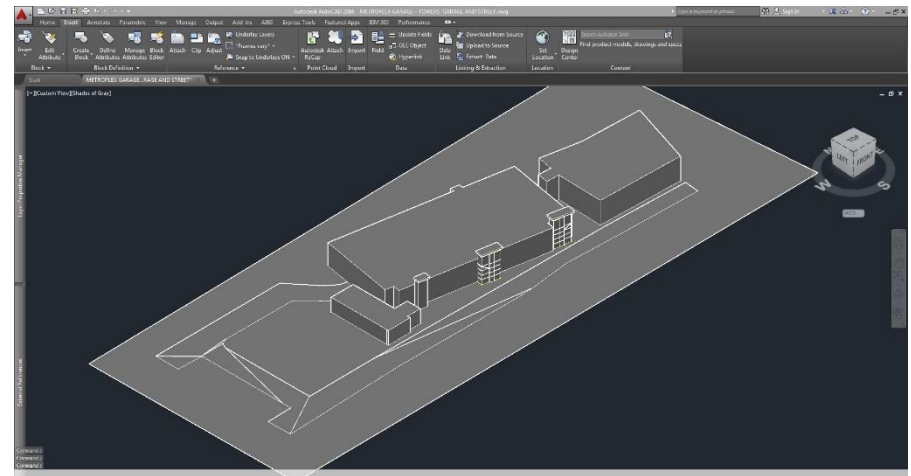
- **Components of a Photometric Calculation File**
 - Solids
 - Rooms
 - Luminaires
 - Calculation Planes
 - Objects
 - Rendering



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■ Building a Rendering File

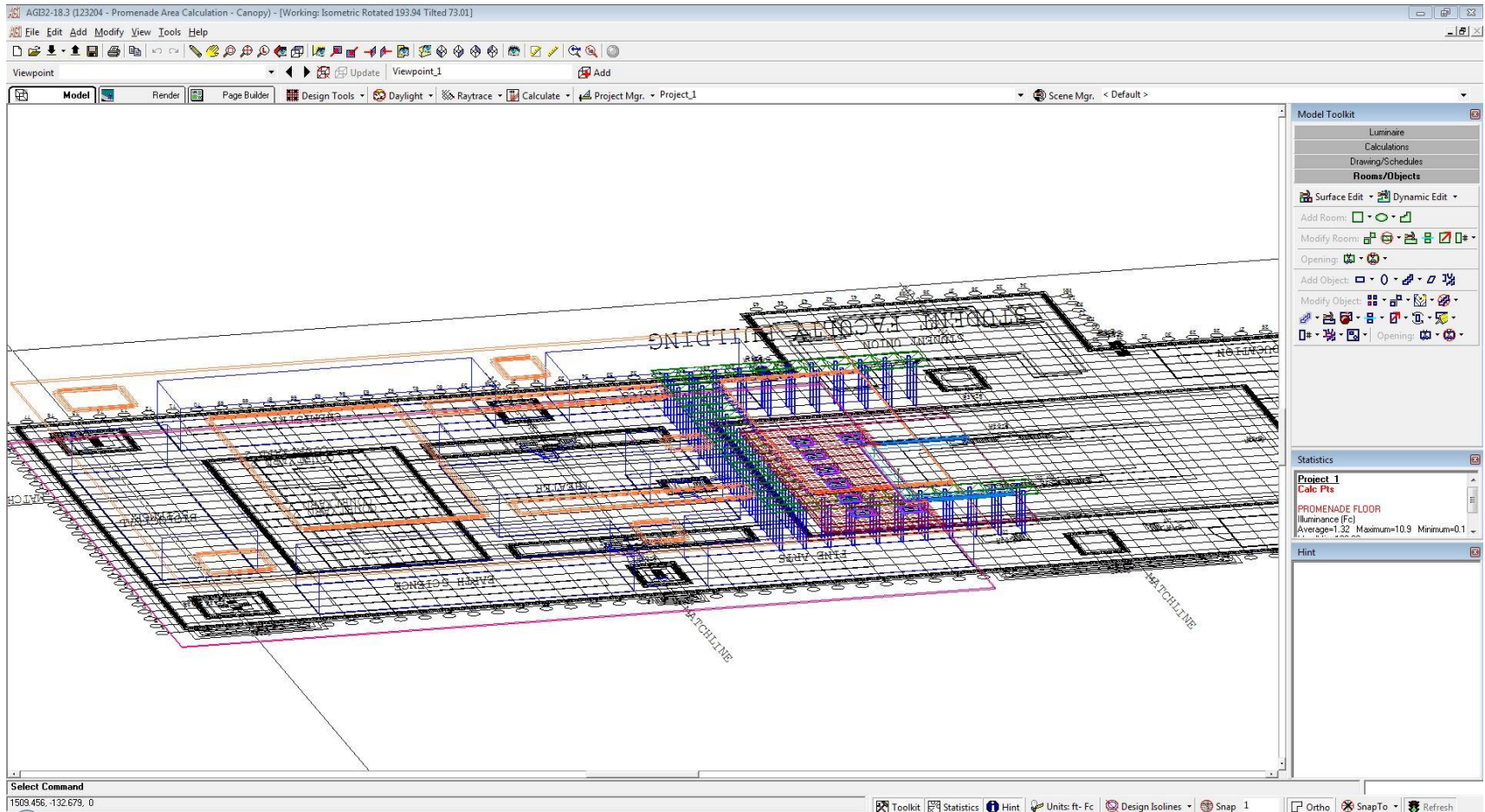
- Export existing REVIT model
 - Optimize for calculation
- Build in 3D software
- Build in lighting software



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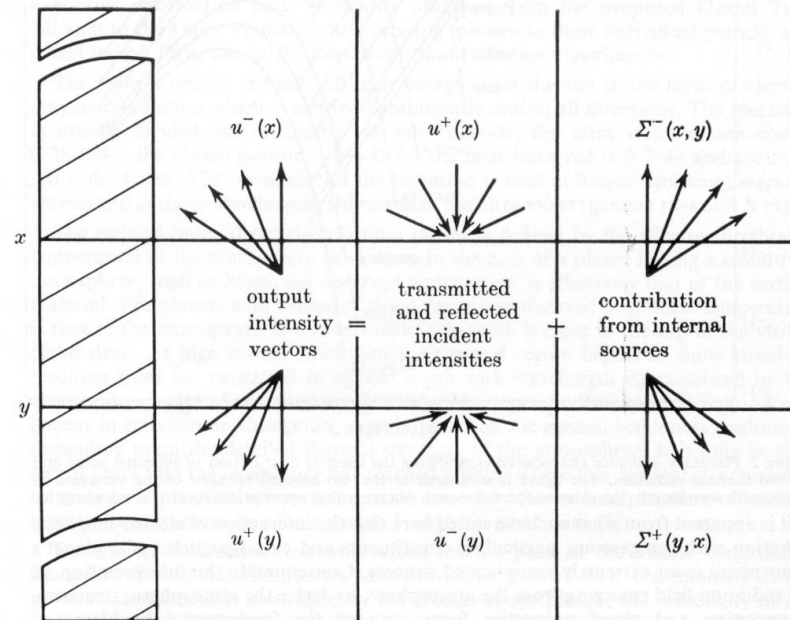
The In's & Out's of Rendering Using Lighting Software



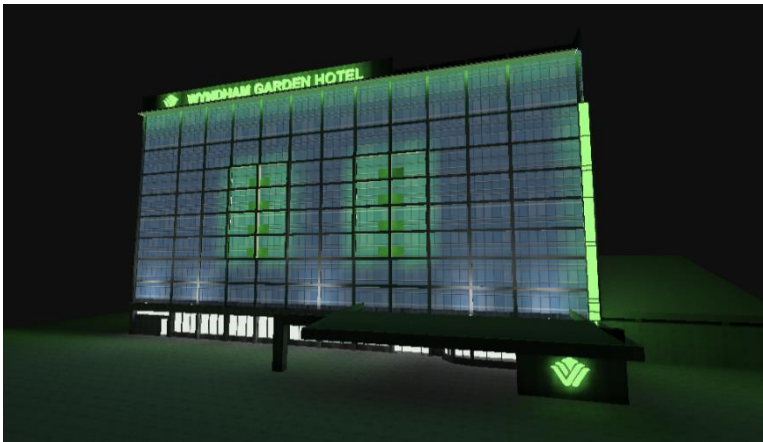
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- Types of Renderers

- Radiative transfer (also called radiosity)
- Ray Tracing
- Hybrids (Radiative transfer followed by a single-bounce ray tracing)

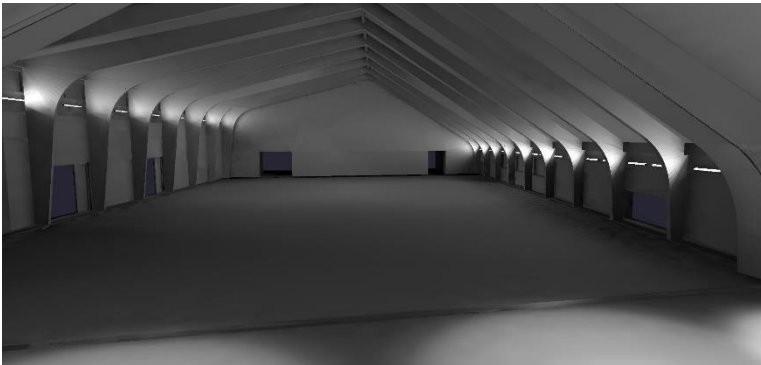
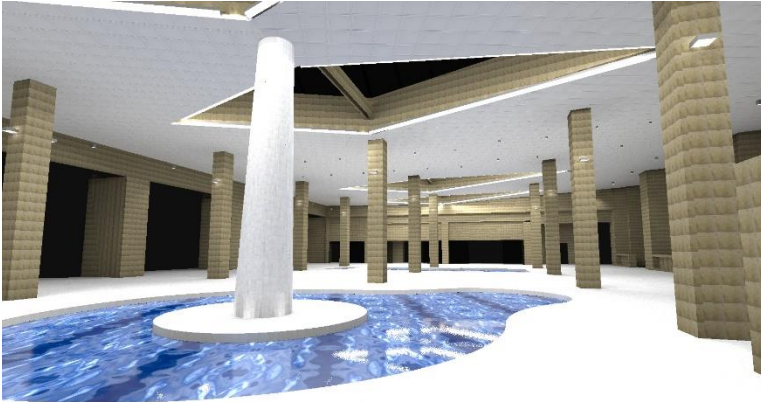


