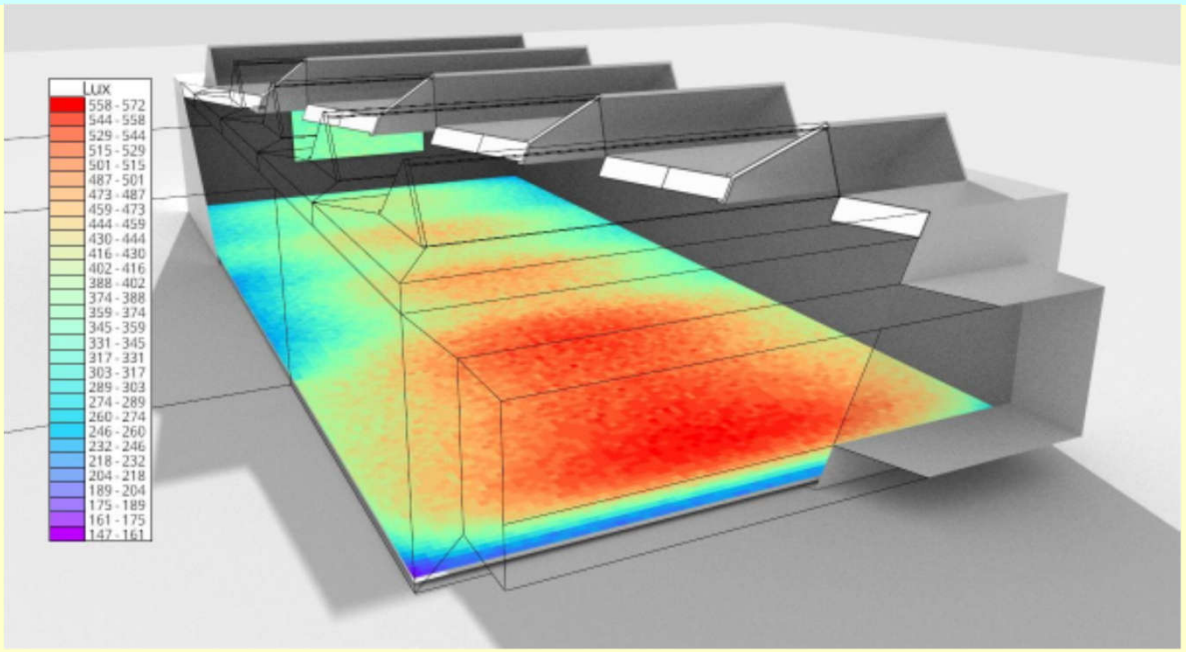
IBTM6010J Lighting Engineering

http://ibse.hk/IBTM6010J/



Computer-aided Lighting Design

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