Value-Driven Solutions

ENGINEERING

Lighting Dynamic

A Division of M/E Engineering, P.C.

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

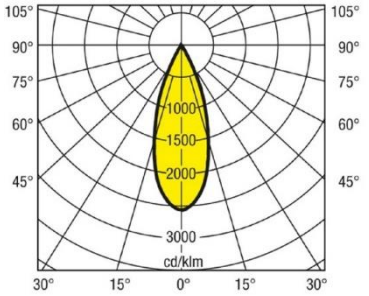
Robert J. Radley LC, LEED AP BD+C

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
  - Ganiophotmeter
  - Manufacturer published IES files



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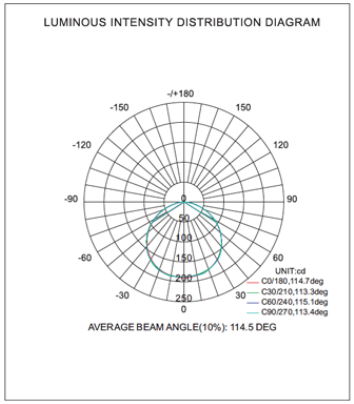
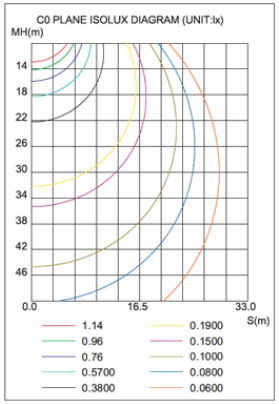
NAME: LD008AL14540	TYPE: Panel Light	WEIGHT: 0.23Kg
DIM.: ø145mm	INPUT POWER(W).: 8	SUR.: 270
	CCT(K).: 4000K±250	PROTECTION ANGLE:

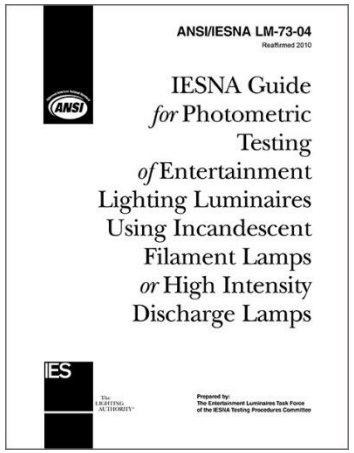
DATA OF LAMP		PHOTOMETRIC DATA Eff: 67.09lm/W			
MODEL	SMD 2835	Imax(cd)	188.93	S/MH(C0/180)	1.27
NOMINAL POWER(W)	8.16	LOR(%)	100.0	S/MH(C90/270)	1.29
RATED VOLTAGE(V)	240	TOTAL FLUX(lm)	547.5	ηUP,DN(C0-180)	1.0,49.9
NOMINAL FLUX(lm)	547.5	CIE CLASS	DIRECT	ηUP,DN(C180-360)	1.0,50.1
LAMPS INSIDE	1	ηup(%)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

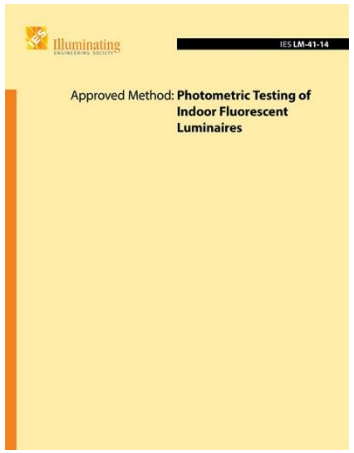


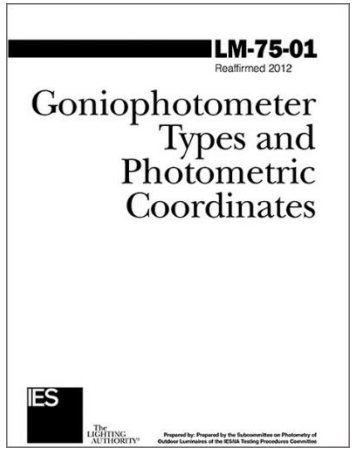


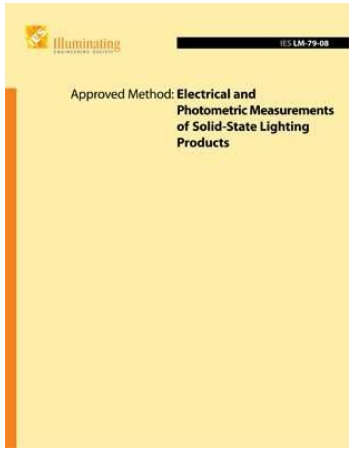
C Range: 0 - 360DEG
C Interval: 5.0DEG
Test Speed: HIGH
Temperature:25.3DEG
Operators: had peng fei
Test Date:2013-08-12

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:









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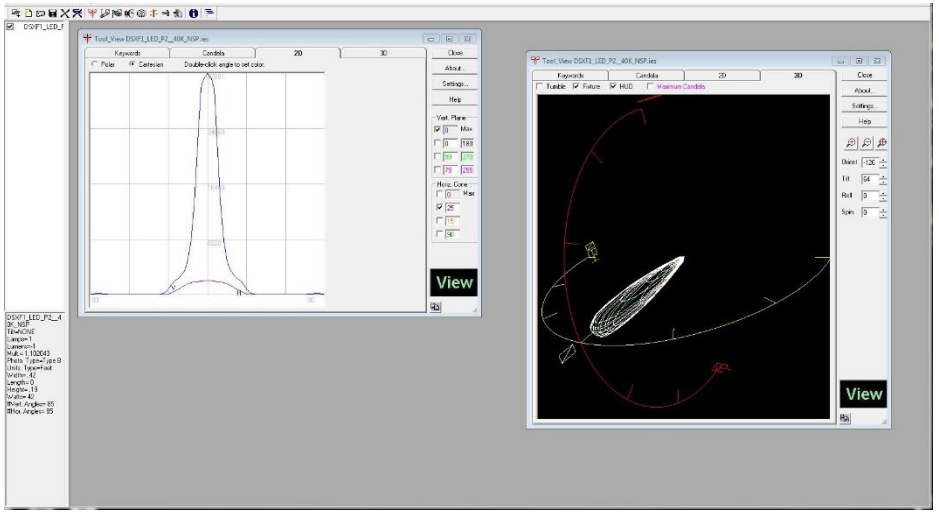
- **Role of Science data in Lighting Design**
  - Experiments for relationship between more-or-less (simply defined) luminous input
  - Utility of the data about lighting sources acquired on that basis
  - Visual performance testing
    - Measurement of speed and accuracy



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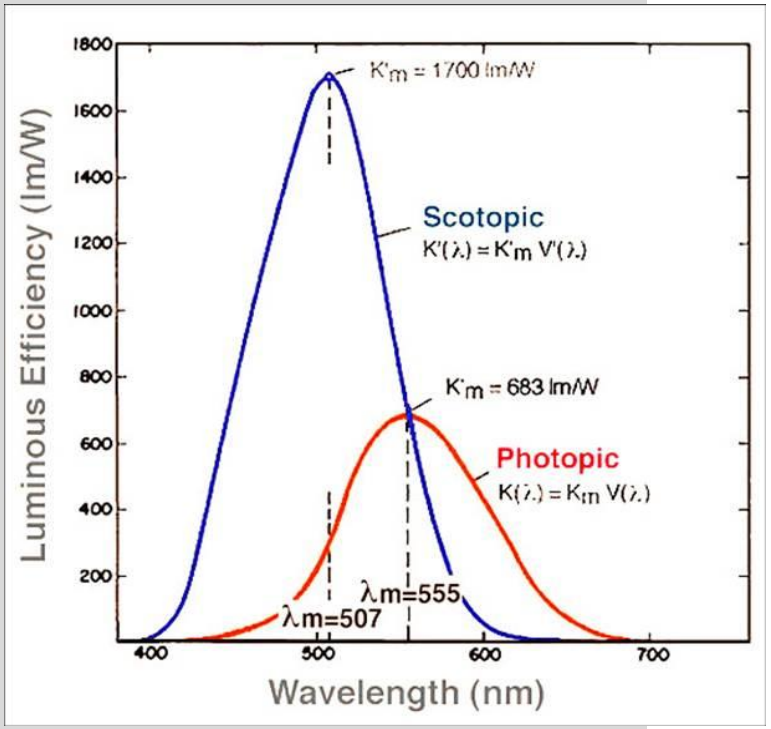
The In's & Out's of Rendering Using Lighting Software

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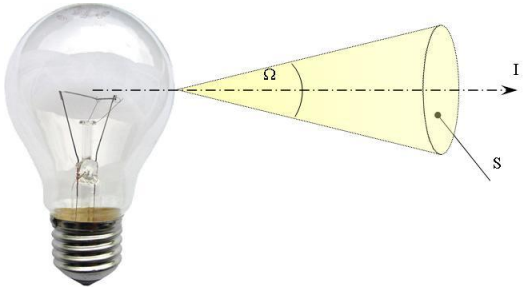
The In's & Out's of Rendering Using Lighting Software

- **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



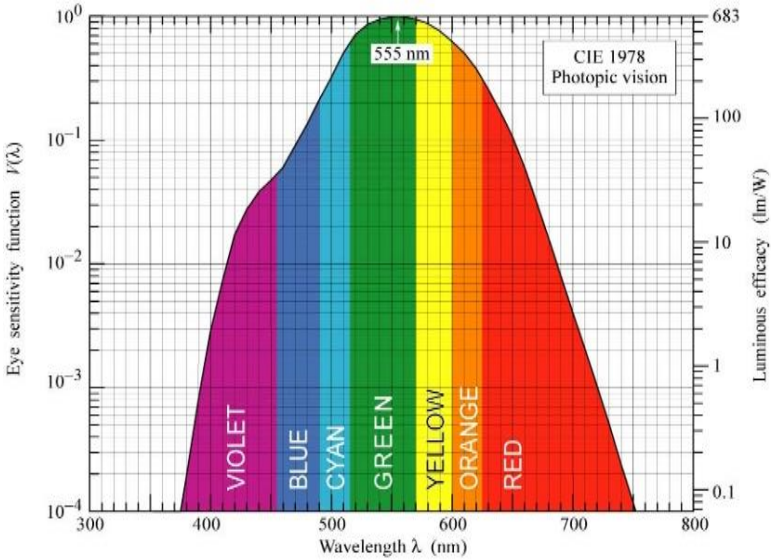


Fig. 16.7. Eye sensitivity function, $V(\lambda)$, (left ordinate) and luminous efficacy, measured in lumens per Watt of optical power (right ordinate). $V(\lambda)$ is greatest at 555 nm. Also given is a polynomial approximation for $V(\lambda)$ (after 1978 CIE data).

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

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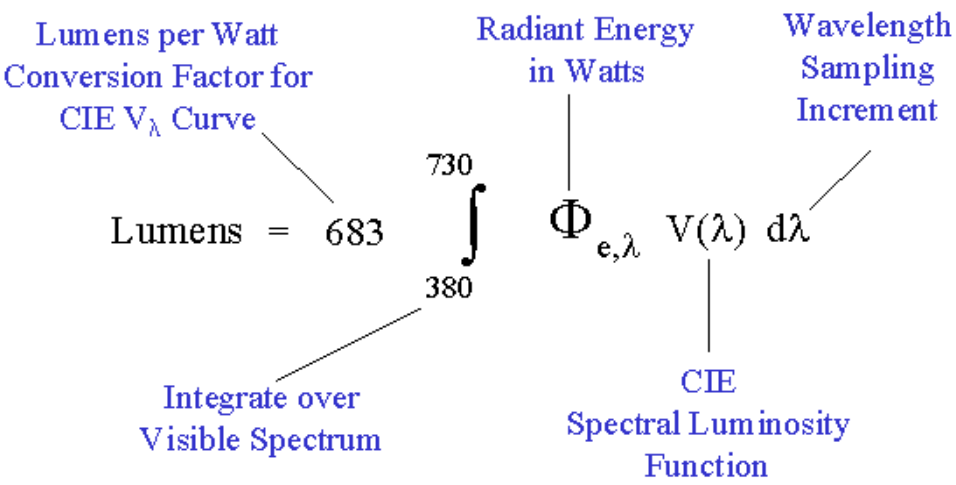
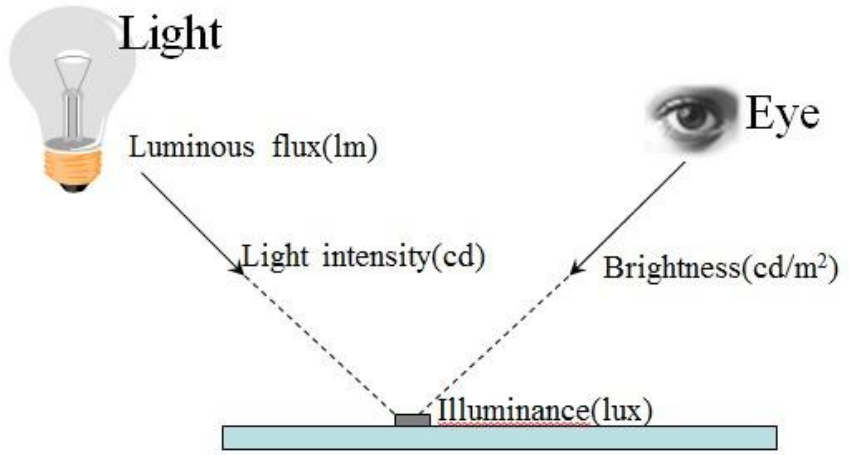
- **Luminous Flux**
  - Defined as " Visually evaluated" radiant power
  - Strength of all photo metrics depends on how "Visually evaluated" is defined
  - Radiant powers ability to provoke the perception of brightness
  - Development of luminous power
  - Luminous strength of one wavelength compared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





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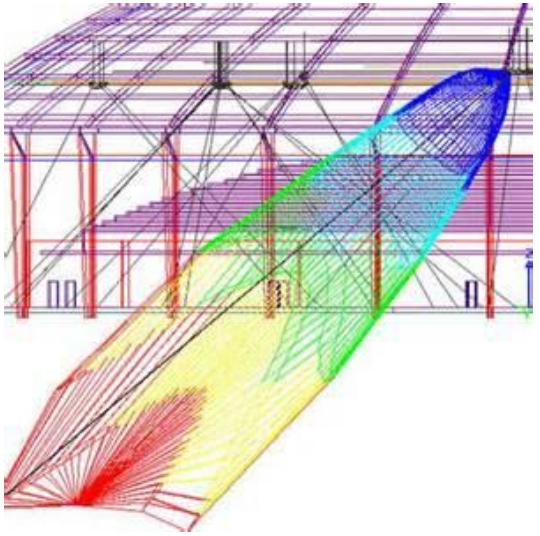
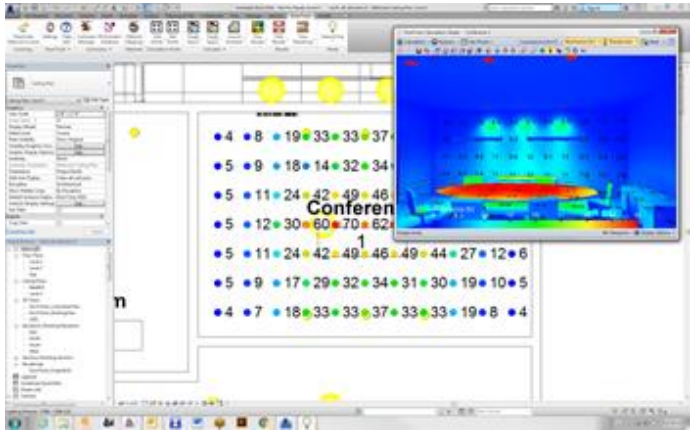
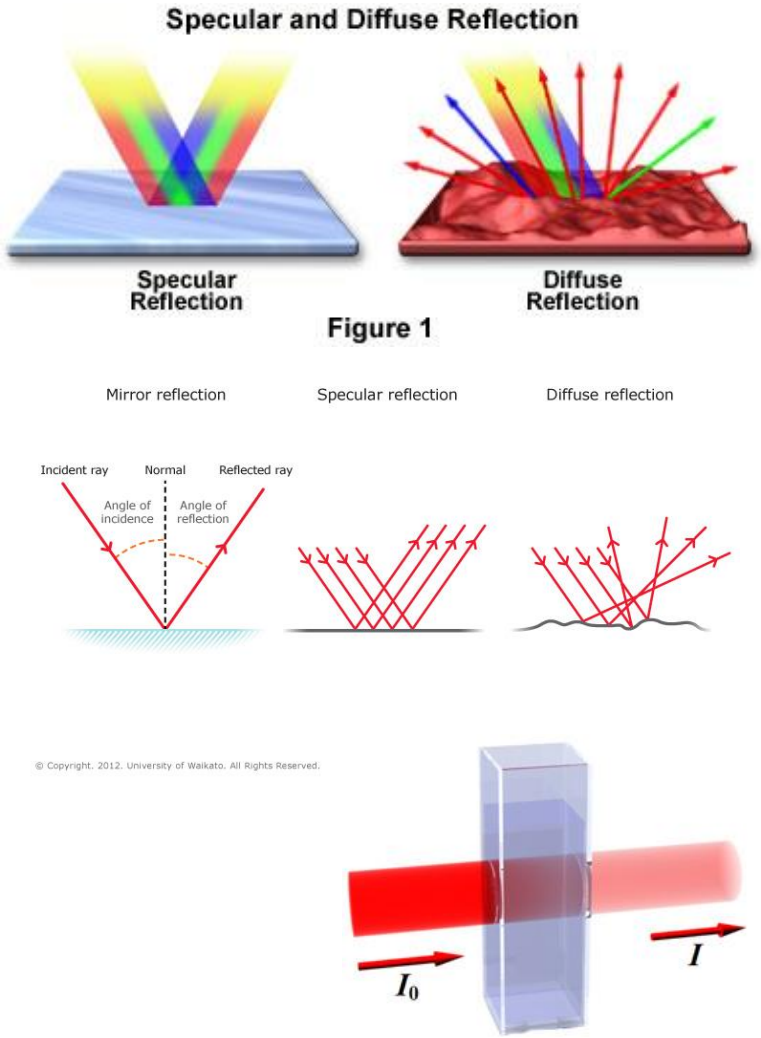
- **Luminous Flux**
  - "Ray of Light" very small cone
  - Represented by a single arrow then collected into bundles
  - Bundles then form densities
    - Surface (lumens/area)
    - Spatial
    - Light forms density