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- Radiative transfer
 - Surface existences determined and displayed
 - Possible dependence on discretization
 - View-position independent
 - Moderate execution times
 - Granular presentation

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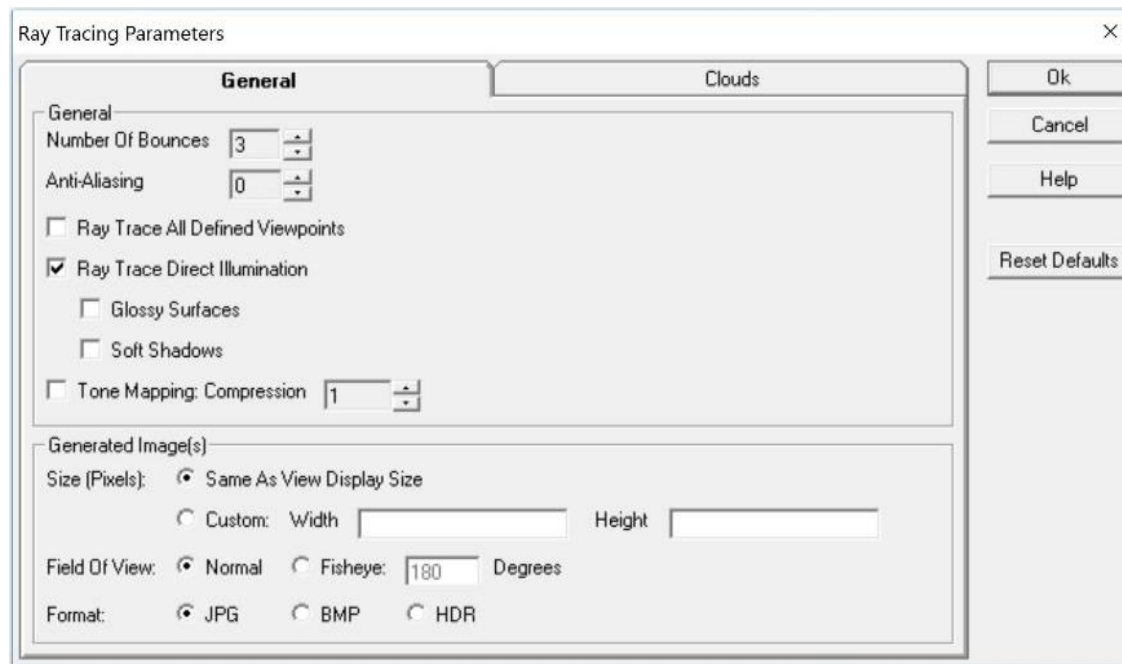
■ Ray Tracing

- Light sources emit rays that are traced through the system of surfaces, ending up at the viewing point
- Rays are traced (backward) from the viewing point to surfaces and light sources
- Reflections spawn “daughter rays” that are also traced
- Result is view-position dependent
- Long execution times

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▪ Ray Tracing

- Settings and output are crucial
- Overlapping surfaces can be come distorted



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■ Hybrid

- “basic” rendering produced with radiative transfer
- Rays traced from light sources to the view position, after reflecting off a non-diffuse surface
 - Glints
 - Mirror-effects

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EMPIRE RESORT CASINO
FACADE LIGHTING DESIGN



CASINO HORIZONTAL LED FAÇADE FEATURE

- MEDIA TUBE RGB APPROX. 815' TOTAL, (5) SEPARATE RUNS
- FULL RGB TIME CONTROL AT 1-PXL INCREMENTS

CASINO SLANTED CANOPY STRUCTURE ACCENT

- LINEAR SHIELD RGB APPROX. 280'
- FULL RGB TIME CONTROL AT 12" ARRAY LENGTH INCREMENTS

CASINO RECTANGULAR METAL WALL STRUCTURE WASH

- LINEAR SHIELD RGB APPROX. 85' TOTAL
- ALL (4) SIDES
- FULL RGB TIME CONTROL AT 6" ARRAY LENGTH INCREMENTS

M/E Reference 121012

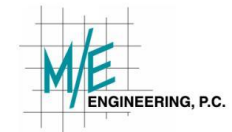
■ Purpose and Goals of Rendering

- Assess a lighting design
- Client presentation
- Marketing
- Compare color change design vs. white only
- Assess the way color light takes to materials
- Code official verification

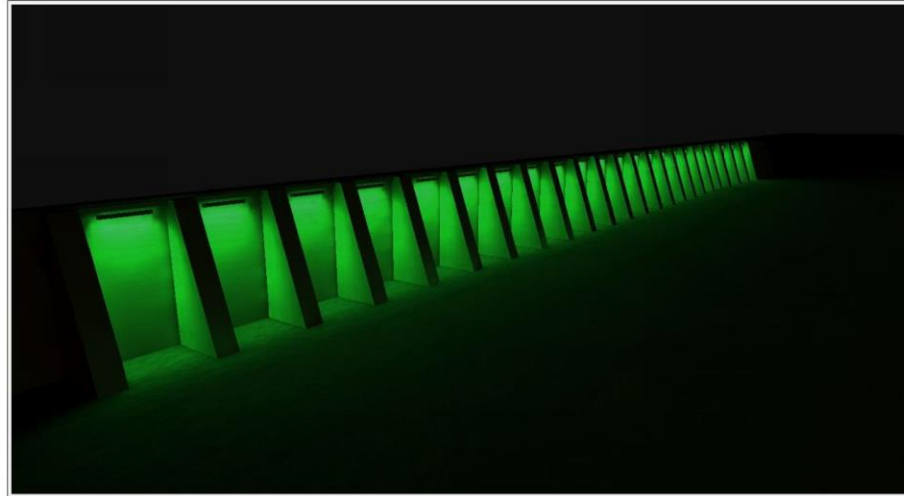
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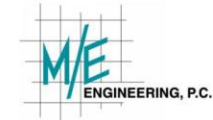
METROPLEX PARKING GARAGE
SCHENECTADY, NY



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METROPLEX PARKING GARAGE
SCHENECTADY, NY



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Schenectady City Hall Lighting

08/25/17



OPTION 1
FLOOD LIGHTING



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Erie Boulevard Bridge Lighting

05/23/2017



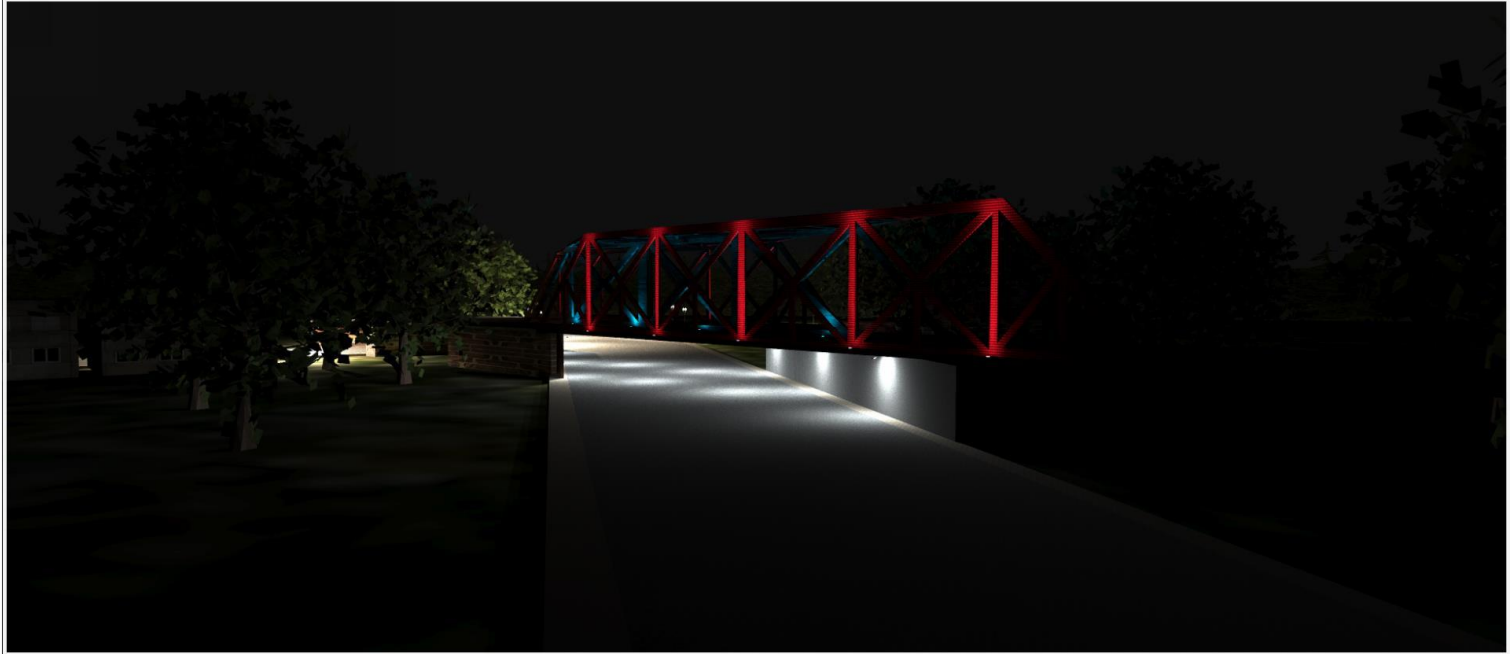
UPLIGHT COLOR WASH
INSIDE WASH & OUTSIDE ACCENTS



The In's & Out's of Rendering Using Lighting Software

Erie Boulevard Bridge Lighting

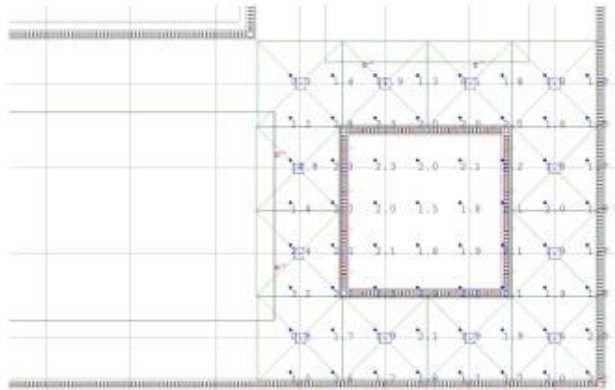
05/23/2017



UPLIGHT COLOR WASH
INSIDE WASH & OUTSIDE ACCENTS



The In's & Out's of Rendering Using Lighting Software



EXTERIOR - PLAN VIEW

DRAWING NOTES:

1. ALL FLOORING LEVELS ARE SHOWN AT GRADE LEVEL.
2. FLOORS ARE FILLED WITH GRID PATTERNS BY EACH INDIVIDUAL FIXTURE MANUFACTURER.