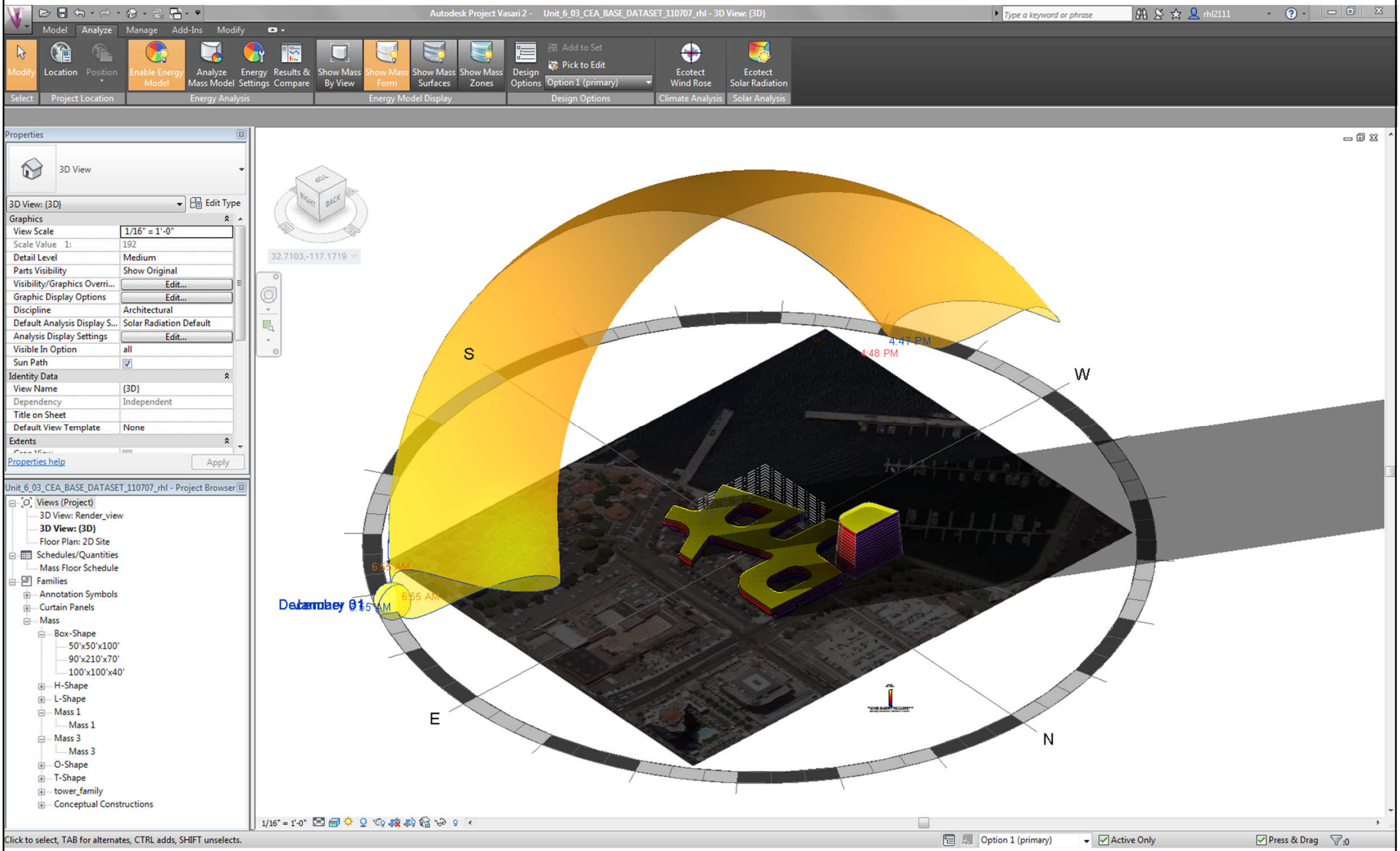
Contents

- Computer-aided design
- Practical examples
- Lighting software
- Lighting simulation
- Online tools