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



- **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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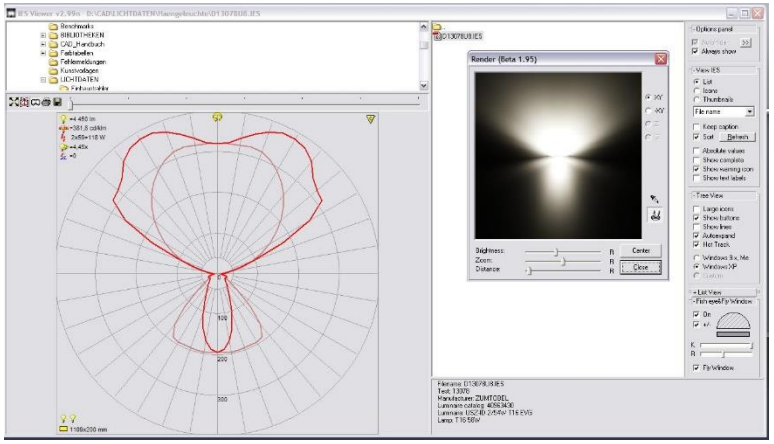
- **Photometric Data Files and Their Format**
  - IES LM-63
    - IESNA Standard 1986
    - LM-63-1986
  - CIBSE TM-14
    - British TM-14
  - CIE 102-1993
    - International (not used)
  - EULUMDAT
    - European standard




```
IESNA:LM-63-2002
[TEST] 1
[TESTLAB]
[TESTDATE] 2014-11-21
[ISSUEDATE] 2014-11-21 14:52:20
[NEARFIELD]
[LAMPPOSITION] 0,0
[OTHER] EVERFINE GO-2000A_V1 SYSTEM
[MANUFAC]
[LUMINAIRE] HiCloud 150W 5000K
[LAMP] 120DEGREE 5000K CRI73
TILT=NONE
1 18434.4 1 37 181 2 2 -0.230 -0.230 0.22
1.000 1 155.3
-90.0  -85.0  -80.0  -75.0  -70.0  -65.0  -60.0  -55.0  -50.0  -45.0
 -40.0  -35.0  -30.0  -25.0  -20.0  -15.0  -10.0  -5.0   0.0    5.0
 10.0   15.0   20.0   25.0   30.0   35.0   40.0   45.0   50.0   55.0
 60.0   65.0   70.0   75.0   80.0   85.0   90.0
-90.0  -89.0  -88.0  -87.0  -86.0  -85.0  -84.0  -83.0  -82.0  -81.0
 -80.0  -79.0  -78.0  -77.0  -76.0  -75.0  -74.0  -73.0  -72.0  -71.0
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 -60.0  -59.0  -58.0  -57.0  -56.0  -55.0  -54.0  -53.0  -52.0  -51.0
```


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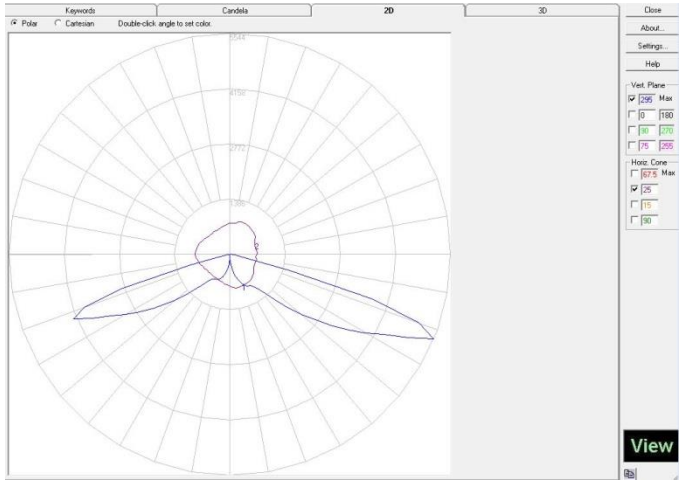
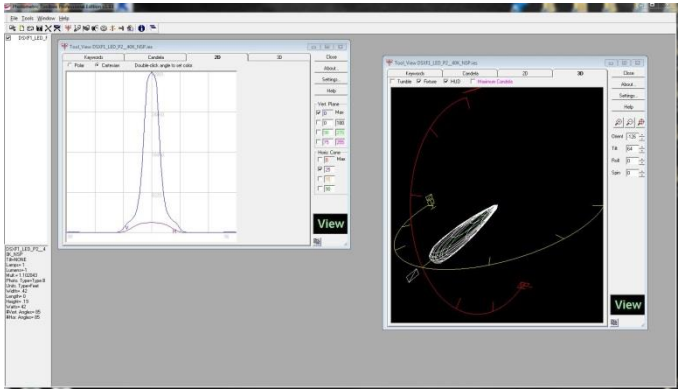
- **IES File Viewer**
  - Evaluate IES matrix file
  - Distribution analyzation
  - Orientation of file for REVIT
  - Compare manufacturers data
  - Evaluate "equal" products
  - Quick check of BUG ratings





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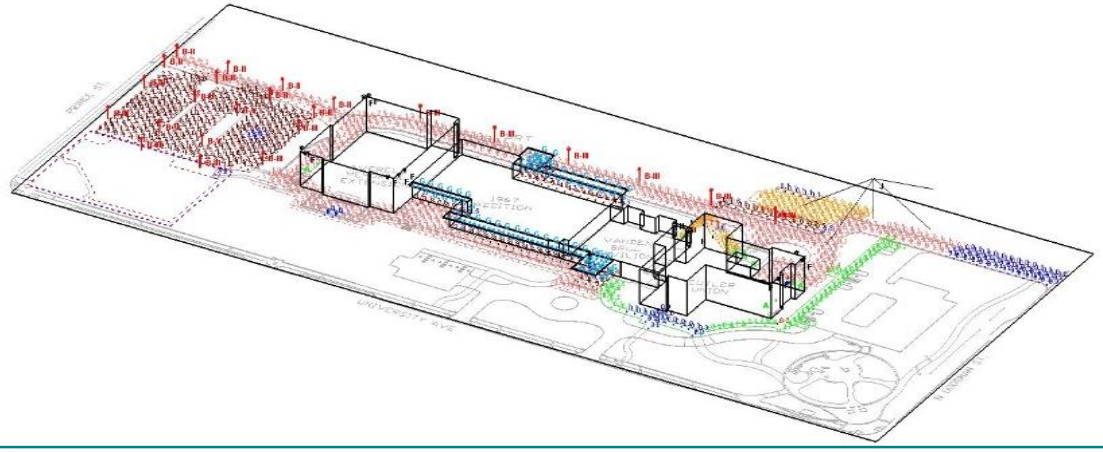
- **Rendering Role for Lighting Design not Architecture**
  - Predict the lighting potential
  - Amounts Ratios and Gradients
  - Architectural Space definition and Potential Glare
  - Predict the movement of the Sun
  - Reflection of light
  - Code compliance



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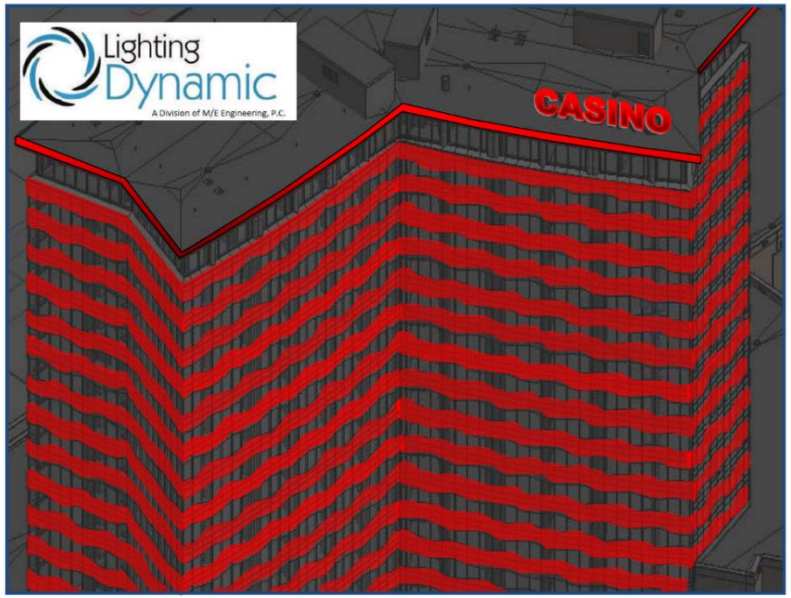

- **Architectural Rendering Software**
  - 3D MAX Design Studio
  - Archicad
  - Revit
  - Sketch UP
  - Rhinoceros
  - Photoshop

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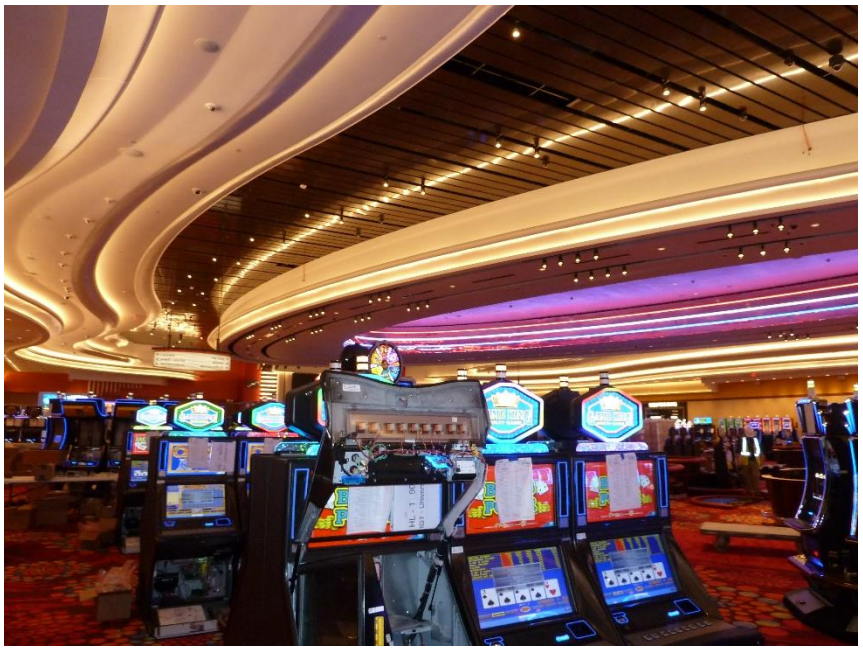

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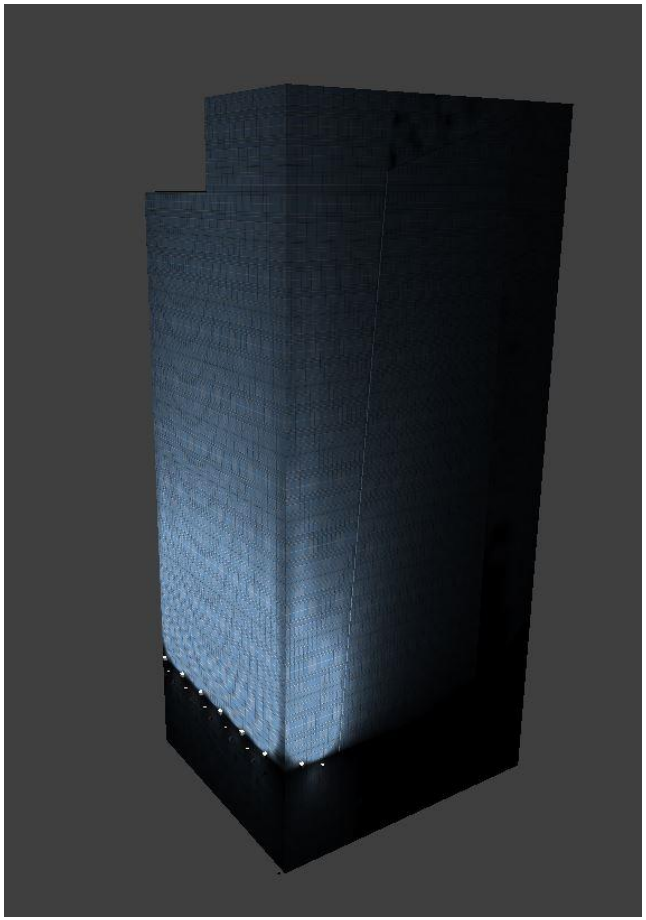

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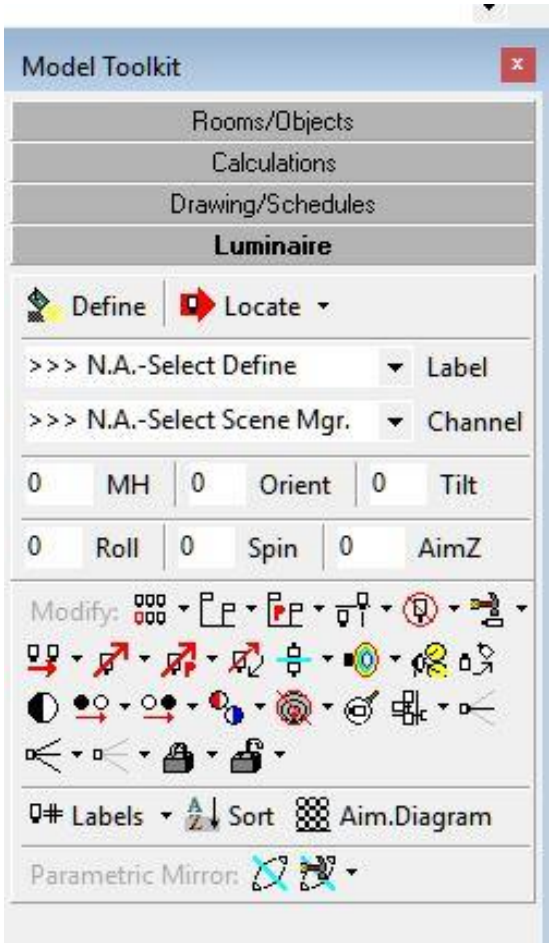
- **Lighting Rendering Software**
  - AGI 32
  - Visual Professional
  - DIA Lux
  - Lumen Designer
  - Radiance
  - Elumtools (AGI32 REVIT)
  - Lite Pro DLX

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

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



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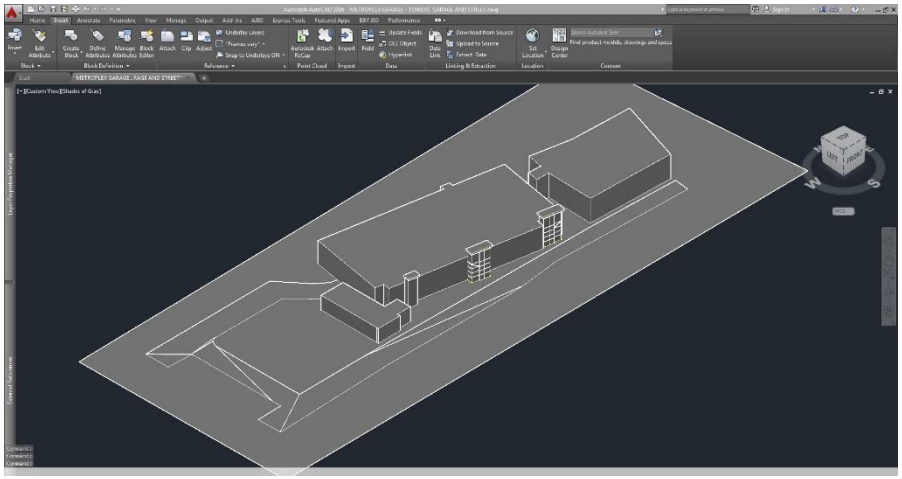
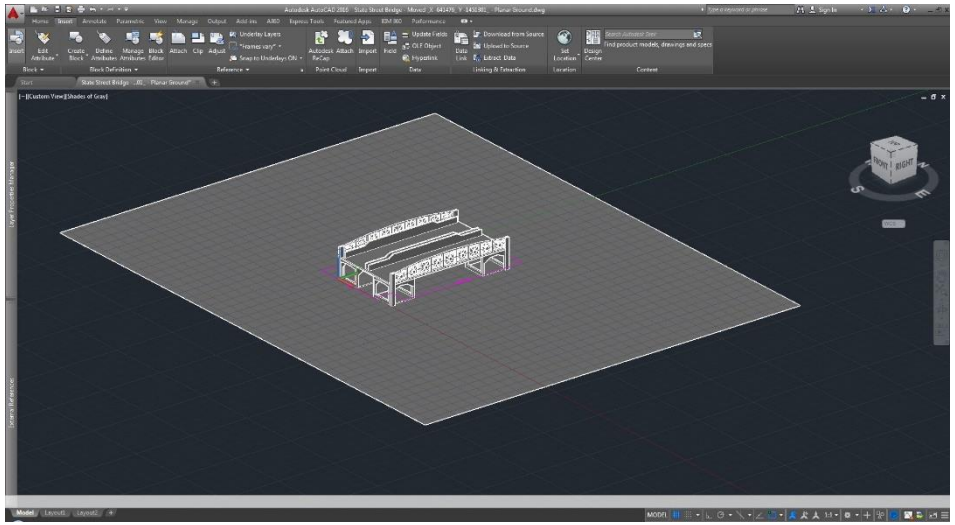
- **Building a Rendering File**
  - Export existing REVIT model
    - Optimize for calculation
  - Build in 3D software
  - Build in lighting software