Revision	Description	By	Check	Date
1	Initial			

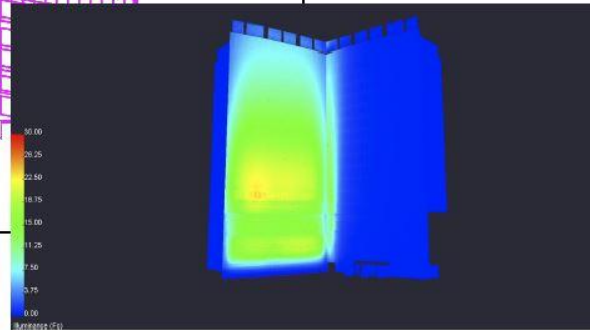
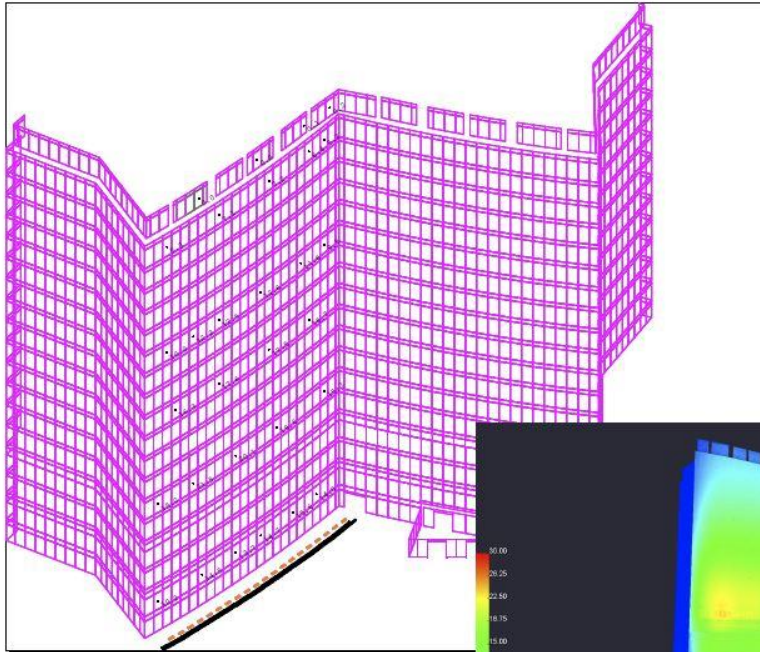
Category	Quantity	Unit	Value	Notes
Lighting	12	RO	12	

UNIVERSITY AT ALBANY
 IMPLEMENT LIGHTING MASTER PLAN
 DORM AREA STUDY - 12" RO FIXTURES

EC-01

07-07-16

The In's & Out's of Rendering Using Lighting Software



PART PLAN TITLE
SCALE: AS NOTED

Luminaire Schedule						
Symbol	Qty	Label	Arrangement	Total Lamp Lumens	LLF	Description
0	23	1W Beach Powercore 23	SINGLE	N.A.	1.000	1W BEACH POWERCORE, 60W, 50-Degree SPREAD
8	83	1W Beach Powercore 8	SINGLE	N.A.	1.000	1W BEACH COMPACT POWERCORE, 9-Degree SPREAD



LAND HOLDING 1 - FRONT FACADE LIGHTING
SCHEMATIC DESIGN
TEST 5

EC-01

10-22-13

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Chain Link Façade Material



Office Mock-up of Chain Link Material

5.1	7.4	5.6	7.7	5.6	7.8	7.5	7.5	7.3	7.3
7.3	7.4	7.9	7.9	7.8	7.7	7.4	7.7	7.7	7.8
7.5	7.9	7.1	7.1	7.6	7.8	7.8	7.9	7.9	7.3
7.4	7.1	7.3	7.3	7.3	7.0	7.6	7.1	7.1	7.9
7.9	7.3	7.4	7.4	7.4	7.0	7.3	7.3	7.3	7.7
7.1	7.4	7.8	7.8	7.7	7.3	7.4	7.8	7.4	7.4
7.3	7.4	7.0	7.0	7.9	7.3	7.5	7.7	7.4	7.9
7.5	7.0	7.2	7.2	7.1	7.4	7.4	7.4	7.7	7.4
7.3	7.4	7.0	7.0	7.4	7.3	7.4	7.3	7.4	7.3
7.5	7.9	7.9	7.9	7.8	7.4	7.0	7.0	7.1	7.0
7.8	7.0	7.2	7.1	7.0	7.8	7.4	7.2	7.1	7.1
7.8	7.0	7.2	7.2	7.1	7.7	7.3	7.1	7.9	7.0
7.9	7.2	7.3	7.3	7.3	7.8	7.3	7.1	7.0	7.0
7.9	7.3	7.3	7.3	7.4	7.9	7.3	7.1	7.0	7.0
7.2	7.5	7.7	7.7	7.6	7.0	7.3	7.1	7.0	7.0
7.4	7.7	7.9	7.9	7.7	7.3	7.3	7.1	7.0	7.0
7.5	7.9	7.1	7.1	7.9	7.3	7.3	7.1	7.0	7.0
7.7	7.1	7.3	7.3	7.1	7.4	7.3	7.1	7.0	7.0
7.9	7.3	7.4	7.4	7.3	7.8	7.2	7.0	7.0	7.0
7.9	7.4	7.4	7.4	7.3	7.8	7.3	7.0	7.0	7.0
7.5	7.8	7.8	7.8	7.7	7.1	7.1	7.0	7.0	7.0
7.5	7.4	7.4	7.4	7.4	7.4	7.0	7.0	7.0	7.0

FOOTCANDLE LEVEL DIAGRAM

RENDERING #3

RENDERING #2

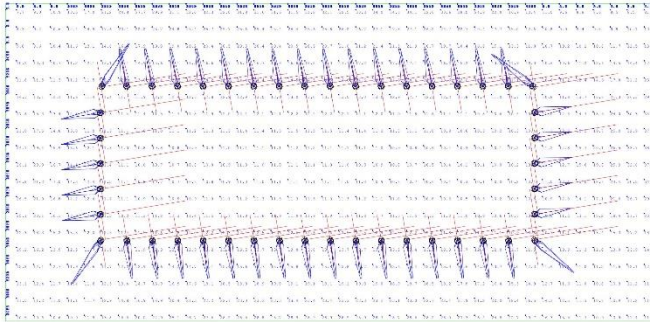
RENDERING #1

EMPIRE TOWER FEATURE WALL
FEATURE WALL STUDY

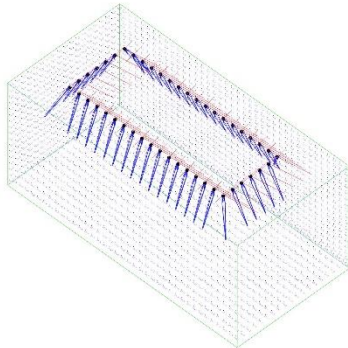
ER-01

11-16-12

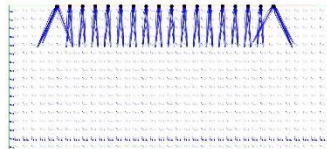
The In's & Out's of Rendering Using Lighting Software



TOP VIEW CALCULATION
Scale: 1 inch= 4 Ft.



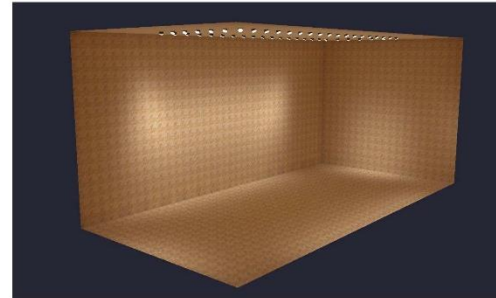
PERSPECTIVE VIEW CALCULATION
Scale: 1 inch= 8 Ft.



TYPICAL WALL VIEW CALCULATION
Scale: 1 inch= 8 Ft.

DRAWING NOTES:

1. ALL DIMENSIONS SHOWN ARE SHOWN ON SURFACE AND VERT. PLANS.
2. PERSPECTIVE FILES HAVE BEEN PROVIDED BY EACH MANUFACTURER'S MANUFACTURER.



UNIVERSITY OF ROCHESTER
FOUNTAIN HALL LIGHTING PHOTOMETRIC CALCULATION - PRELIMINARY

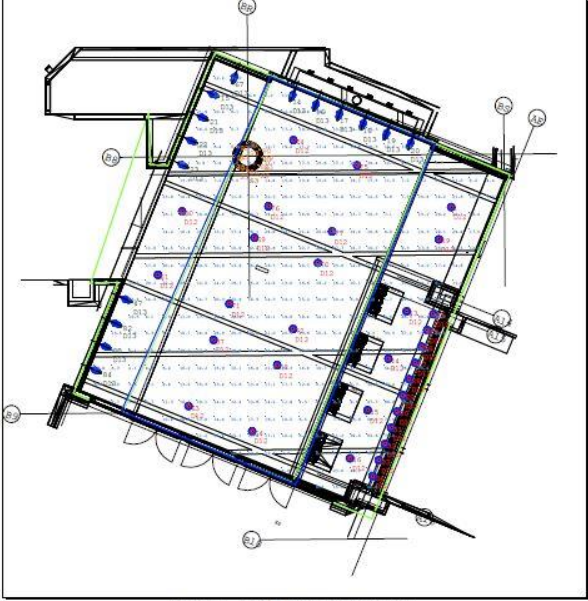
Fixture Schedule System	Label	Manufacturer	Total Lamp Hours	TFP	Manufacturer	lum. watts
00	480-110-138-R-000	480-110-138-R-000	240000	2.351	480-110-138-R-000	22.71

Calculation Summary							
Label	Category	Hours	Wp	Wp	Wp	Wp/Wp	
Fountain Hall_001_3	illumination	80	23.25	18.73	2.2	2.20	27.14
Fountain Hall_001_1	illumination	80	13.00	11.13	5.11	2.49	4.14
Fountain Hall_001_2	illumination	80	13.00	11.13	2.2	5.18	12.14
Fountain Hall_001_3	illumination	80	0.00	0.0	0.0	0.0	0.0
Fountain Hall_001_4	illumination	80	12.74	10.73	5.2	1.80	3.25