Computer-aided design

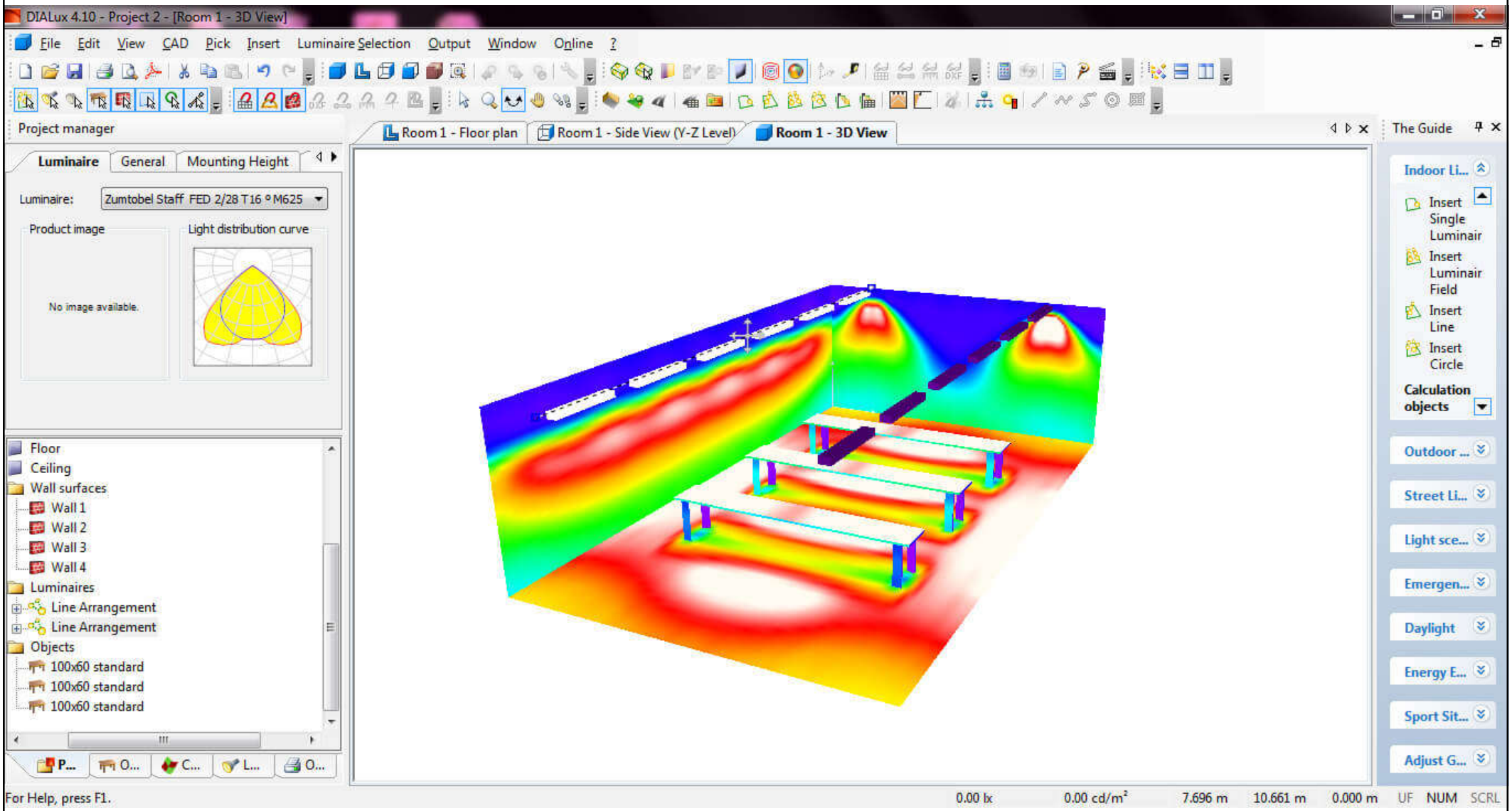
- Lighting designers often use computer software as a design tool to complement & contribute to the design process
  - Perform simple calculations, develop lighting concept & strategy (for design/control)
  - Assist in space analysis, lighting layouts, or specification of lighting products
  - Provide photo-realistic rendering & visualization
  - Check compliance with building energy codes & green building rating systems (e.g. LEED)

Conceptual energy analysis: study how the sun affects the design



(Source: Autodesk Project Vasari (retired))

Lighting calculations & simulation with DIALux 4.10 (now replaced by DIALux evo)



(Source: DIALux http://www.dial.de/)

Lighting calculations & analysis using ADELINE & Radiance

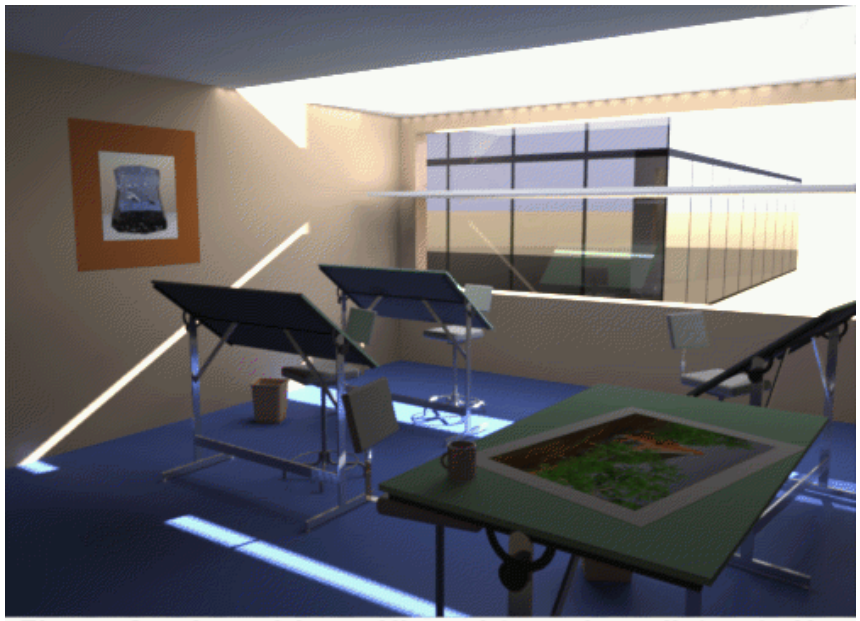


Figure 9a. A drafting office with a mirror light shelf slicing the window and redirecting light upwards.