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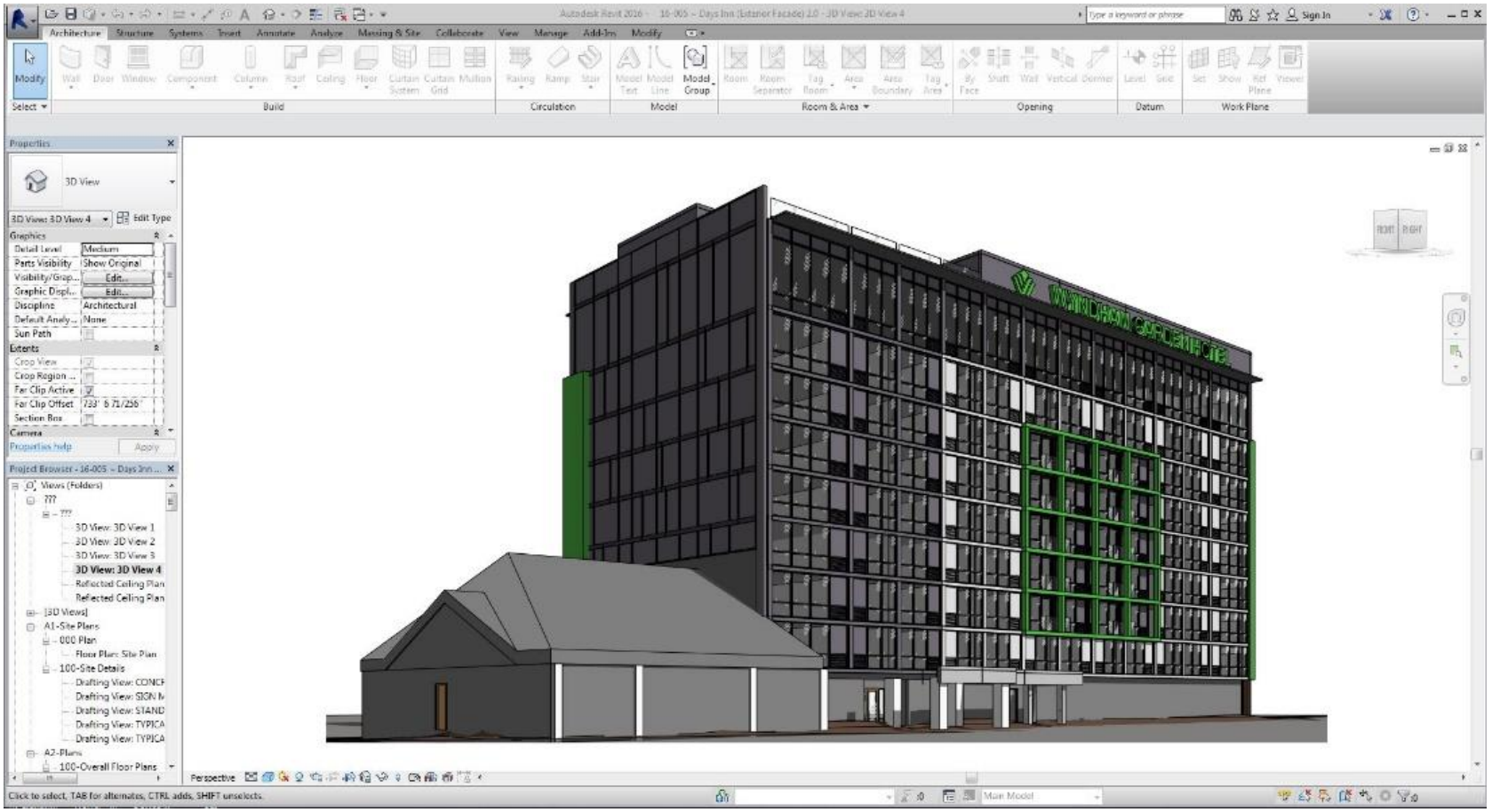

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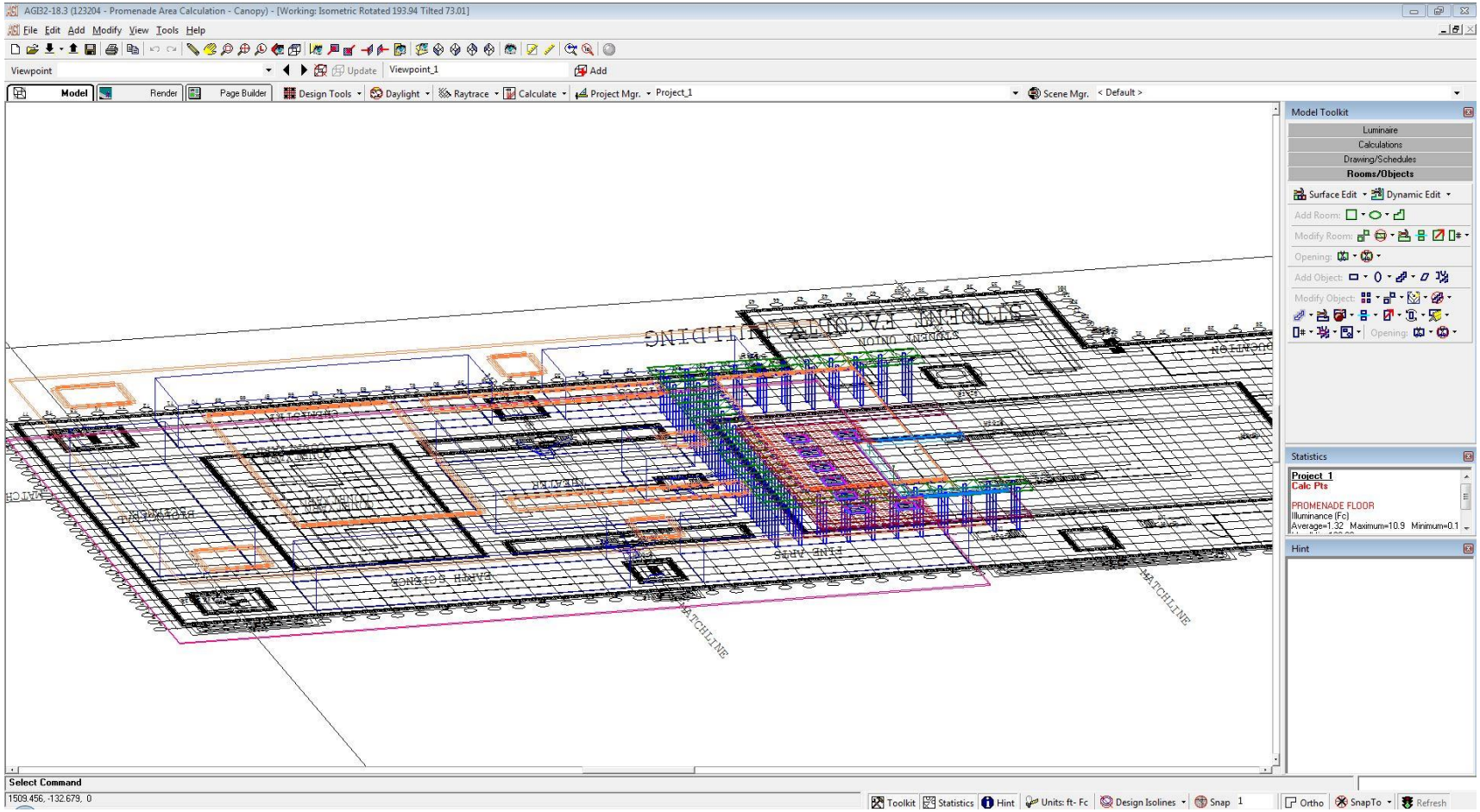

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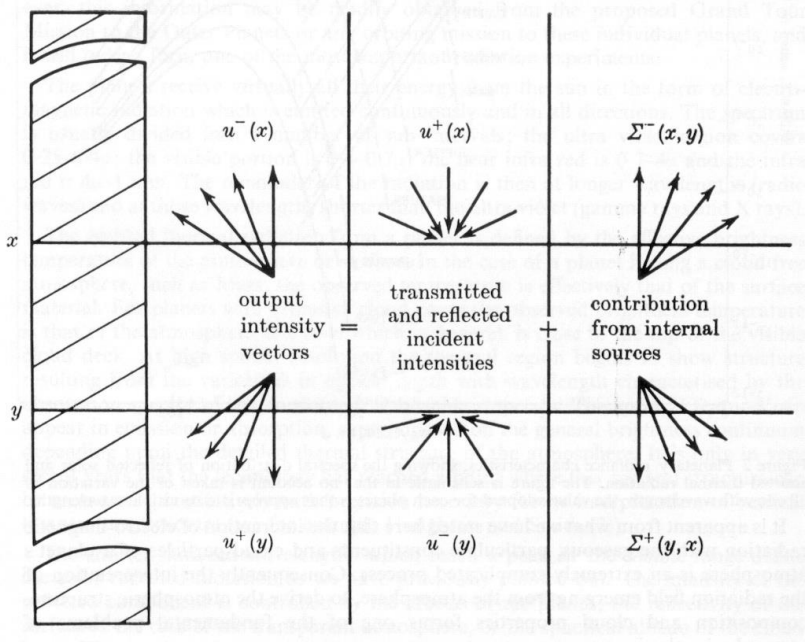
- **Types of Renderers**
  - Radiative transfer (also called radiosity)
  - Ray Tracing
  - Hybrids (Radiative transfer followed by a single-bounce ray tracing)



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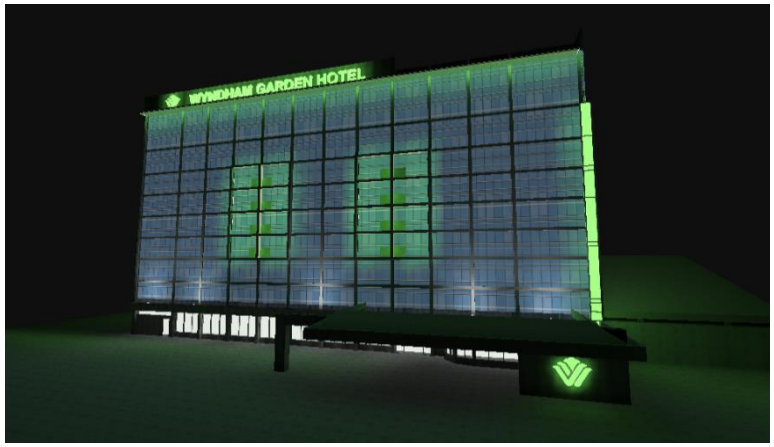

- **Radiative transfer**
  - Surface existences determined and displayed
  - Possible dependence on discretization
  - View-position independent
  - Moderate execution times
  - Granular presentation

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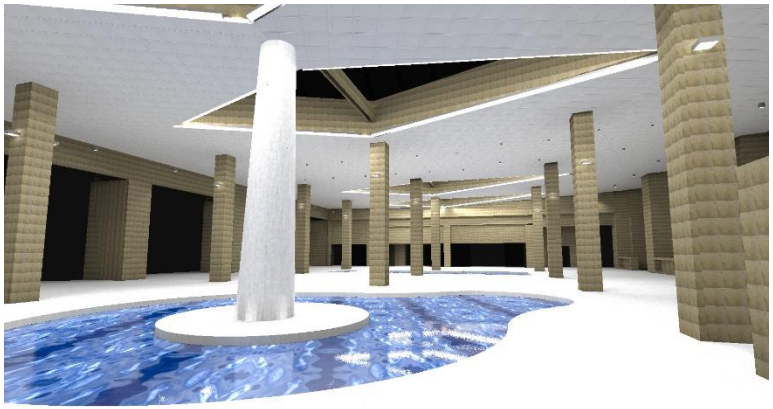

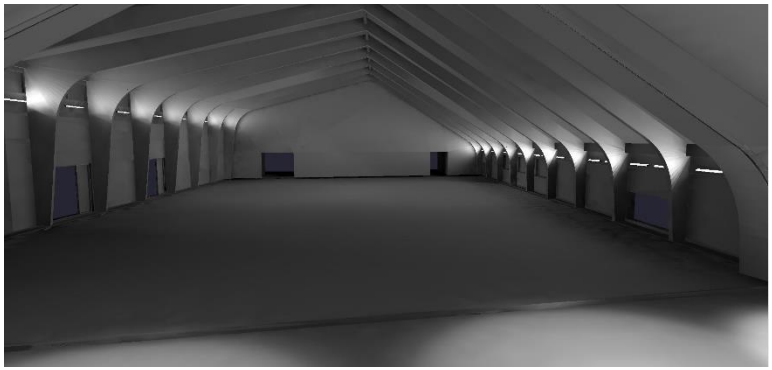

- **Ray Tracing**
  - Light sources emit rays that are traced through the system of surfaces, ending up at the viewing point
  - Rays are traced (backward) from the viewing point to surfaces and light sources
  - Reflections spawn "daughter rays" that are also traced
  - Result is view-position dependent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

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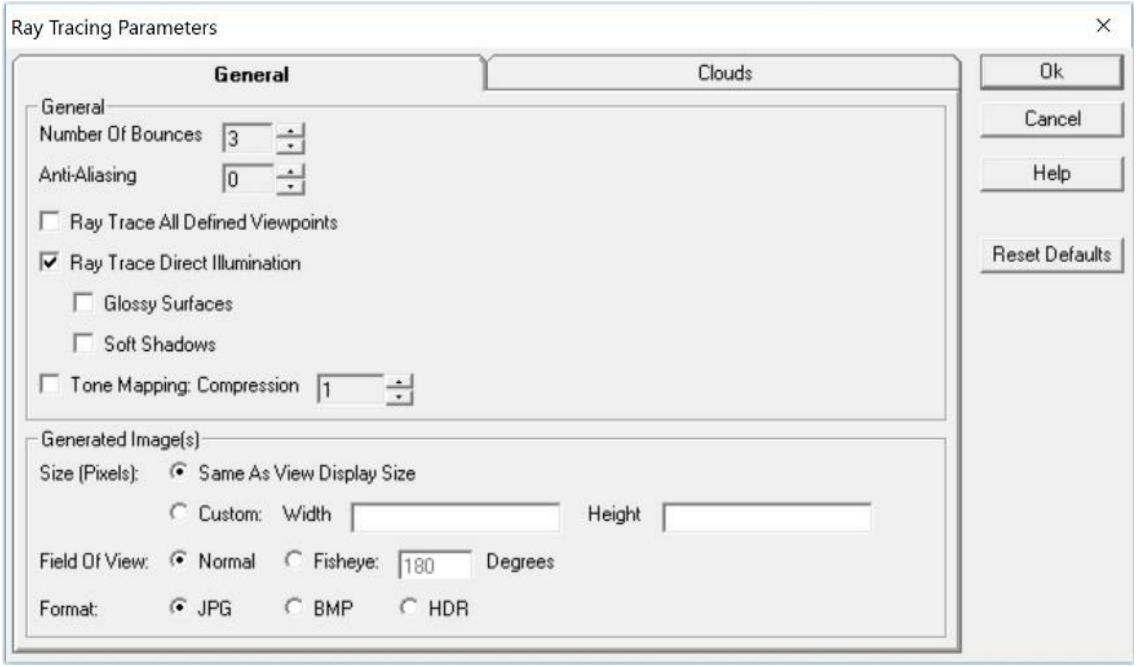
- **Ray Tracing**
  - Settings and output are crucial
  - Overlapping surfaces can be come distorted



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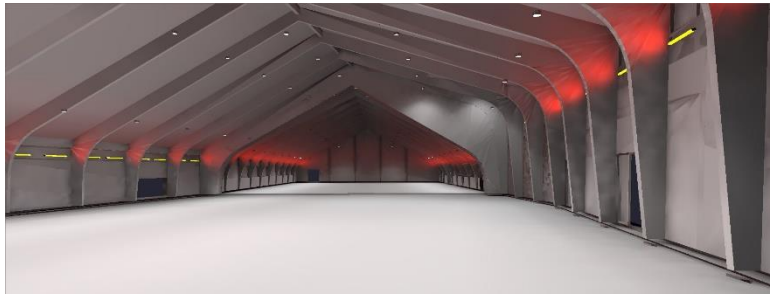

- **Hybrid**
  - "basic" rendering produced with radiative transfer
  - Rays traced from light sources to the view position, after reflecting off a non-diffuse surface
    - Glints
    - Mirror-effects