EC-01

06-07-16

The In's & Out's of Rendering Using Lighting Software

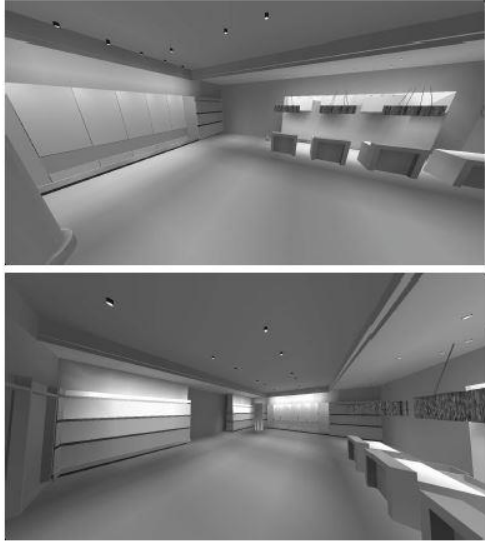



PARTIAL FLOOR PLAN HOTEL LOBBY:
SCALE: 1/4" = 1'-0"

NO.	SYMBOL	DESCRIPTION	MANUFACTURER	MODEL	WATTAGE	HEIGHT	BEAM ANGLE	SPACING
1		RECESSED LIGHTING	OSRAM	OSRAM	100	5'	30°	4'
2		TRACK LIGHTING	OSRAM	OSRAM	100	5'	30°	4'

DRAWING NOTES:

1. ALL FOOT CANDLE LEVELS ARE SHOWN AT GRADE LEVEL.
2. PHOTOMETRIC FILES HAVE BEEN PROVIDED BY EACH RESPECTIVE FIXTURE MANUFACTURER.



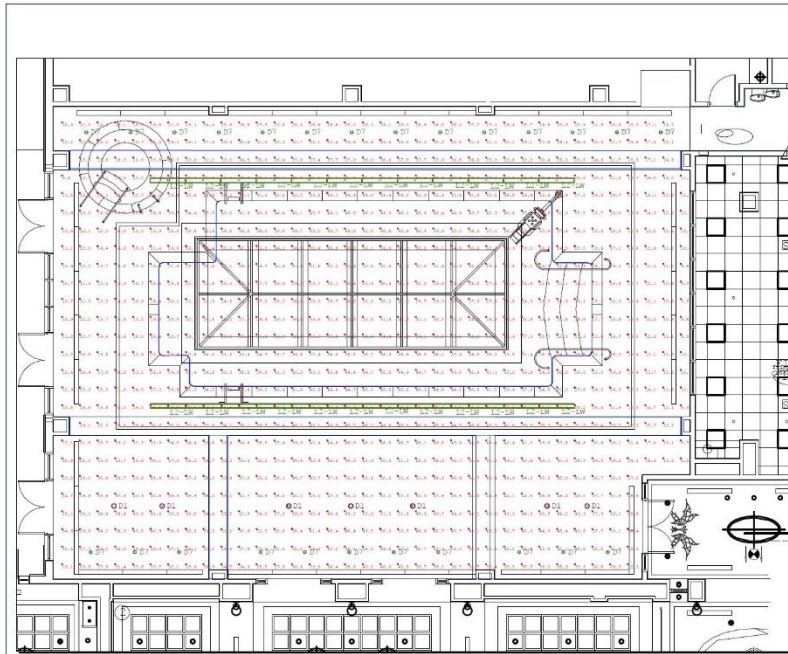


SULLIVAN COUNTY CASINO - HOTEL LOBBY
PHOTOMETRIC CALCULATION - PRELIMINARY DESIGN

EC-01

07-15-13

The In's & Out's of Rendering Using Lighting Software



PART PLAN TITLE

SCALE: AS NOTED

Luminaire Schedule				
Symbol	Qty	Label	Total Lamp Lumens	LLF
○	27	D7	N.A.	1.000
○	7	D1	N.A.	1.000
—	24	22'-LW	N.A.	1.000

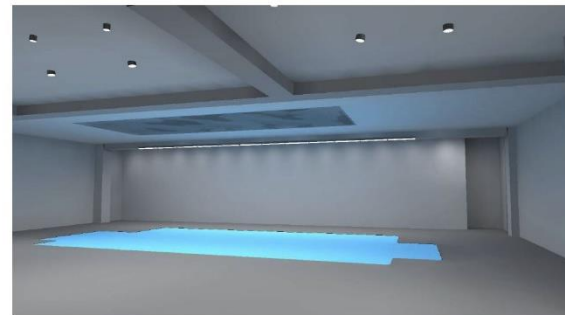
Calculation Summary						
Label	Units	Avg	Max	Min	Avg/Min	Max/Min
Pool Area 1	Fc	31.10	52.6	6.5	4.78	8.05

DRAWING NOTES:

1. ALL FOOT CANDLE LEVELS ARE SHOWN AT POOL DECK LEVEL.
2. DIMENSIONED FIXES HAVE BEEN PROVIDED BY EACH RESPECTIVE FIXTURE MANUFACTURER.
3. RENDERING SHOWN IS FOR ILLUSTRATION PURPOSES ONLY AND DOES NOT INCLUDE EXACT FINISHES.



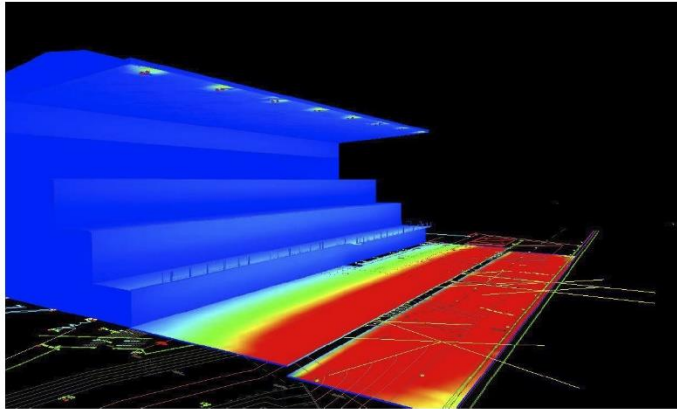
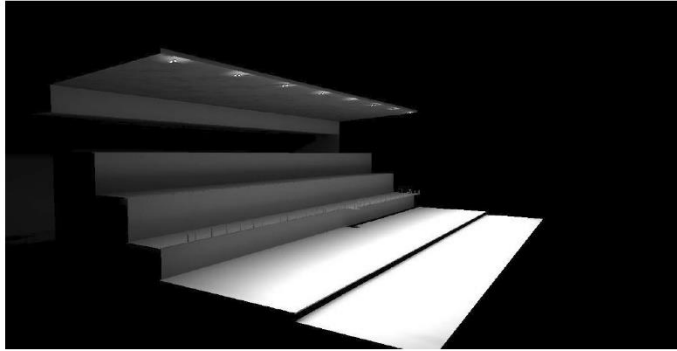
SARATOGA HOTEL ADDITION - POOL LIGHTING
 PHOTOMETRIC CALCULATION - CODE REVIEW



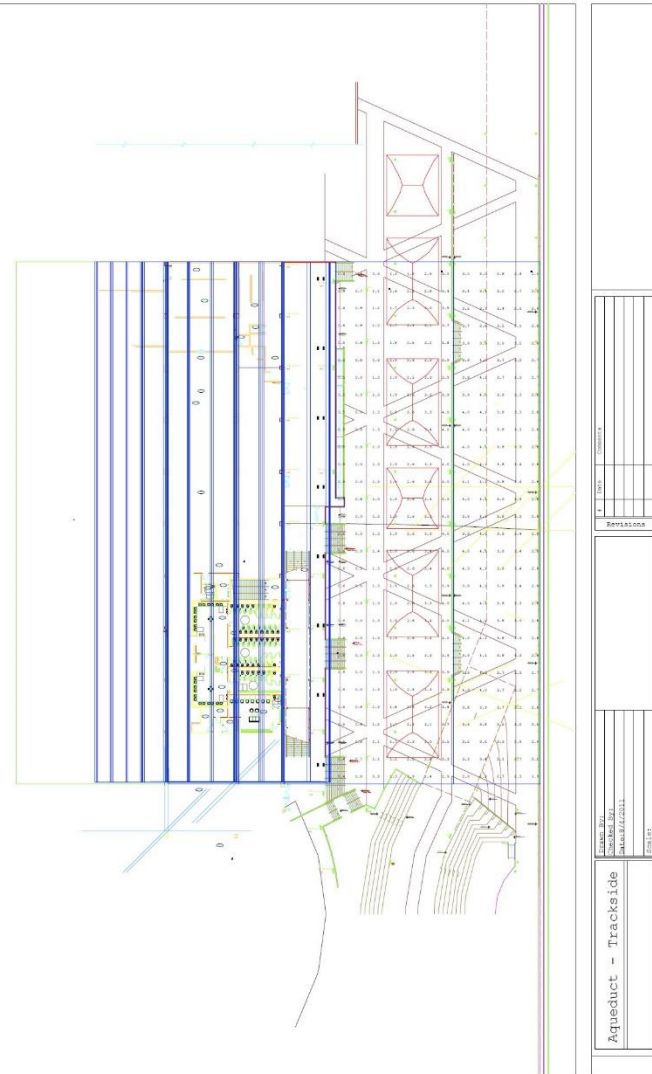
EC-01

10-26-15

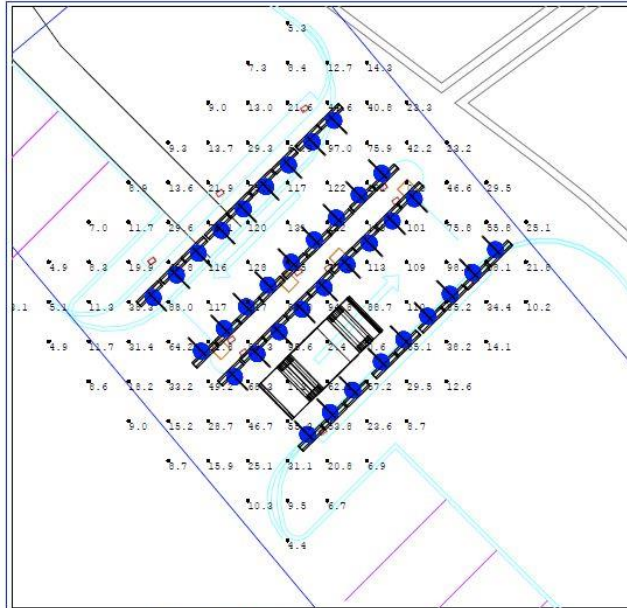
The In's & Out's of Rendering Using Lighting Software