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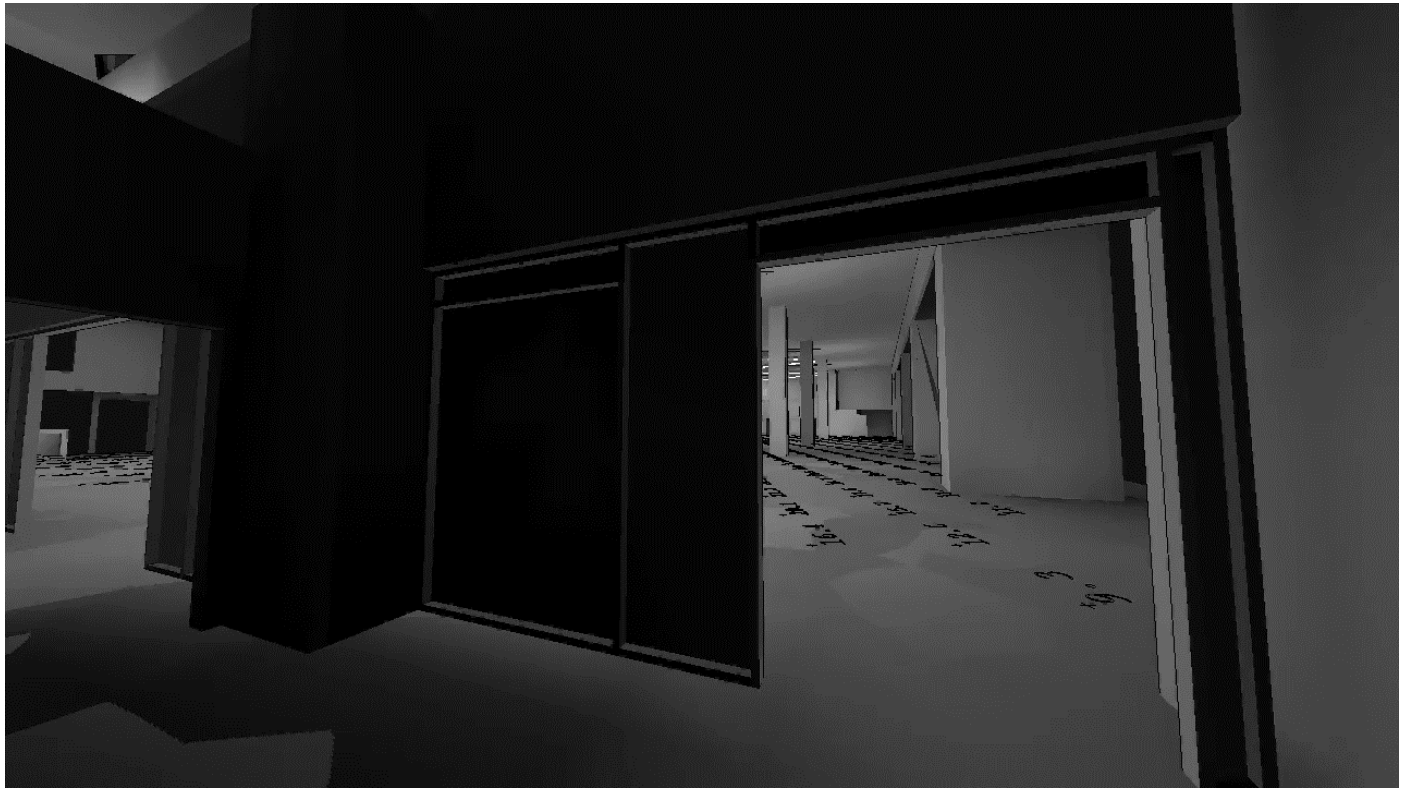

The In's & Out's of Rendering Using Lighting Software

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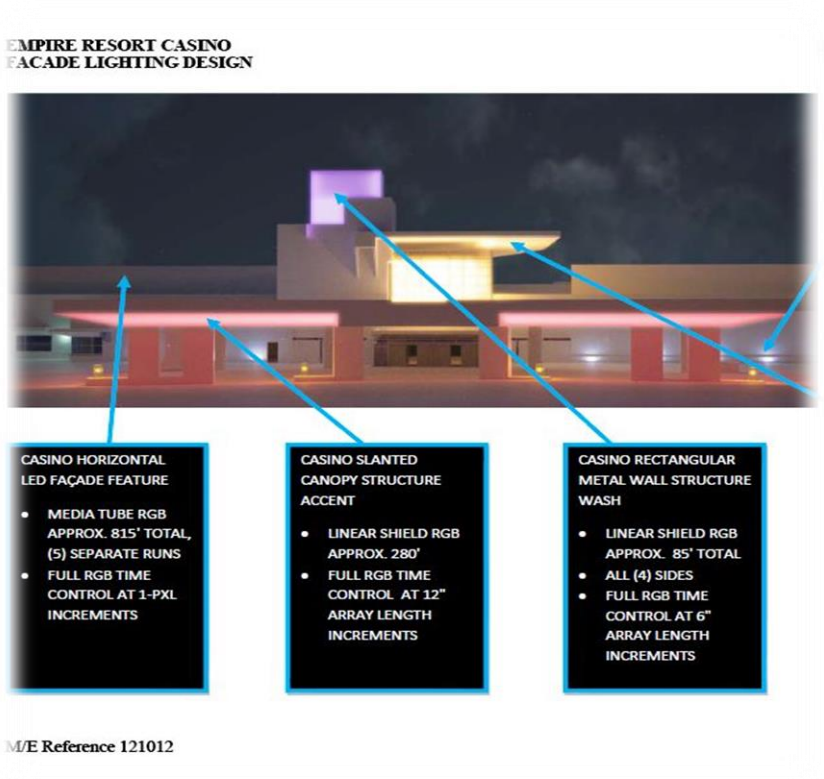
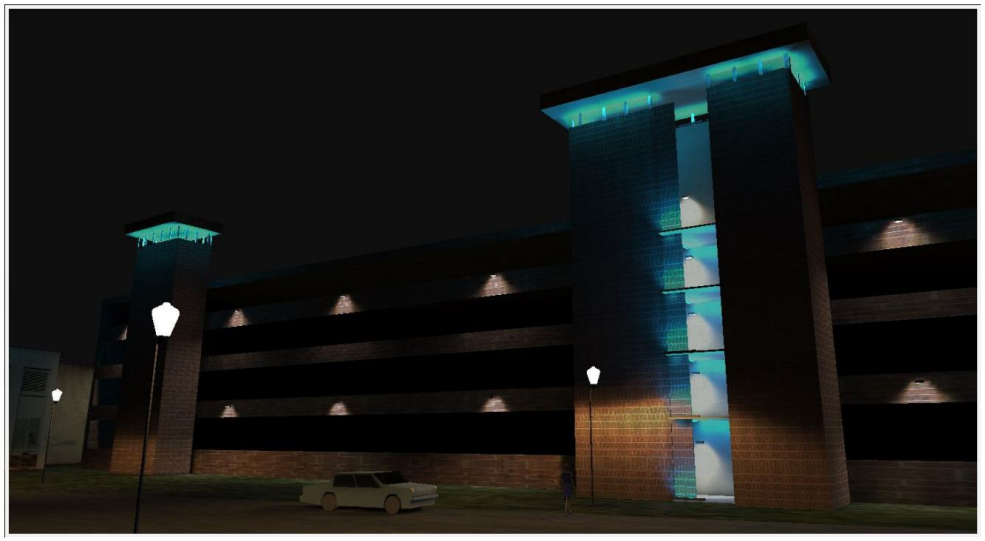


- **Purpose and Goals of Rendering**
  - Assess a lighting design
  - Client presentation
  - Marketing
  - Compare color change design vs. white only
  - Assess the way color light takes to materials
  - Code official verification

ENGINEERING

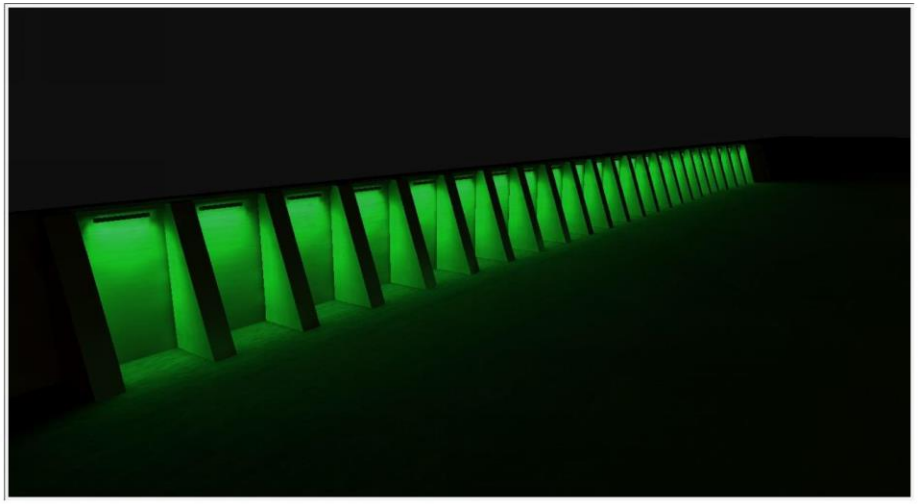
The In's & Out's of Rendering Using Lighting Software



METROPLEX PARKING GARAGE
SCHENECTADY, NY

Value-Driven Solutions

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



METROPLEX PARKING GARAGE
SCHENECTADY, NY

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

OPTION 1

FLOOD LIGHTING

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

Erie Boulevard Bridge Lighting

05/23/2017

UPLIGHT COLOR WASH

INSIDE WASH & OUTSIDE ACCENTS

TW&A CONSTRUCTION MANAGEMENT

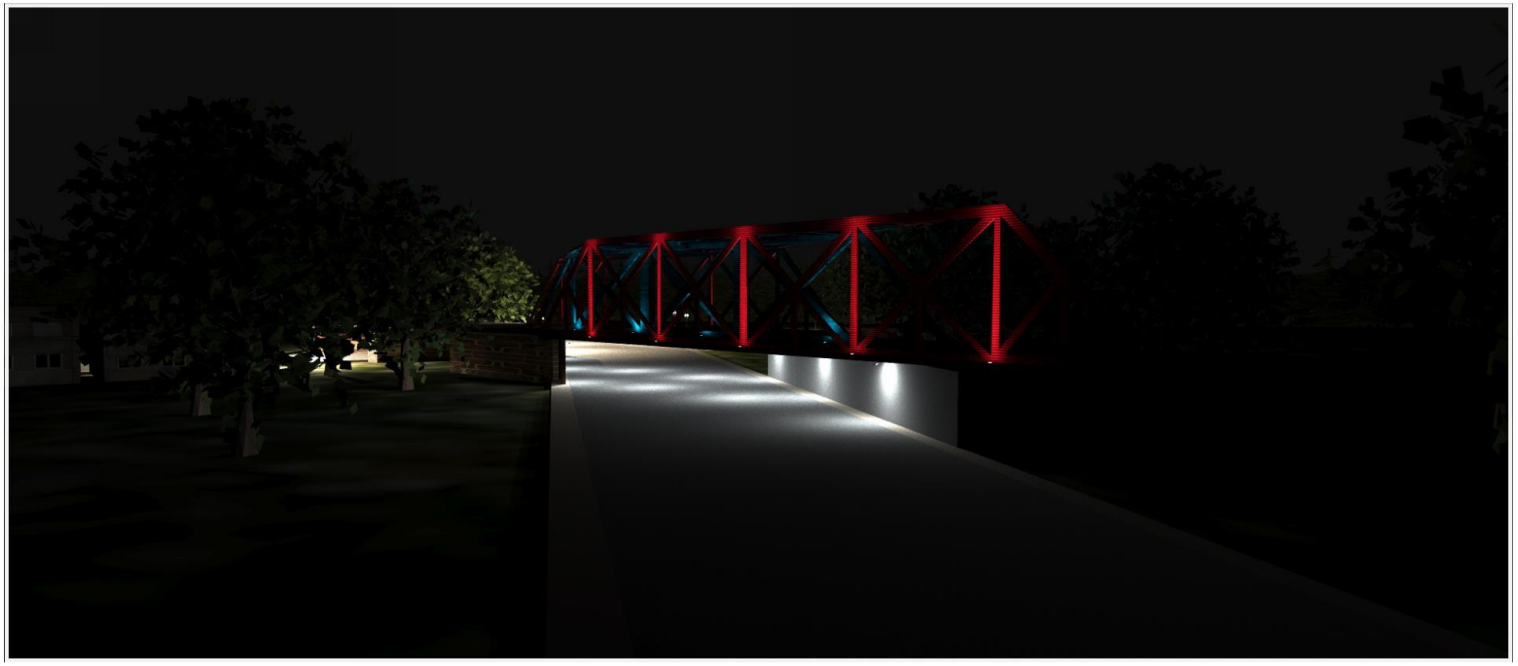
Lighting Dynamic

ME ENGINEERING

ME ENGINEERING

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

Erie Boulevard Bridge Lighting 05/23/2017



UPLIGHT COLOR WASH

INSIDE WASH & OUTSIDE ACCENTS

TWA CONSTRUCTION MANAGEMENT

Lighting Dynamic

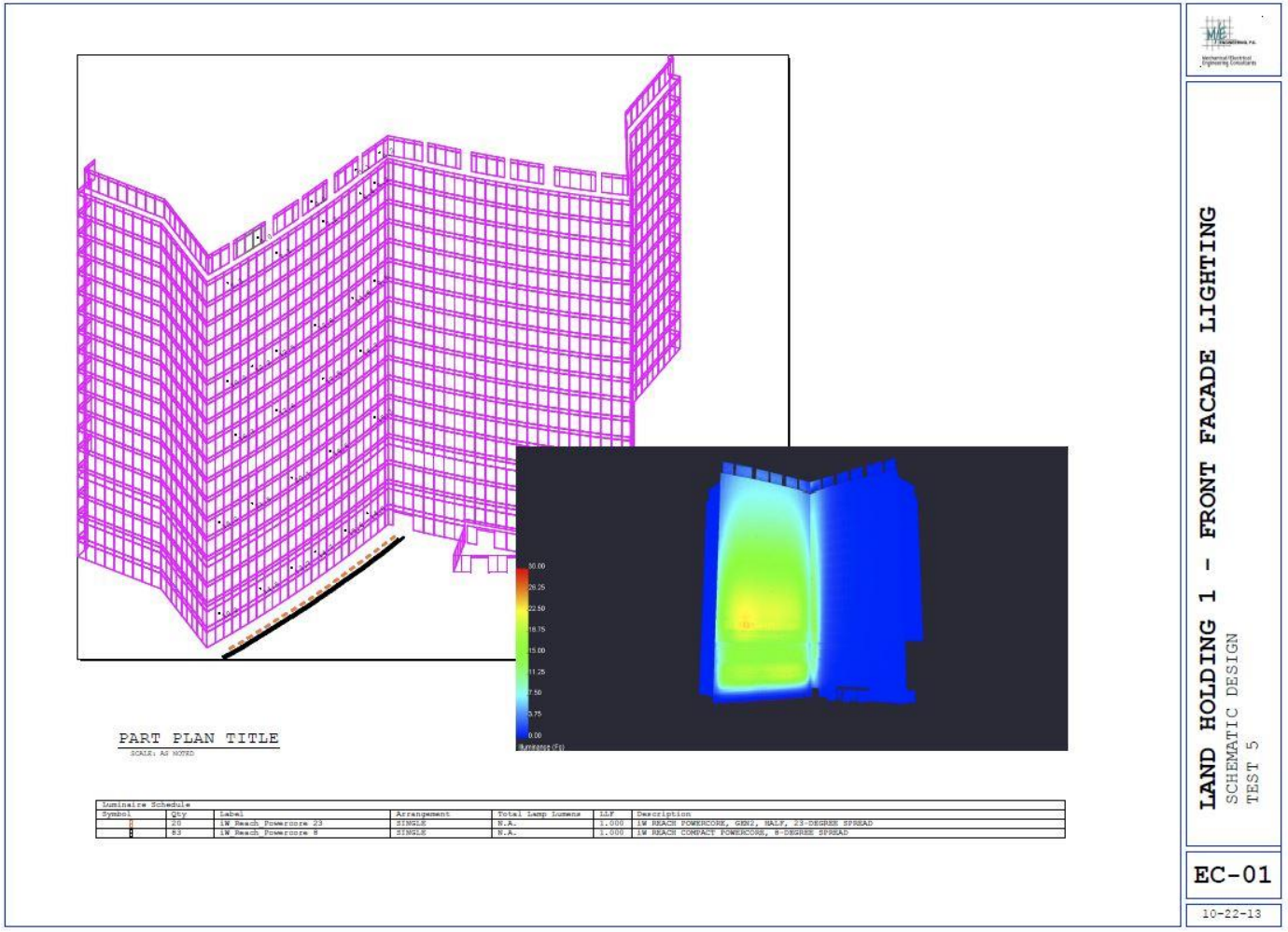
ME ENGINEERING

ME ENGINEERING

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

ENGINEERING

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



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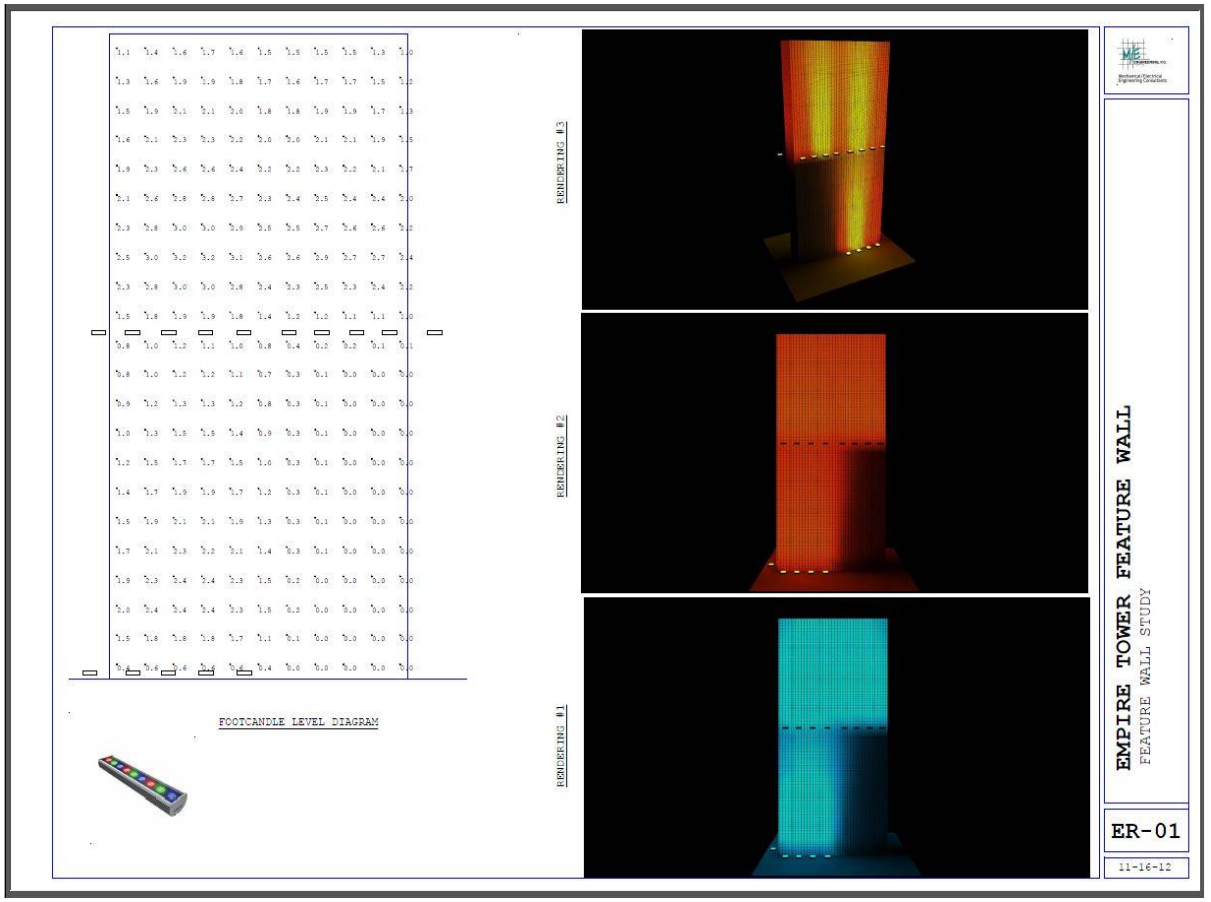
The In's & Out's of Rendering Using Lighting Software

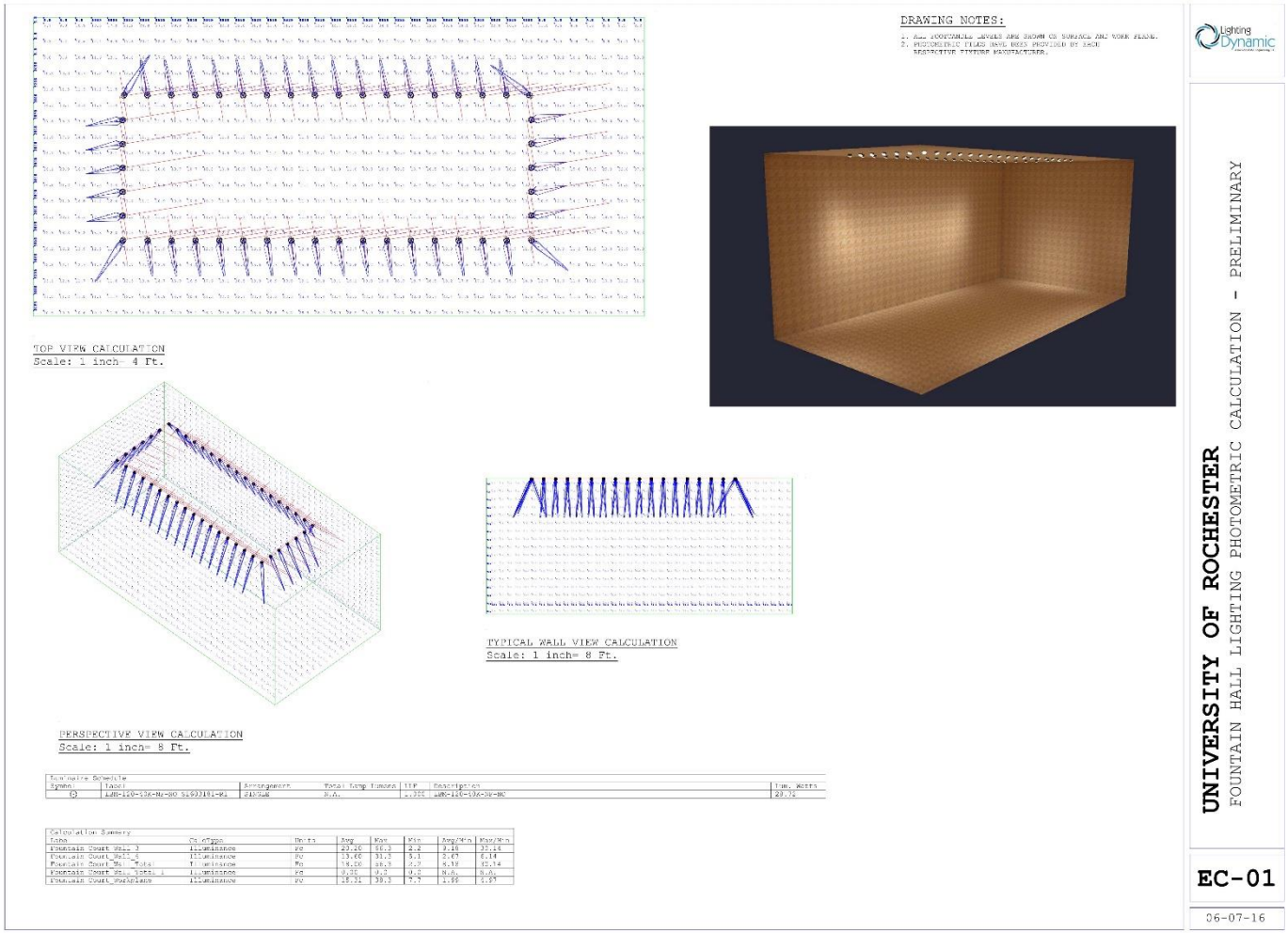
Chain Link Façade Material

Office Mock-up of Chain Link Material



ENGINEERING

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



Luminaire Schedule

Symbol	Label	Arrangement	Total Lamp Lumens	LLF	Description	Lum. Watts
(C)	LBR-120-40K-NF-NO S1603181-R1	SINGLE	N.A.	1.000	LBR-120-40K-NF-NO	20.72

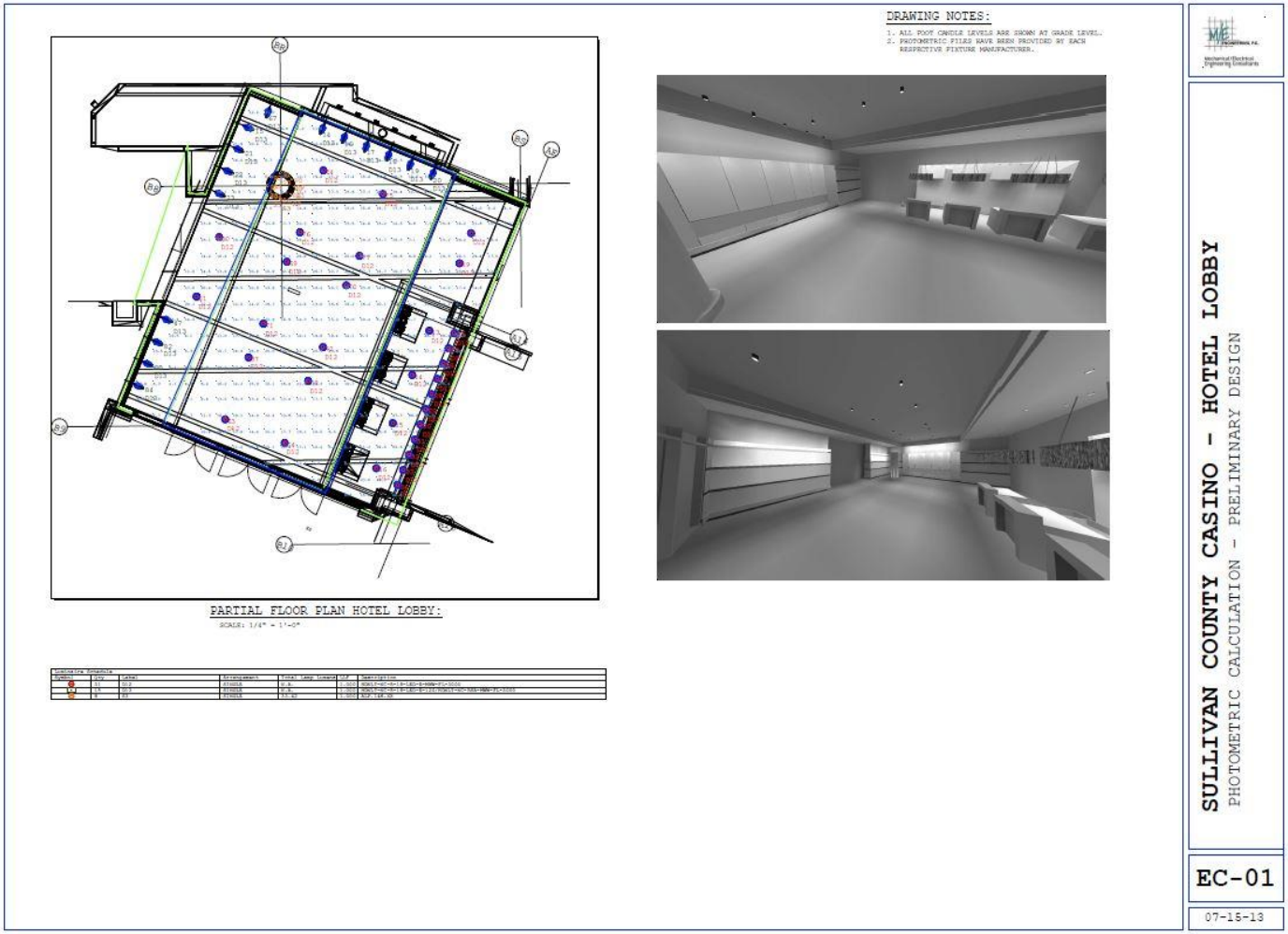
Calculation Summary

Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
Fountain Court_Wall_3	Illuminance	Fc	20.20	56.3	2.2	9.18	25.14
Fountain Court_Wall_4	Illuminance	Fc	13.60	31.3	5.1	2.67	6.14
Fountain Court_Wall_Total	Illuminance	Fc	18.00	56.3	2.2	8.18	25.14
Fountain Court_Wall_Total_1	Illuminance	Fc	0.50	0.2	0.2	N.A.	N.A.
Fountain Court_Workplane	Illuminance	Fc	15.21	39.3	7.7	1.99	4.97

Value-Driven Solutions

ENGINEERING

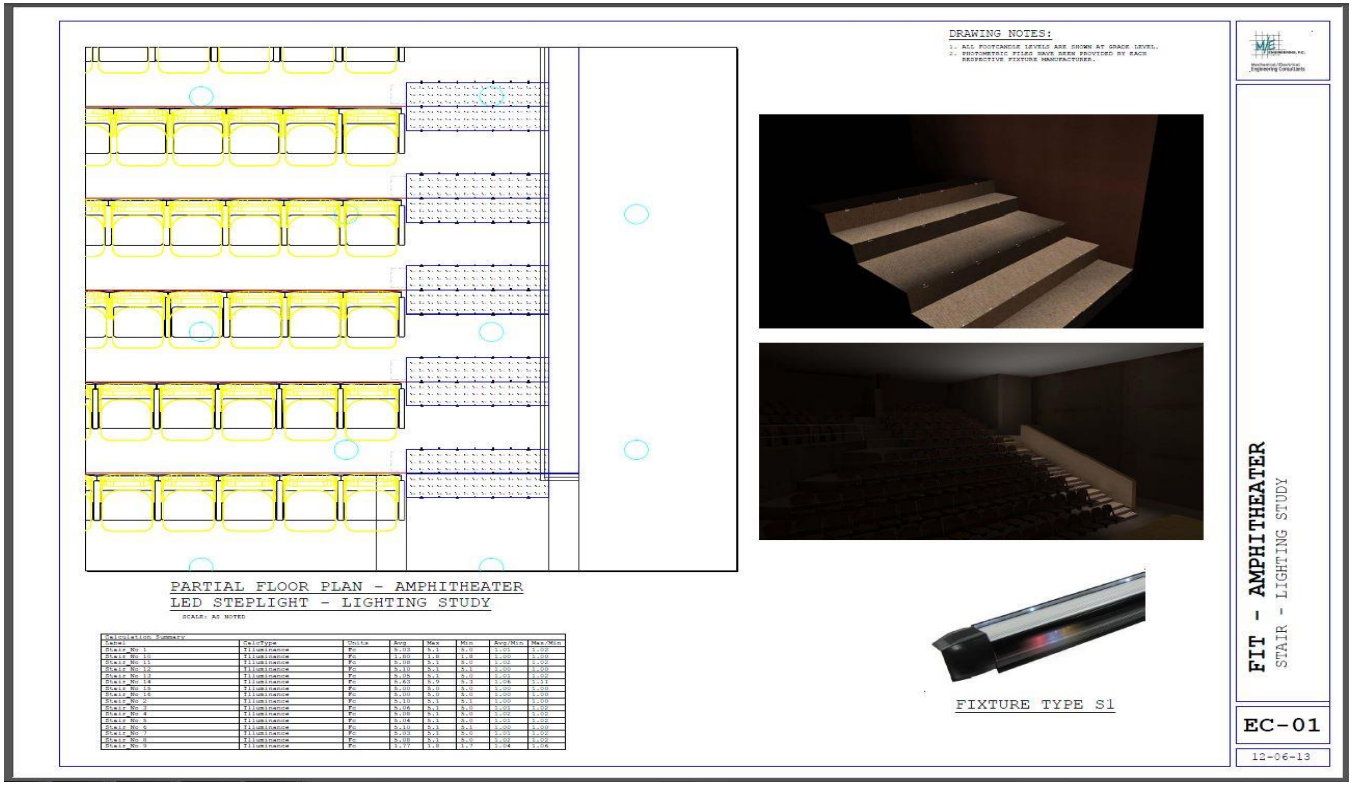
The In's & Out's of Rendering Using Lighting Software



Value-Driven Solutions

ENGINEERING

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



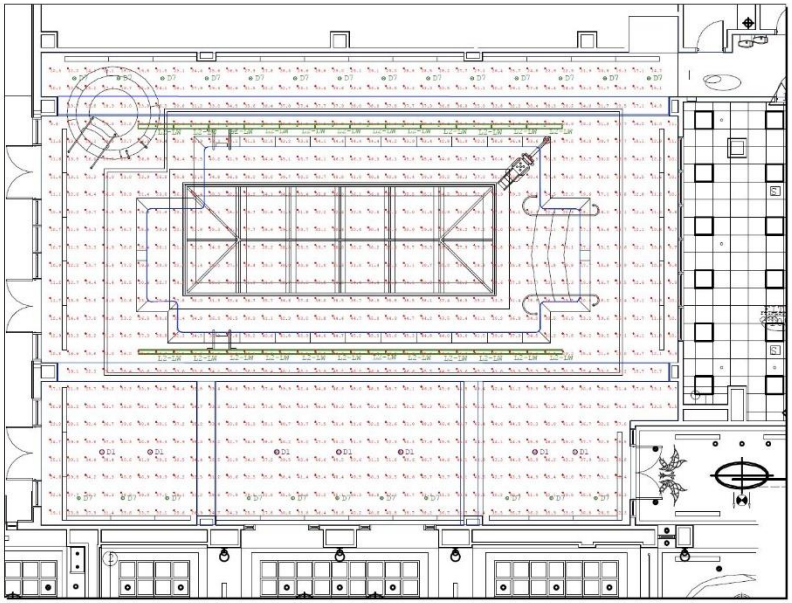
Value-Driven Solutions

ENGINEERING

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

DRAWING NOTES:

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



PART PLAN TITLE

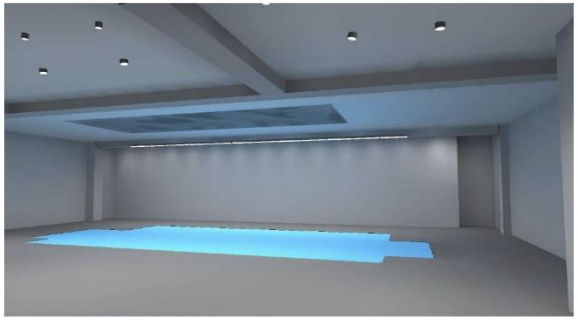
SCALE: AS NOTED

Luminaire Schedule

Symbol	Qty	Label	Total Lamp Lumens	LLF
○	27	D7	N.A.	1.000
○	7	D1	N.A.	1.000
-	24	L2-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	8.09



SARATOGA HOTEL ADDITION - POOL LIGHTING

PHOTOMETRIC CALCULATION - CODE REVIEW

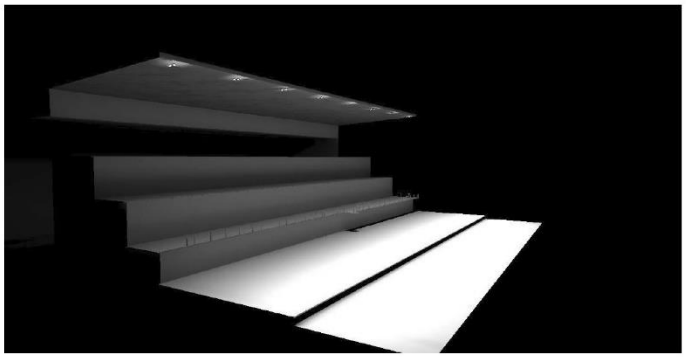
EC-01

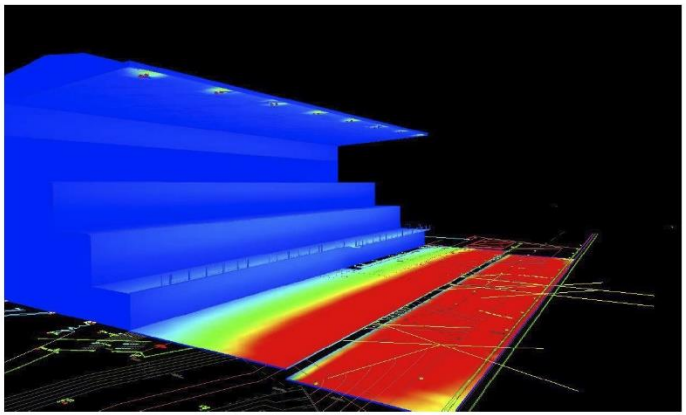
10-26-15

Value-Driven Solutions

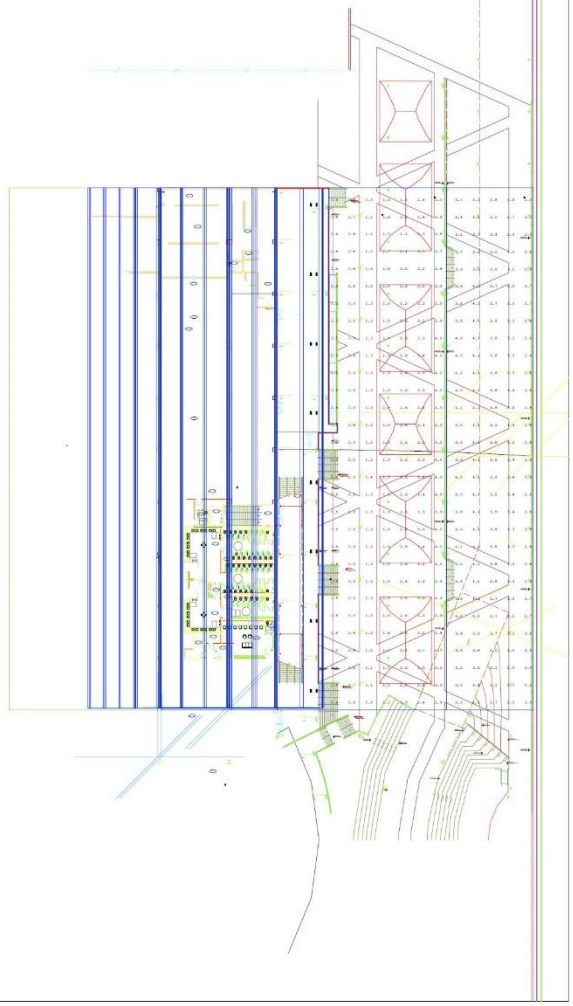
ENGINEERING

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





Calculation Summary							
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
Grade Level_1_Top	Illuminance	Fc	3.42	4.2	1.9	1.80	2.21