Calculation Summary							
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
Grade Level - Top	Illuminance	Ft	3.42	4.12	1.9	1.80	2.11



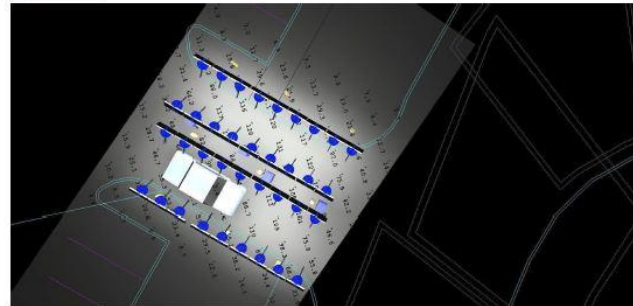
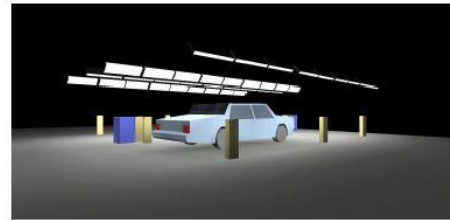
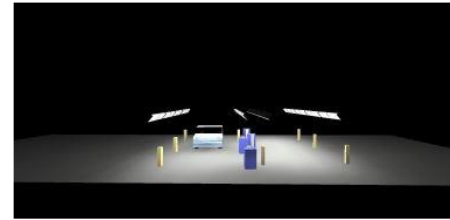
The In's & Out's of Rendering Using Lighting Software



HD CAMERA LIGHTING
SCALE: 1/4" = 1'-0"

DRAWING NOTES:

1. ALL FOOT ELEVATION LEVELS ARE FROM AT GRADE LEVEL.
2. PHOTO-METRIC FILES HAVE BEEN PROVIDED BY EACH RESPECTIVE FIXTURE MANUFACTURER.



EMPIRE RESORT
HD CAMERA SYSTEM
EXTERIOR PHOTOMETRIC CALCULATION

EC-08

02-08-13

The In's & Out's of Rendering Using Lighting Software

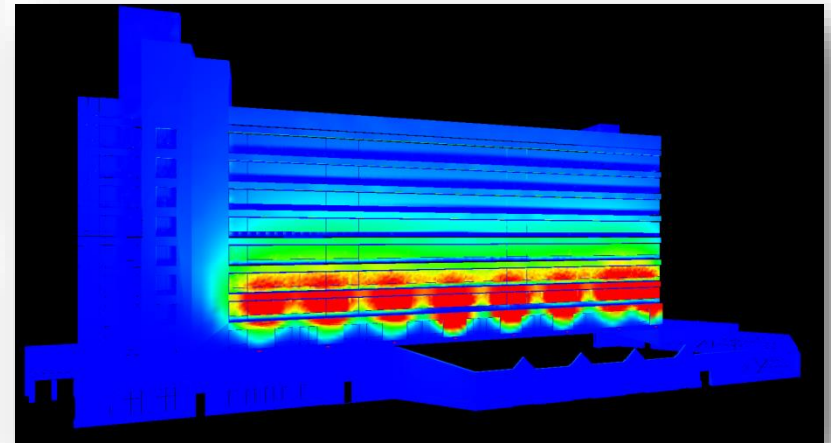
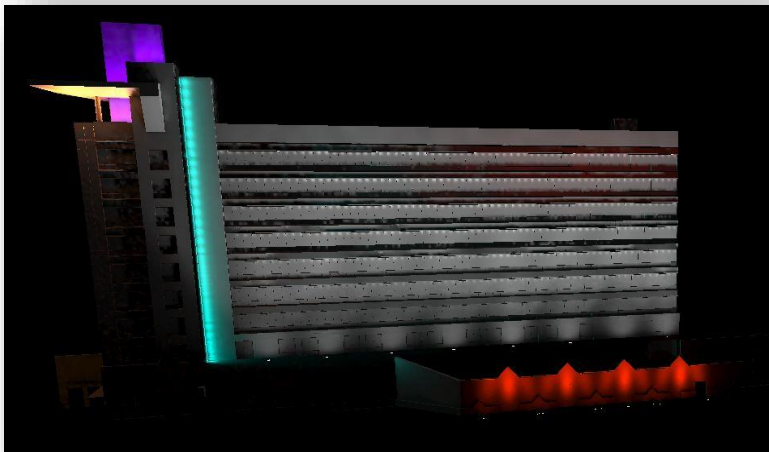
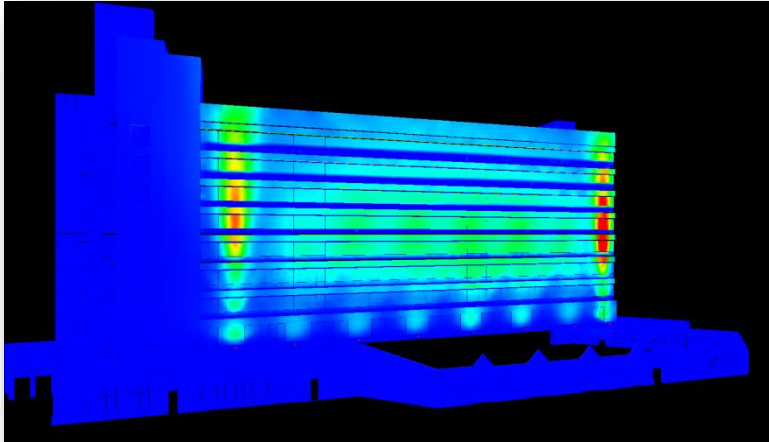


Existing Facility Image

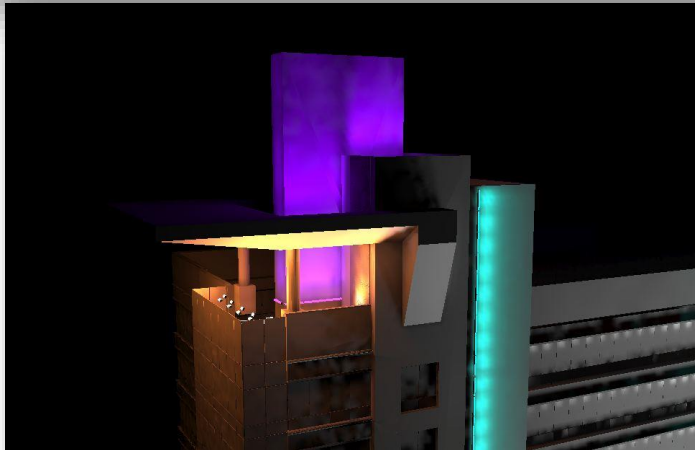


Existing Facility Rendering

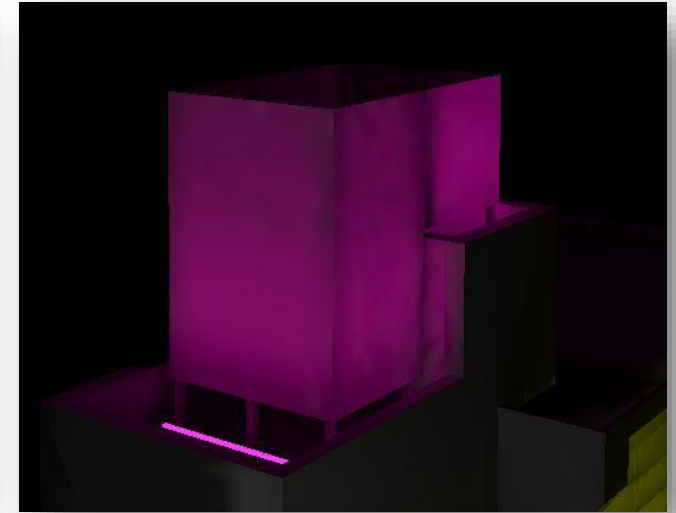
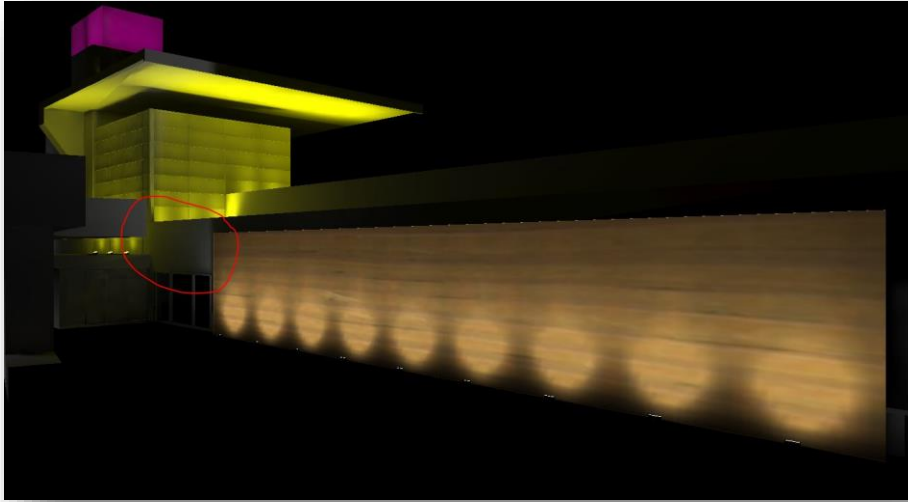
The In's & Out's of Rendering Using Lighting Software