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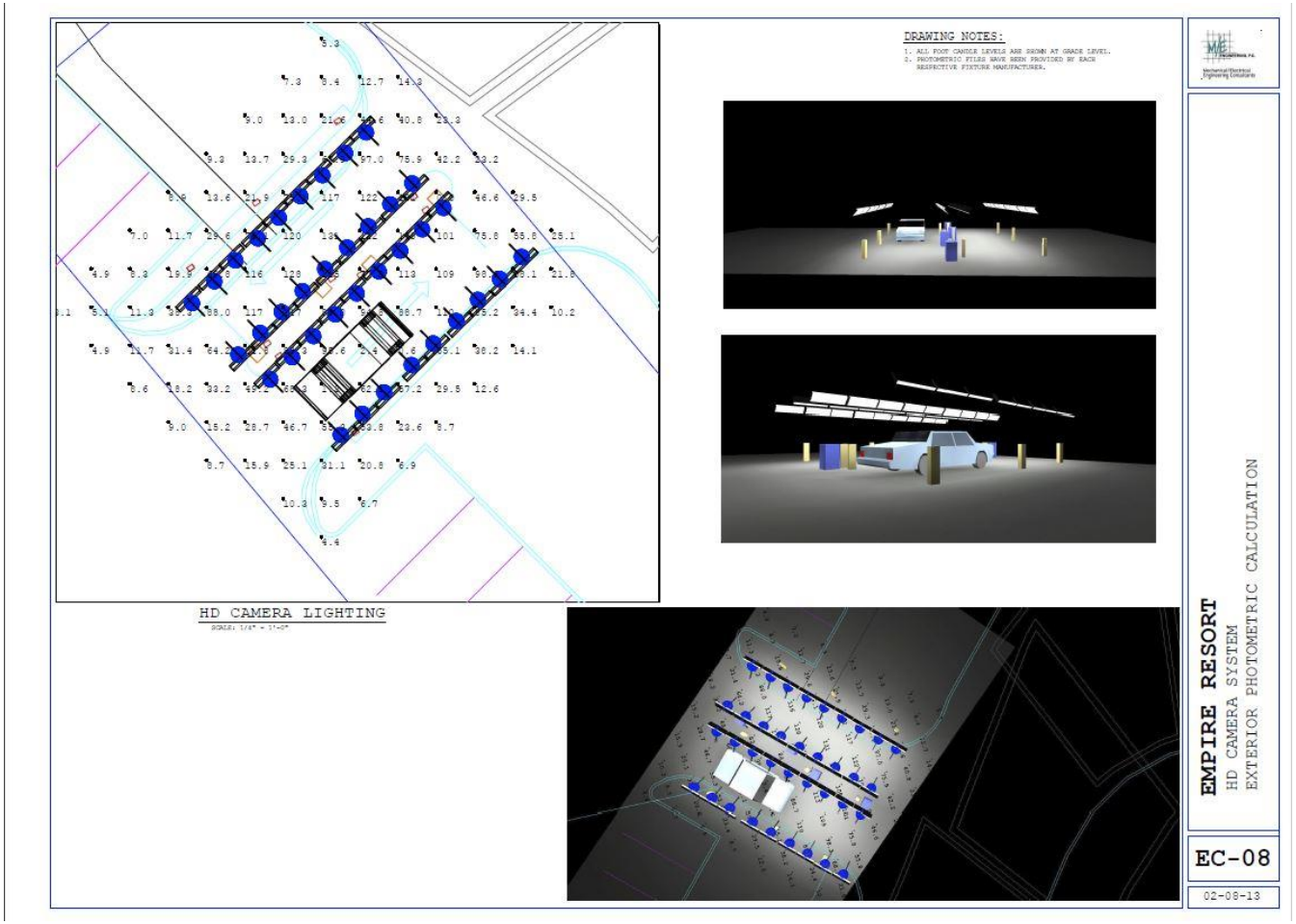

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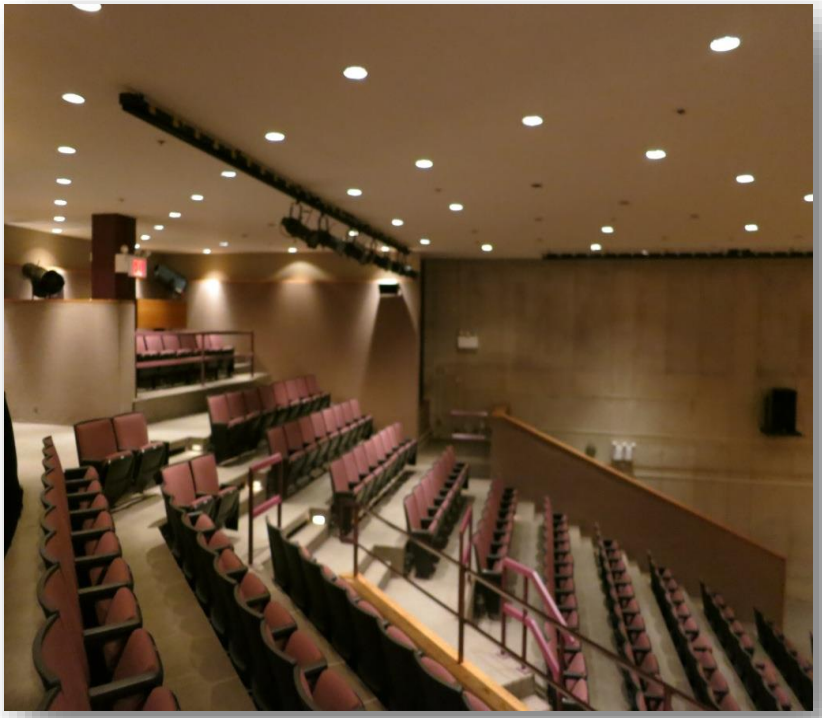
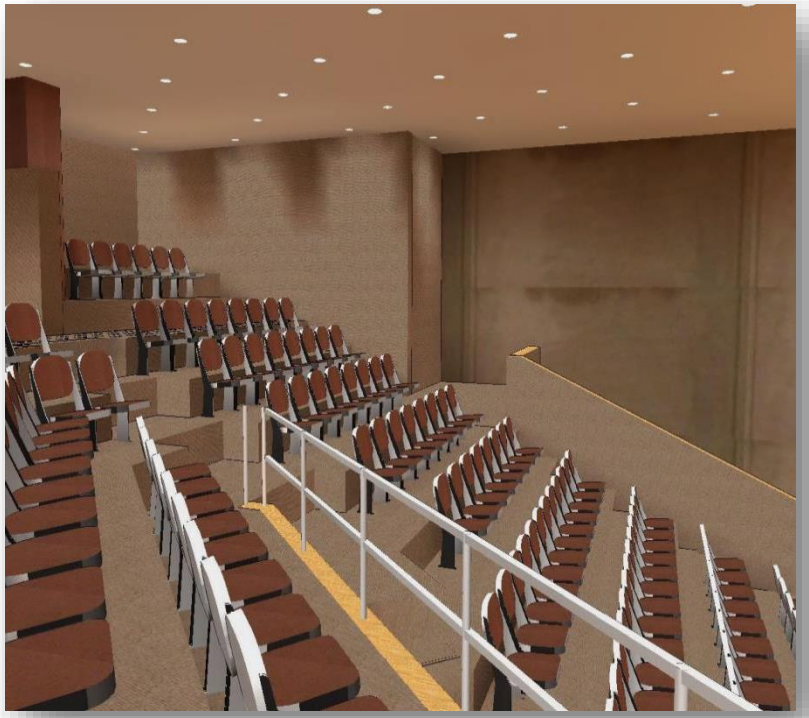
The In's & Out's of Rendering Using Lighting Software

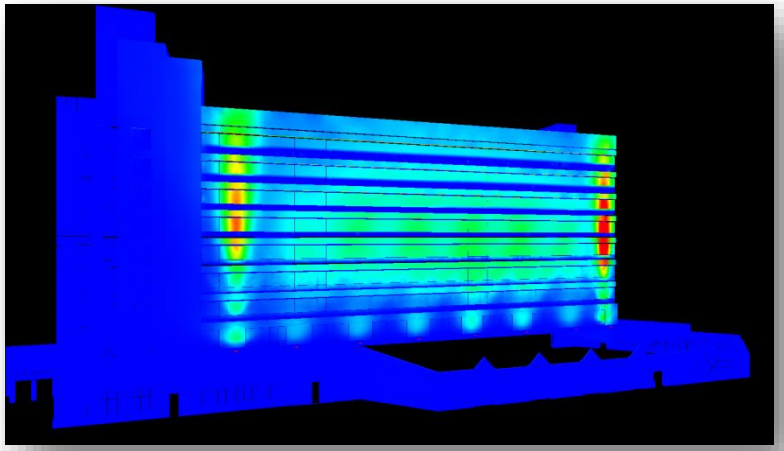


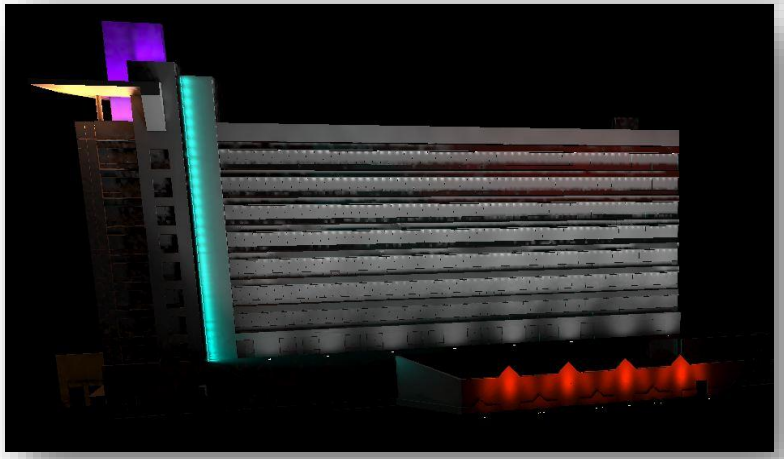
Existing Facility Image

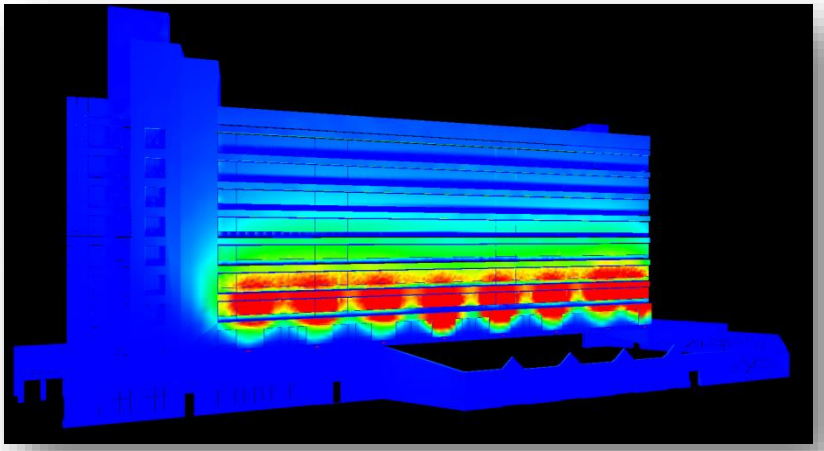


Existing Facility Rendering

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







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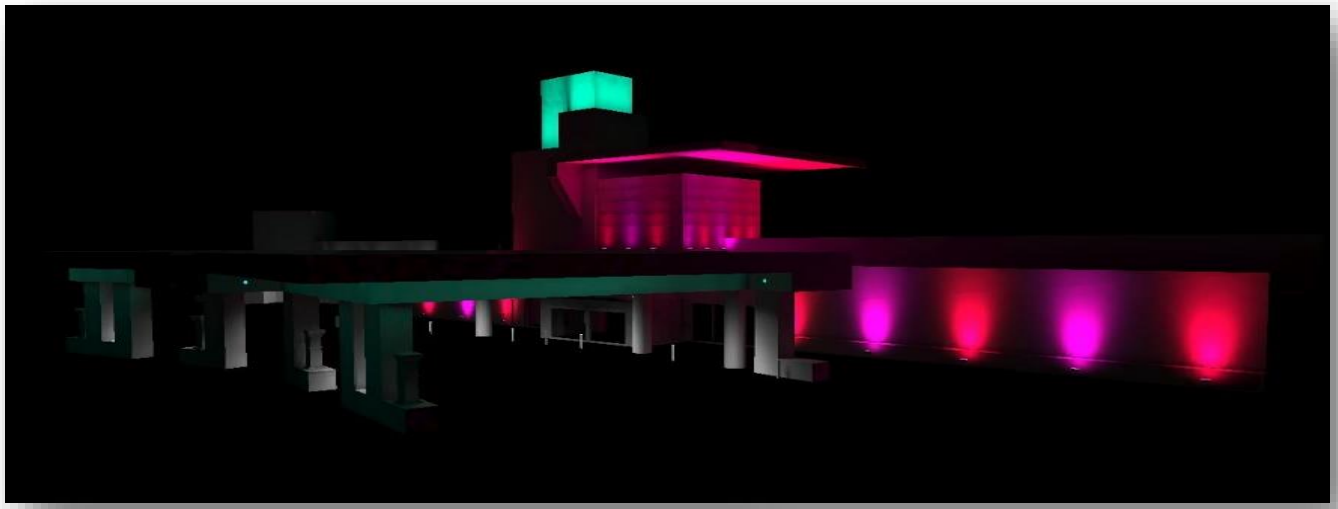

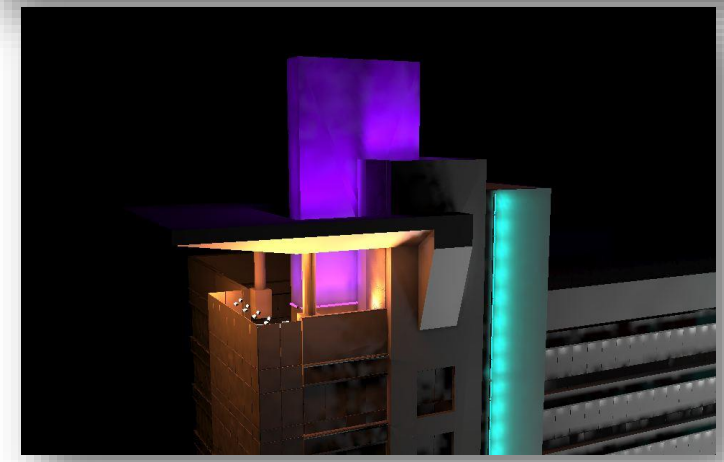

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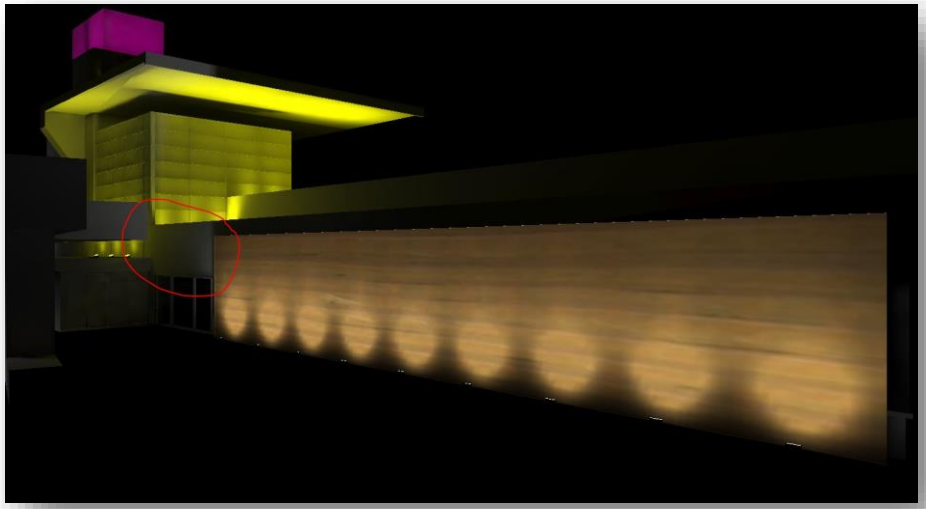