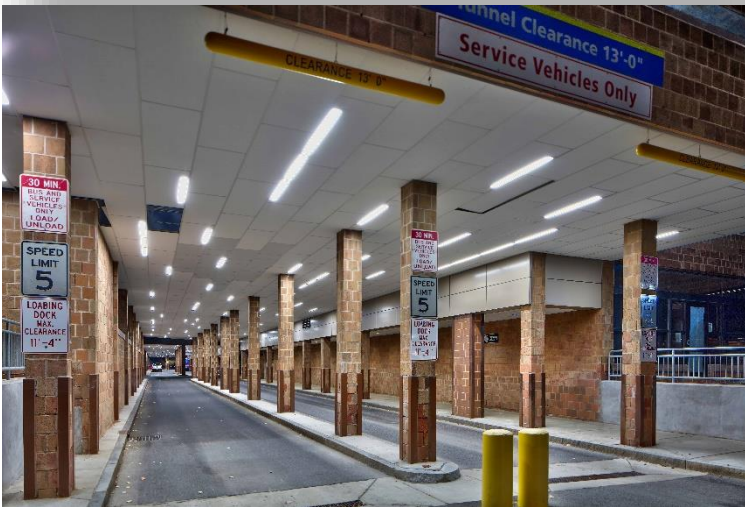
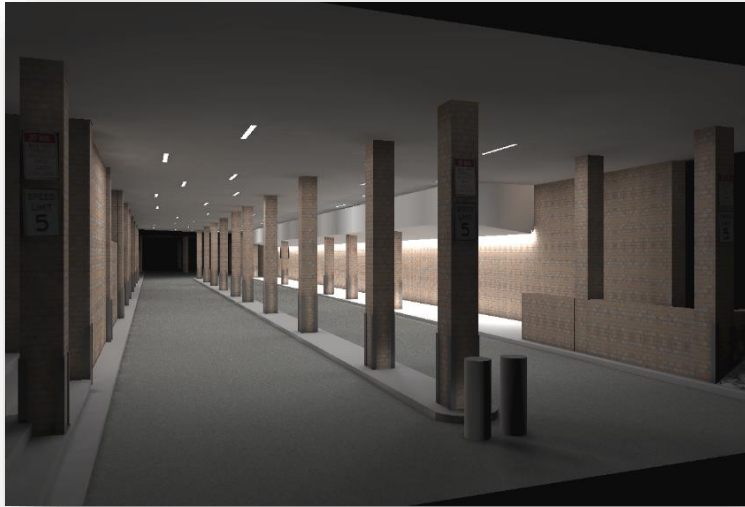
The In's & Out's of Rendering Using Lighting Software



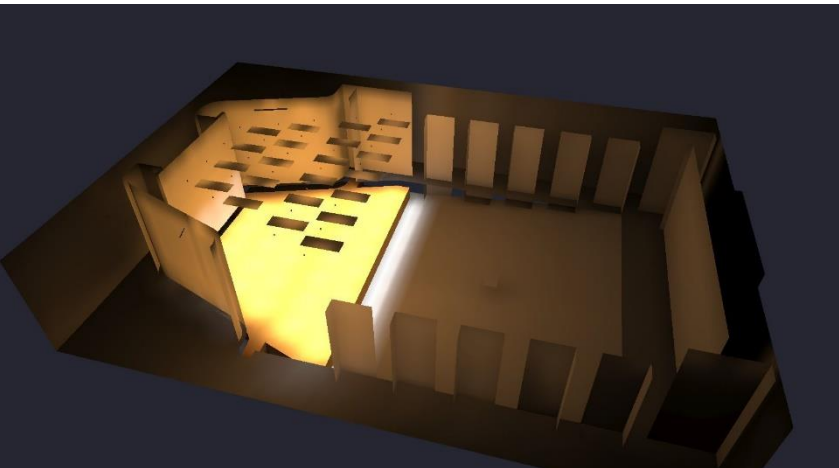
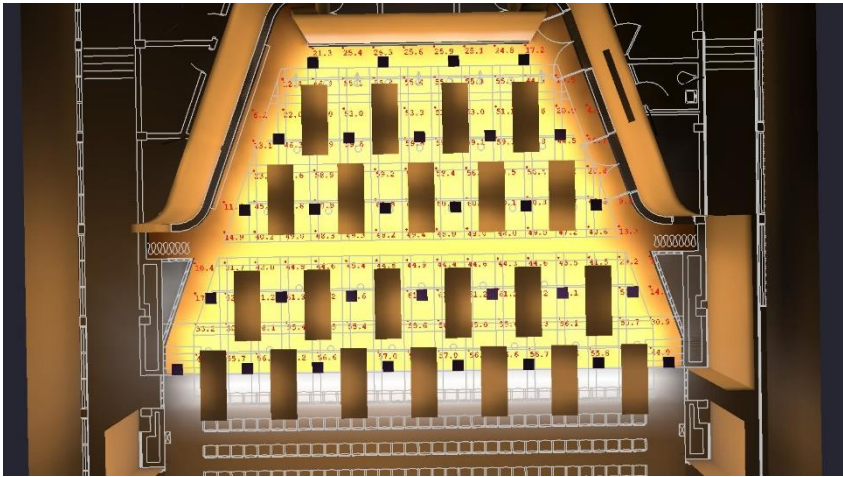
The In's & Out's of Rendering Using Lighting Software



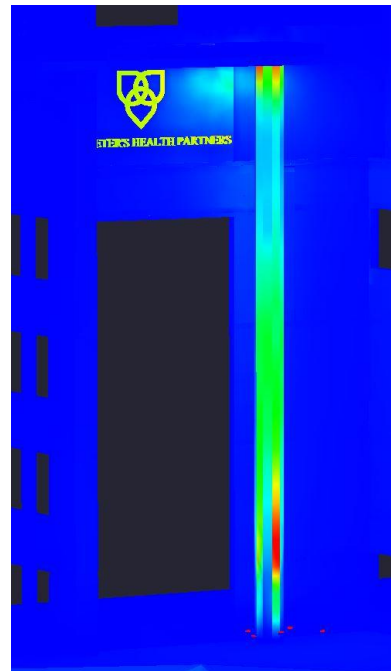
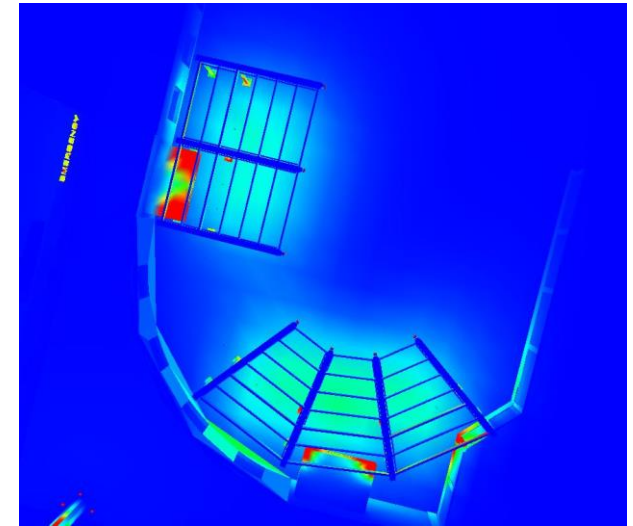
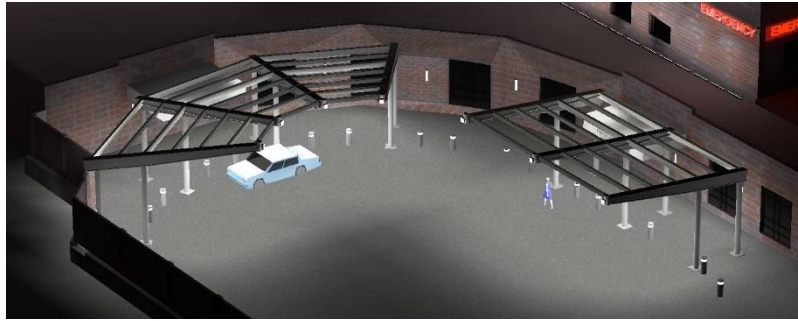
The In's & Out's of Rendering Using Lighting Software



The In's & Out's of Rendering Using Lighting Software



The In's & Out's of Rendering Using Lighting Software



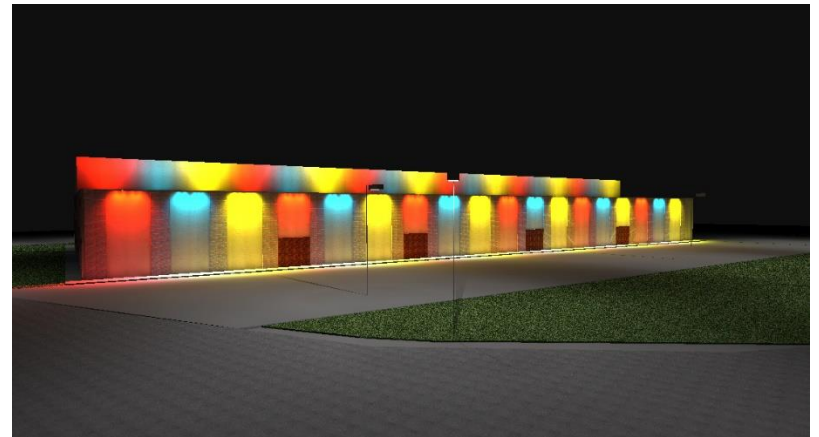
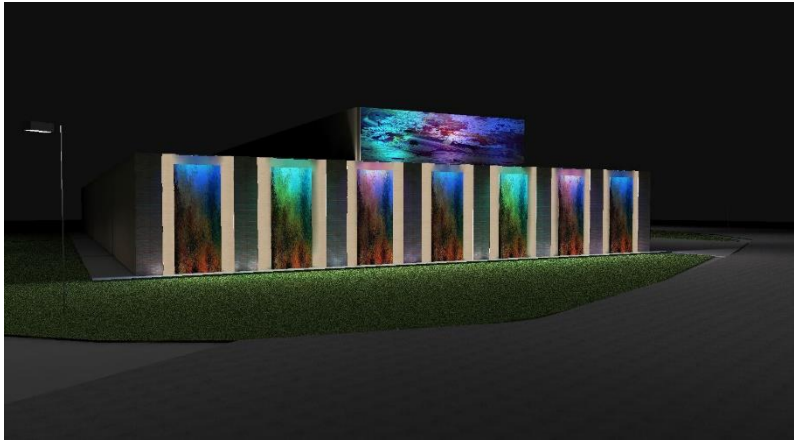
The In's & Out's of Rendering Using Lighting Software



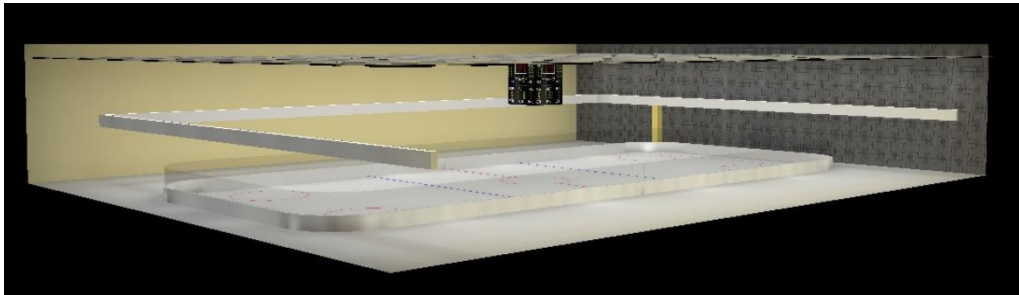
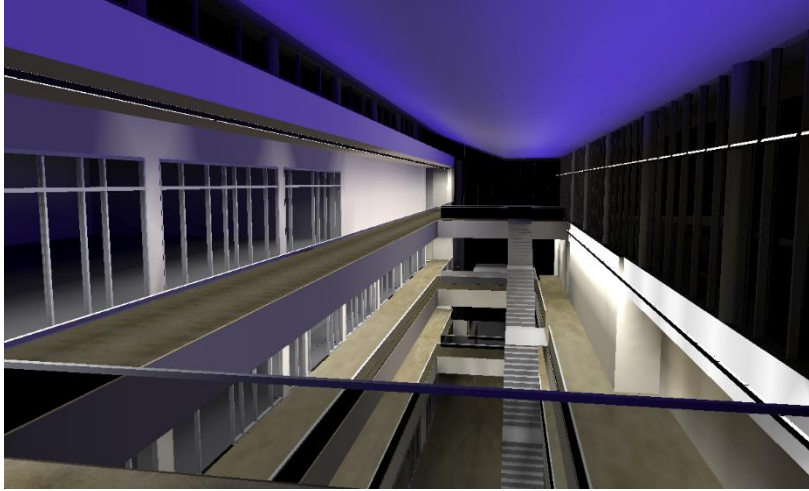
The In's & Out's of Rendering Using Lighting Software



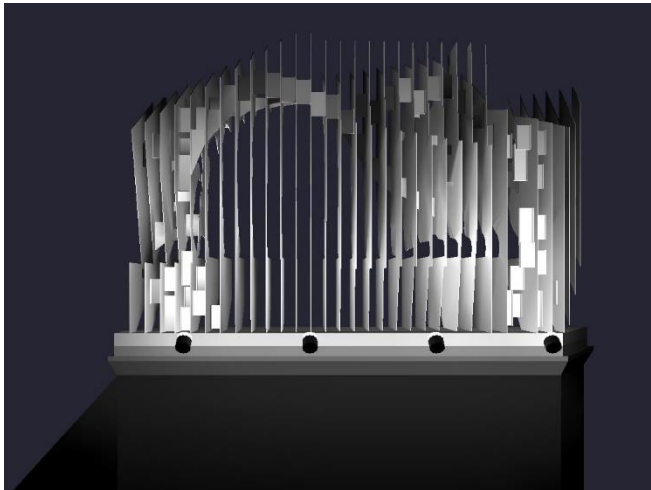
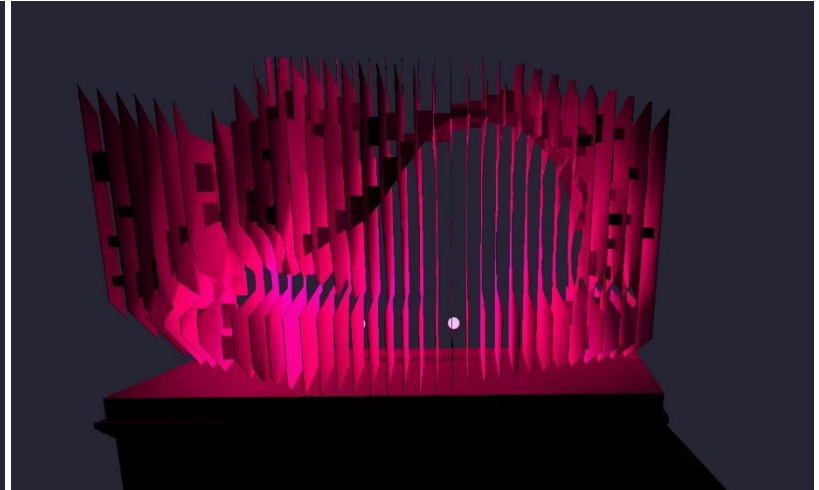
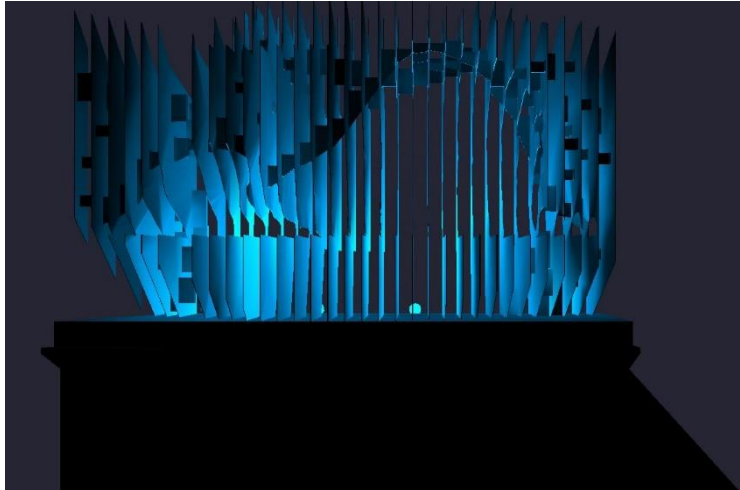
The In's & Out's of Rendering Using Lighting Software



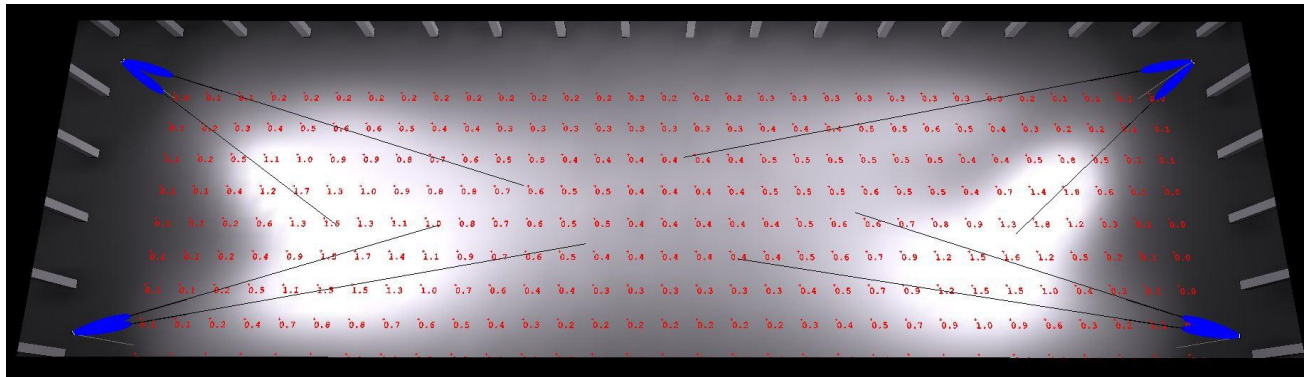
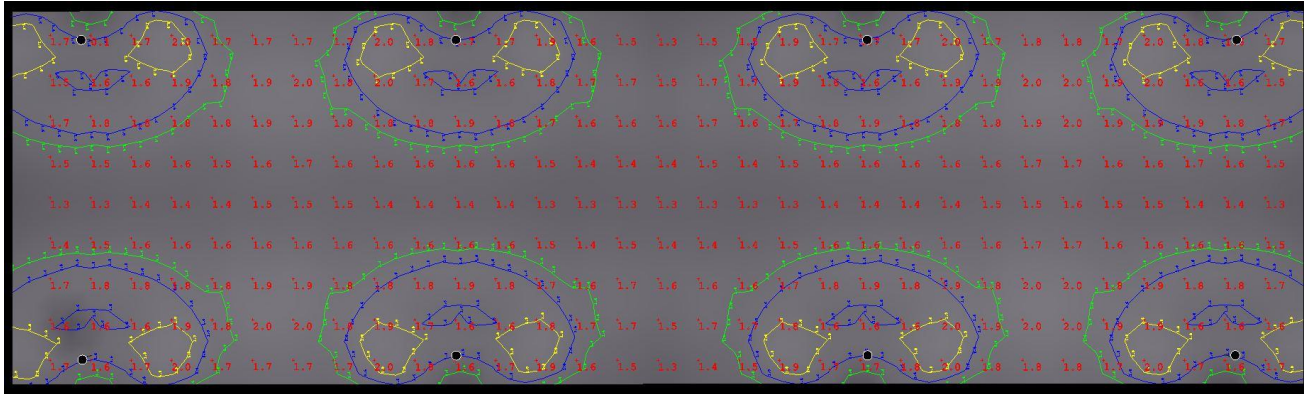
The In's & Out's of Rendering Using Lighting Software