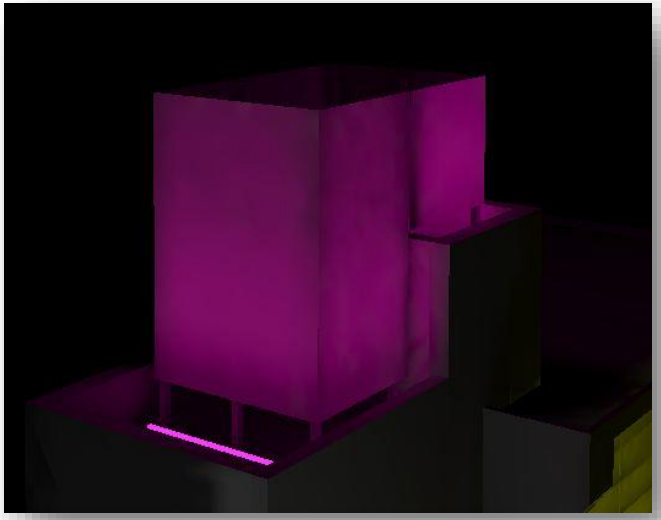

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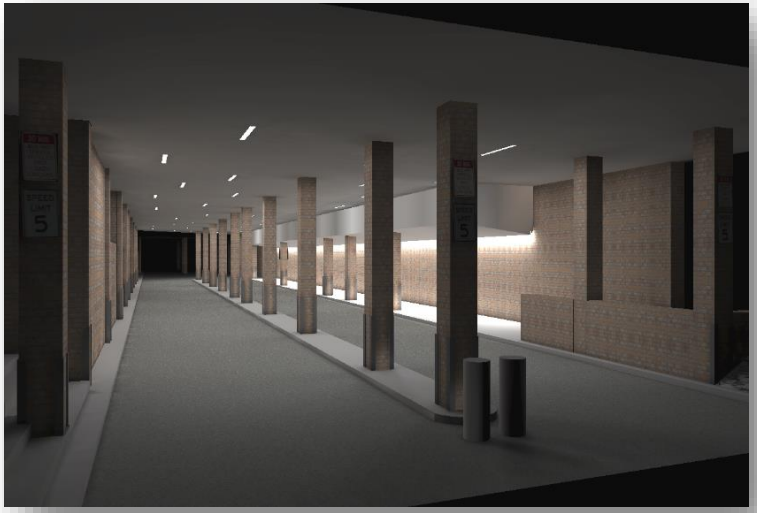

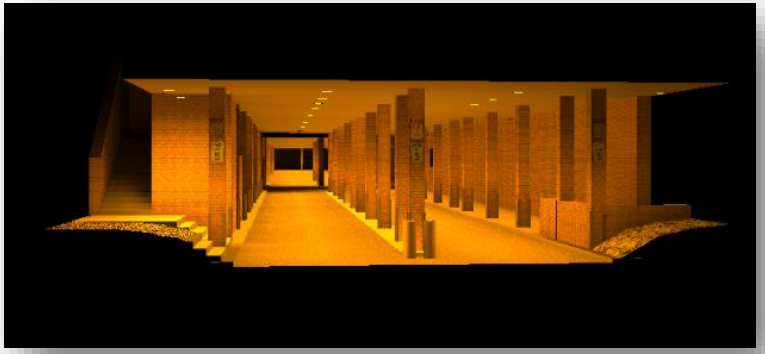

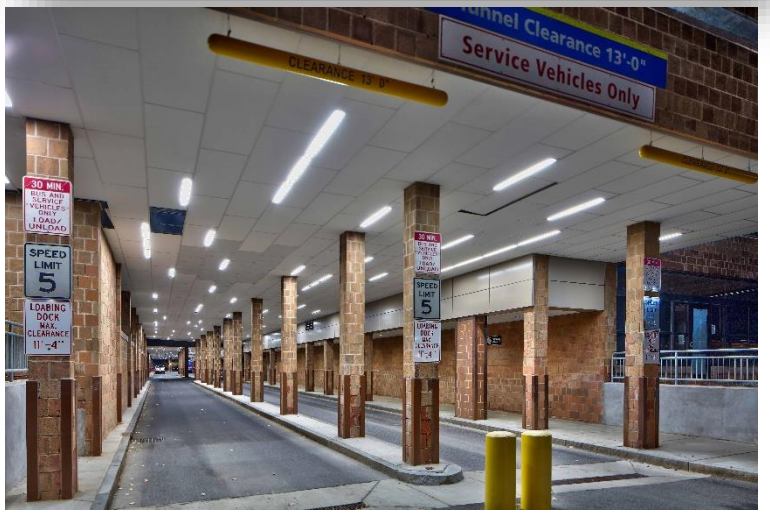

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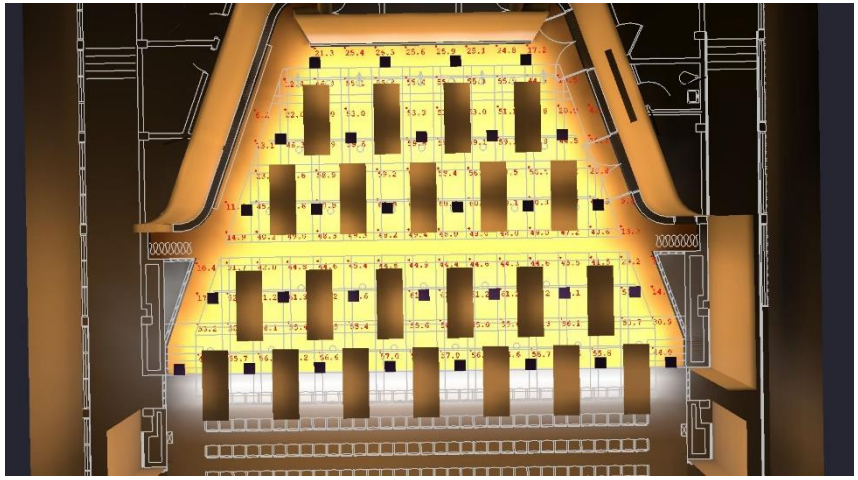

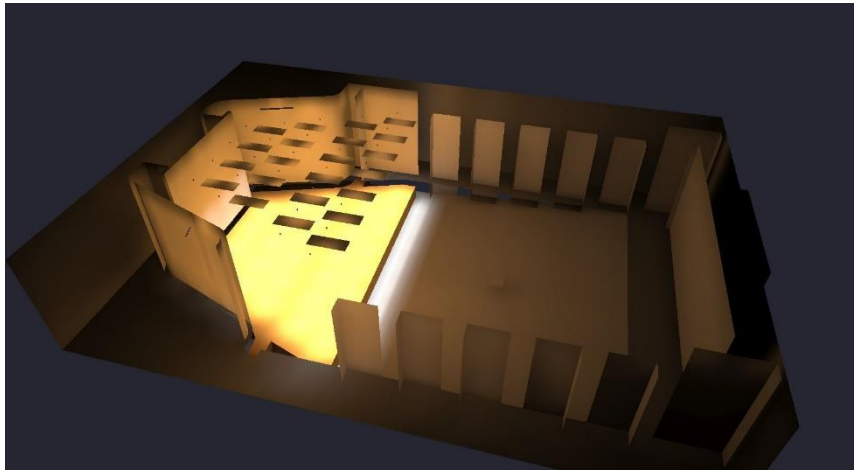

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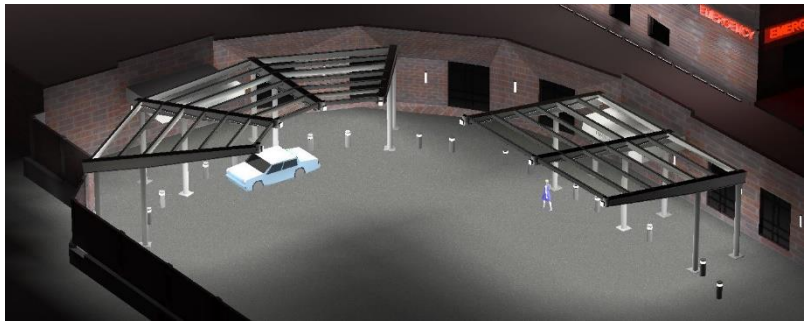

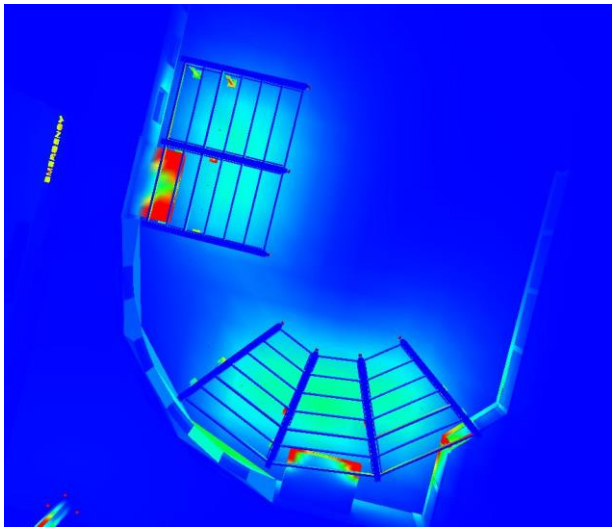

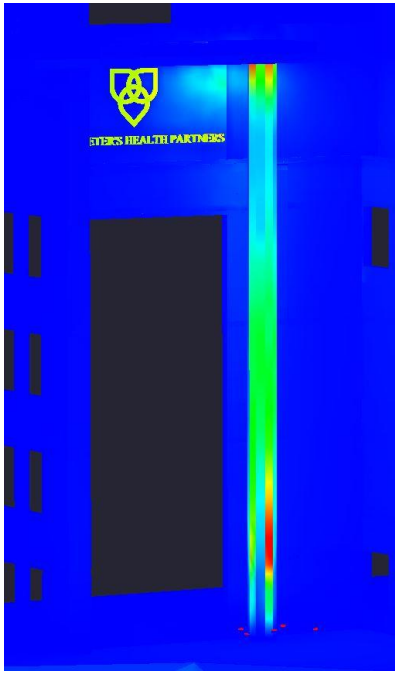

ME ENGINEERING

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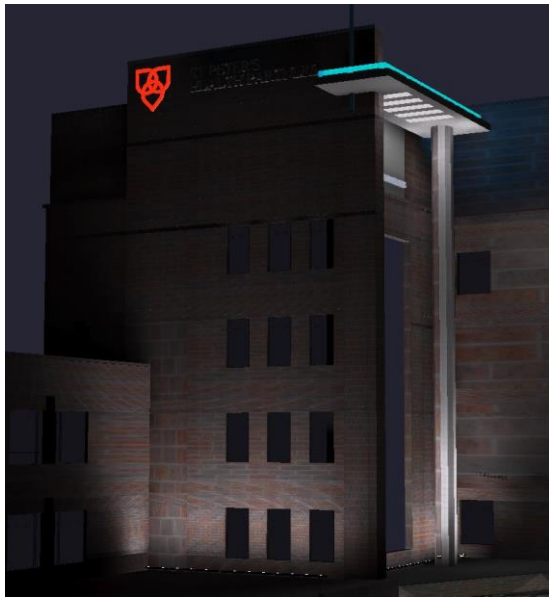

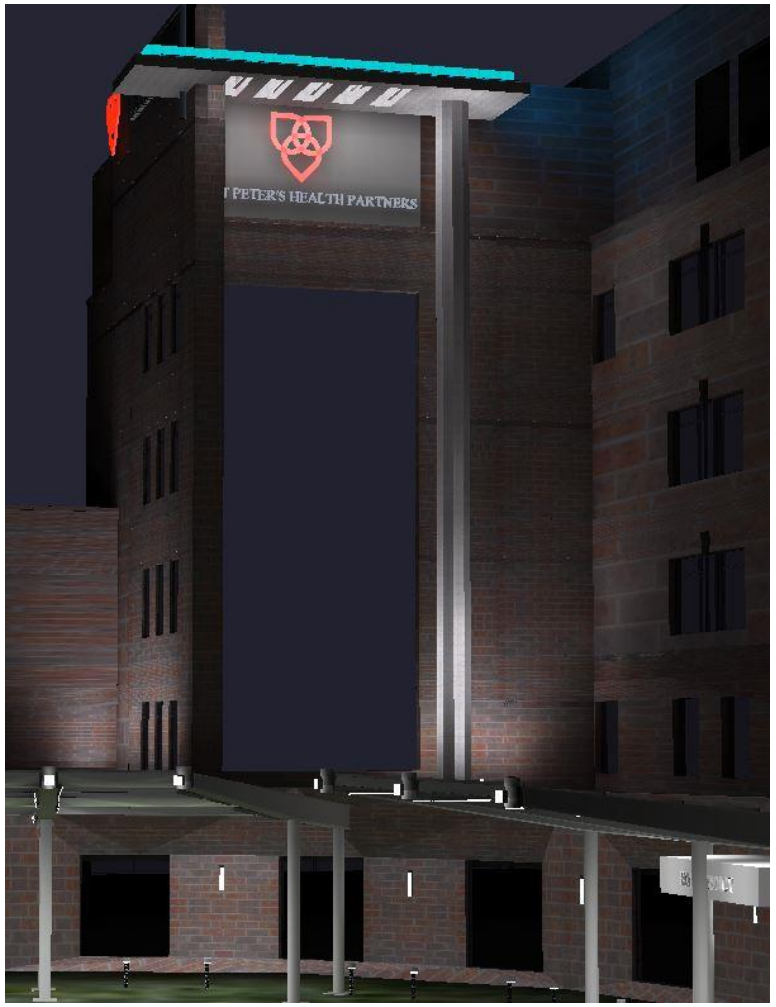

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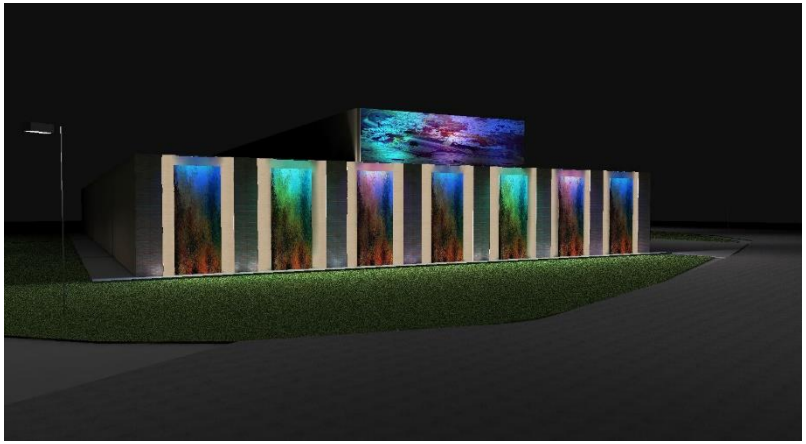

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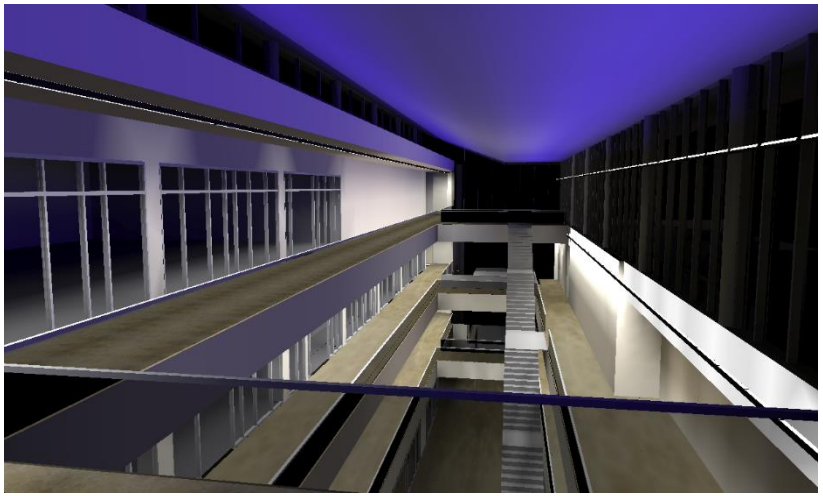

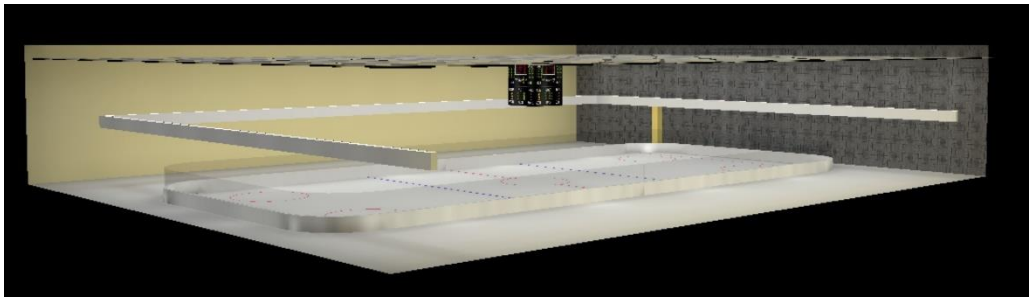

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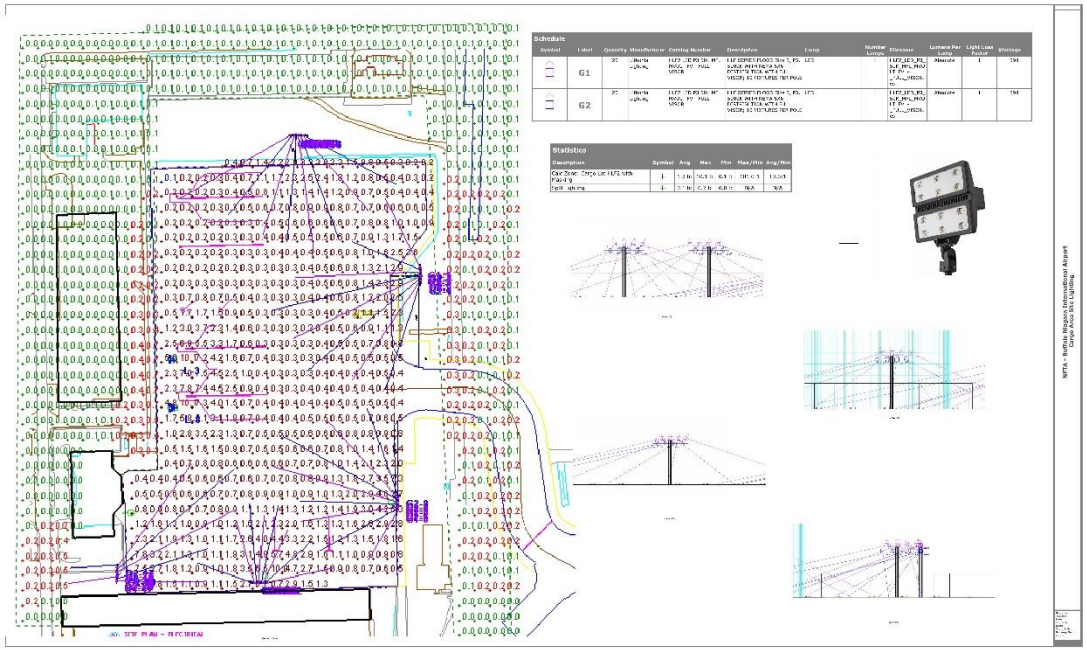