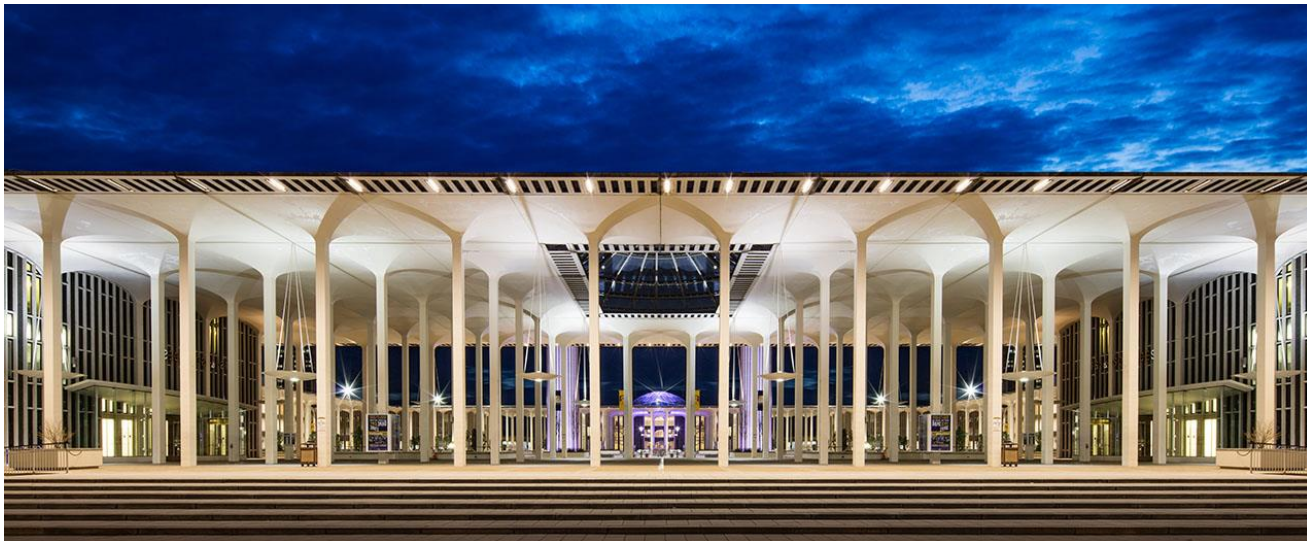
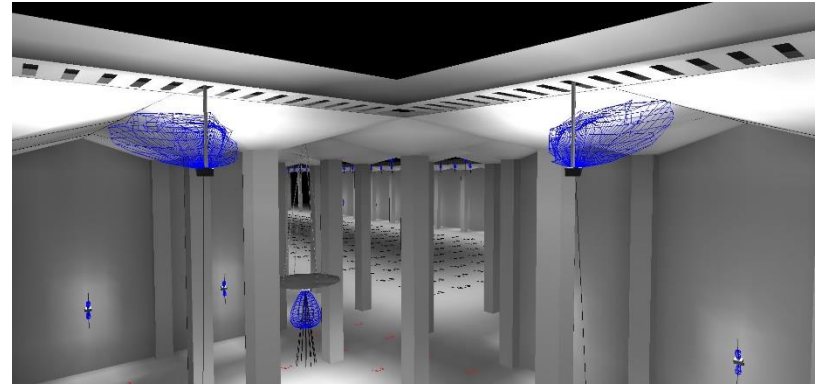
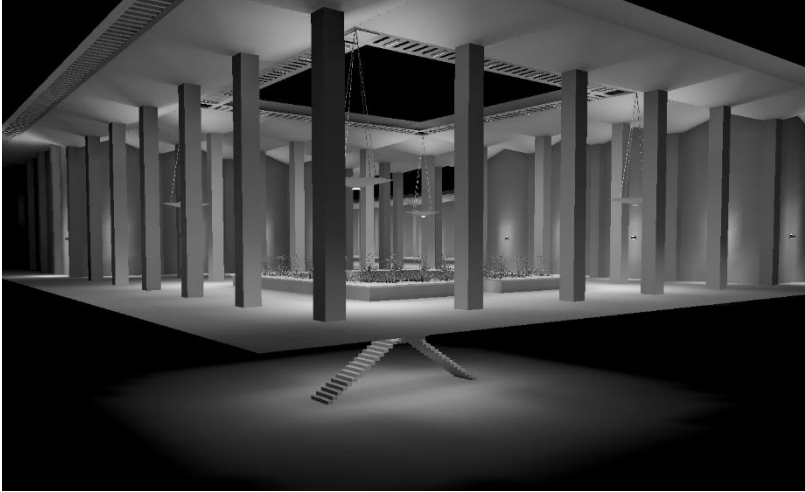
The In's & Out's of Rendering Using Lighting Software



The In's & Out's of Rendering Using Lighting Software



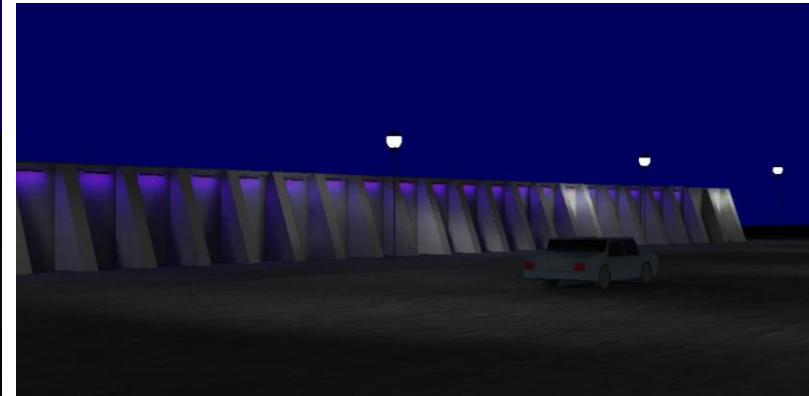
The In's & Out's of Rendering Using Lighting Software



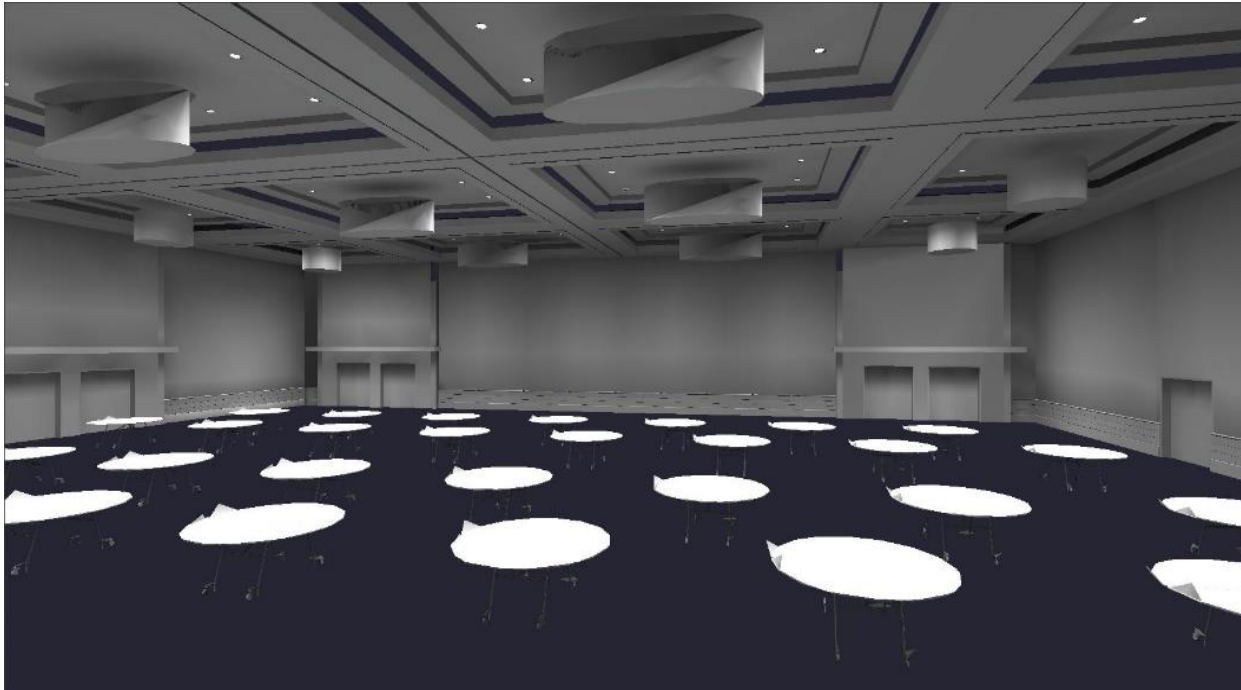
The In's & Out's of Rendering Using Lighting Software



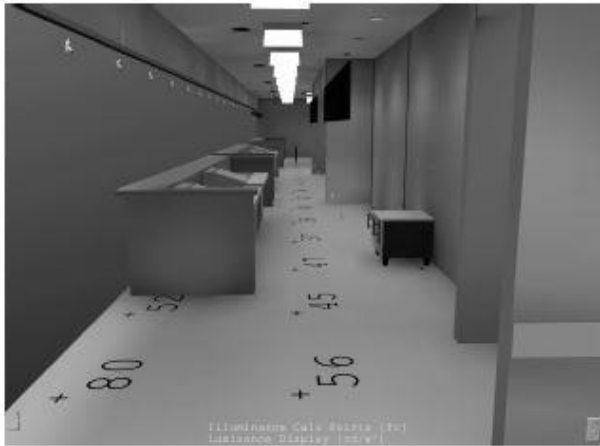
The In's & Out's of Rendering Using Lighting Software



The In's & Out's of Rendering Using Lighting Software



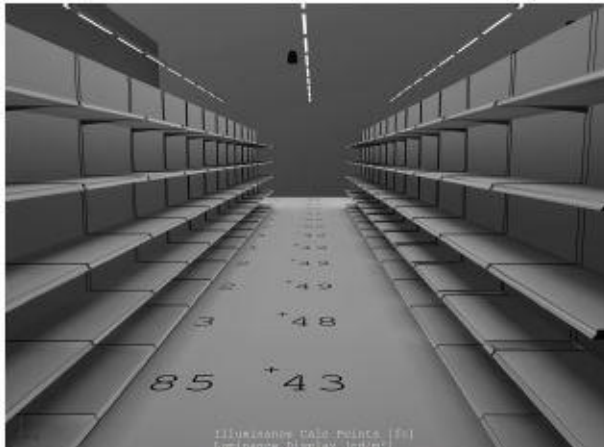
The In's & Out's of Rendering Using Lighting Software



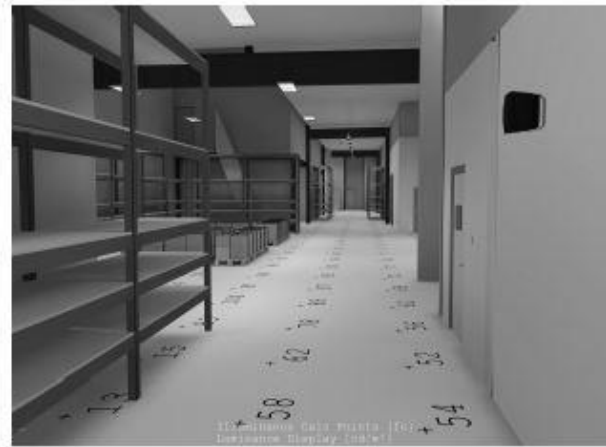
COFFEE & TO GO - CALCULATION RENDERING



BAR AREA - CALCULATION RENDERING



SHOPPING AREA - CALCULATION RENDERING



SHOPPING WAREHOUSE - CALCULATION RENDERING

The In's & Out's of Rendering Using Lighting Software

- **Rendering in Conclusion**
 - Efficient use of software
 - Understanding the goal of the rendering
 - Understanding who you are presenting to and to what format
 - Tool for design, used in conjunction with real world product study
 - Aiming diagrams and complete team process
 - Code compliance or design check