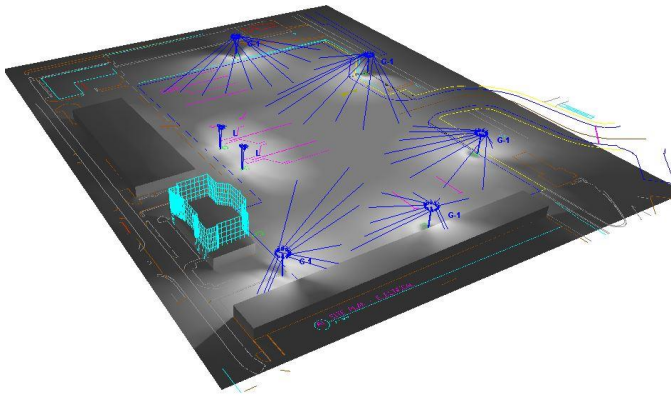

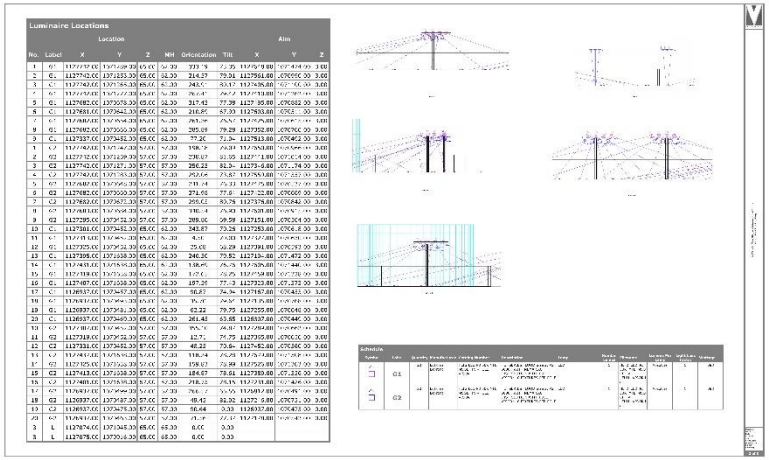

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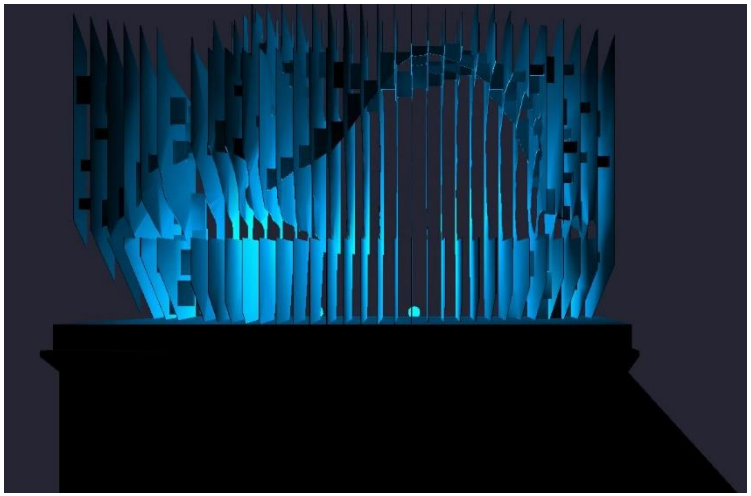
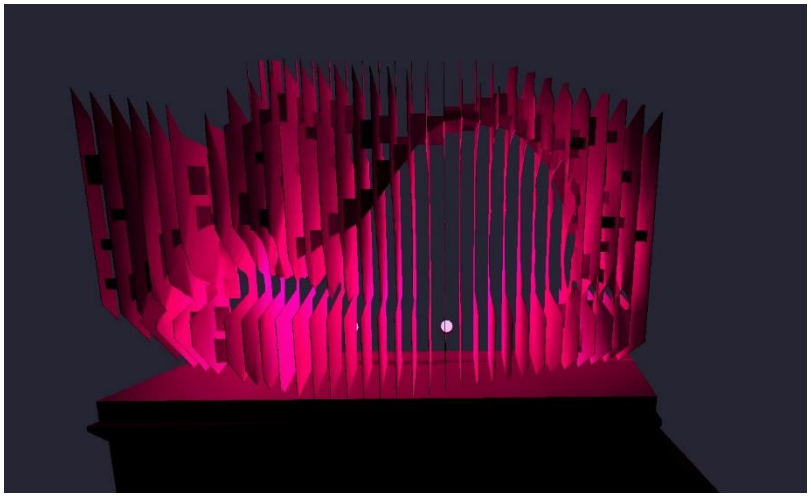
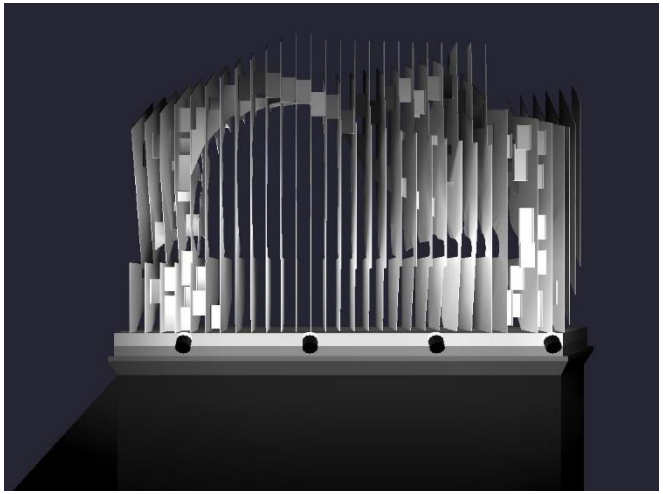
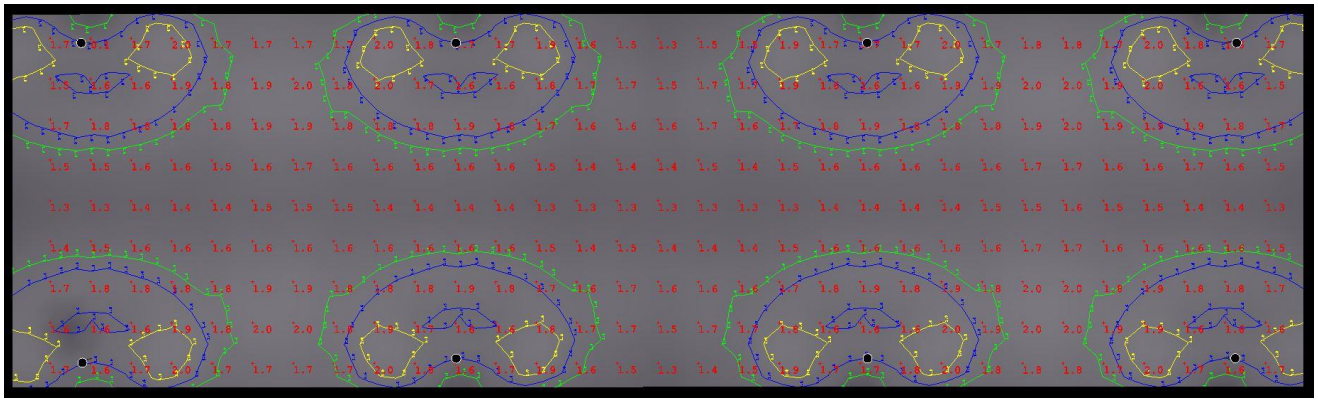


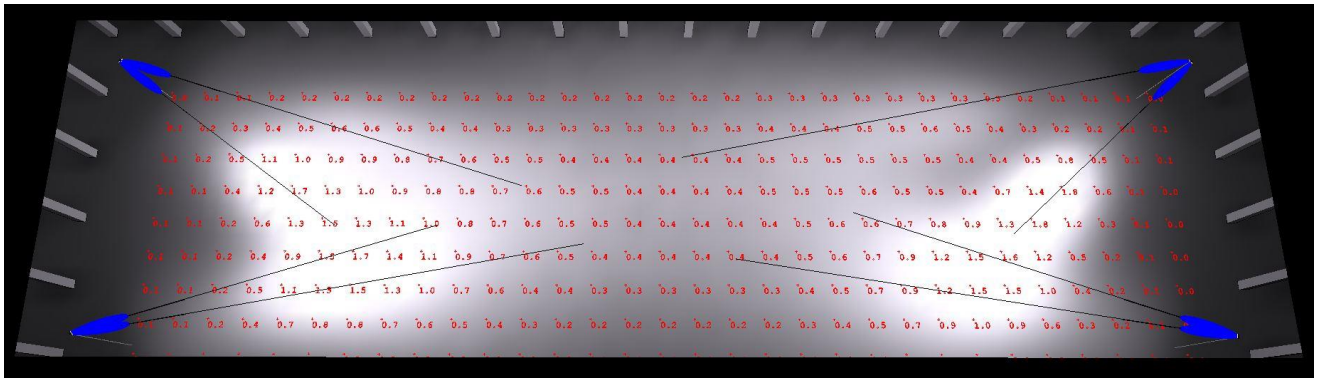




ENGINEERING

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





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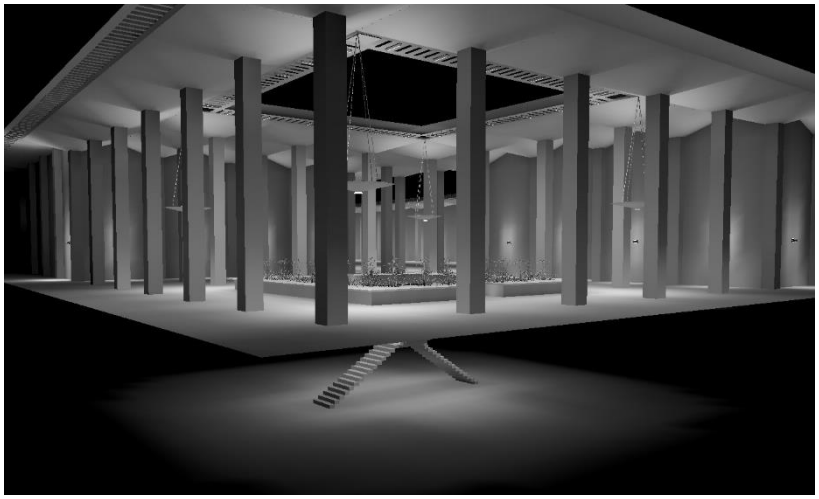
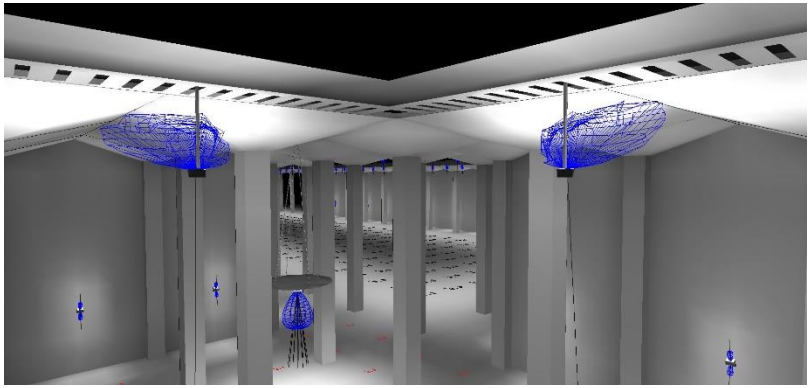
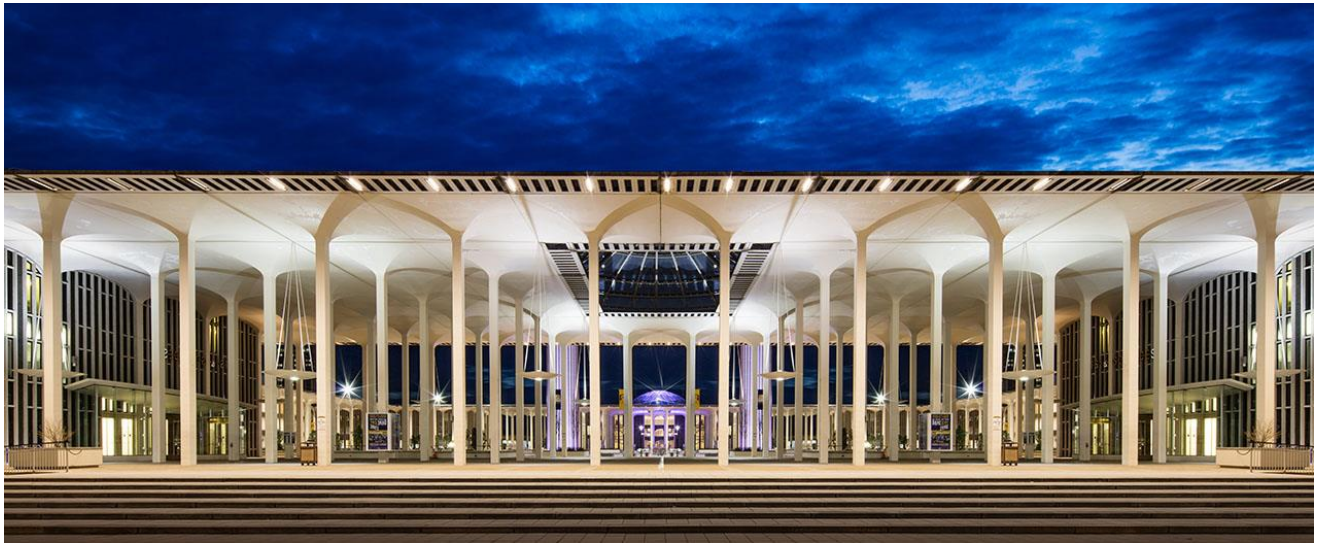




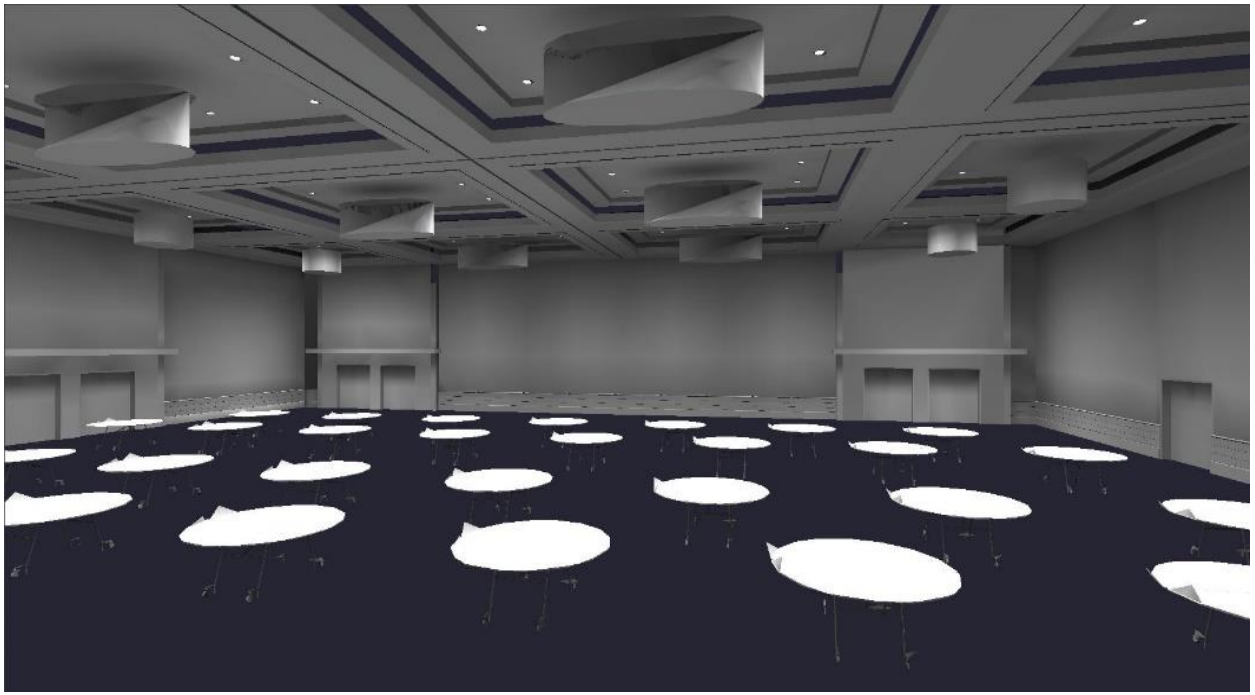


The In's & Out's of Rendering Using Lighting Software

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

ENGINEERING

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



ENGINEERING

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