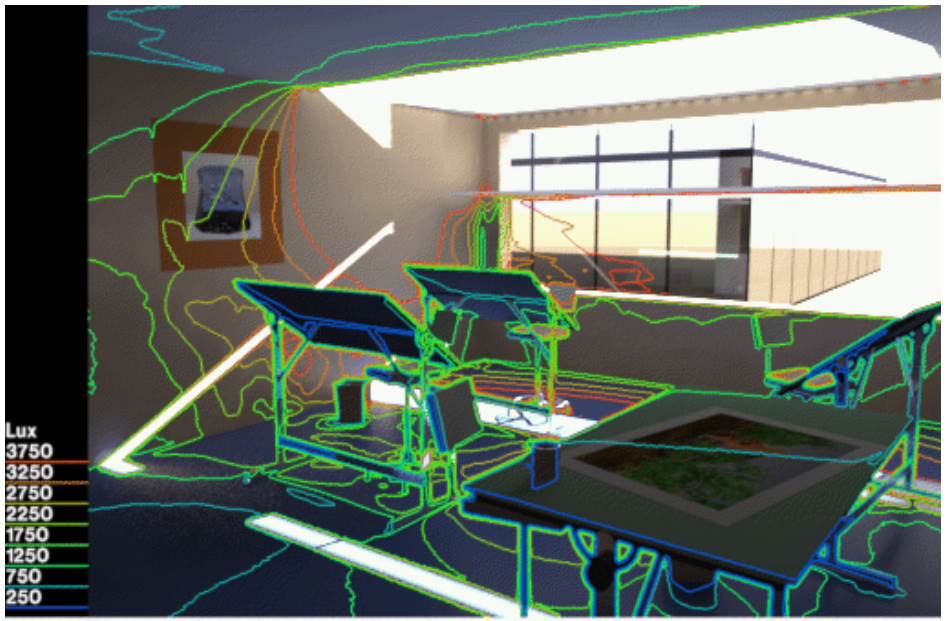


Figure 9c. A visualization of the illuminance levels on the room surfaces in the drafting office.

(Source: http://radsite.lbl.gov/radiance/refer/)

Lighting simulation using Radiance (real vs. simulated)

Figure I-1. Real vs. Radiance simulations of conference room and bathroom.

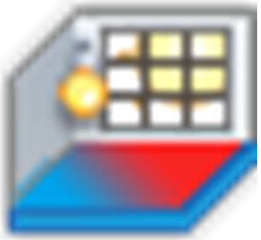
(Source: http://radsite.lbl.gov/radiance/refer/)

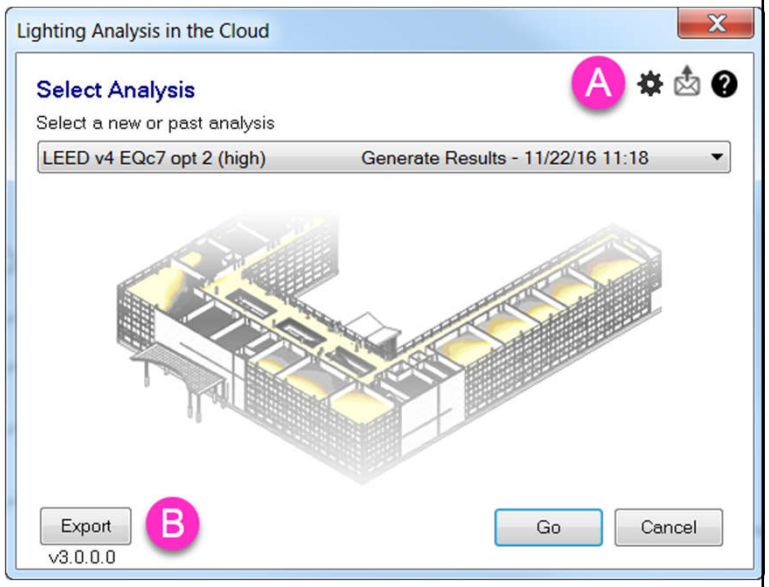
Computer-aided design

- Lighting design tools: practical application
  - Building information modelling (BIM)
    - BIM & AutoCAD library files for lighting products
    - Digital model & platform for design coordination
    - Information about building geometry, lighting products & mounting positions (BIM workflow integration)
  - Lighting analysis & simulation
    - Calculations, simulation/modelling & visualization
  - Lighting product plug-ins (from manufacturers)
    - Technical data & information for design & installation
    - Databases & standard format

Computer-aided design

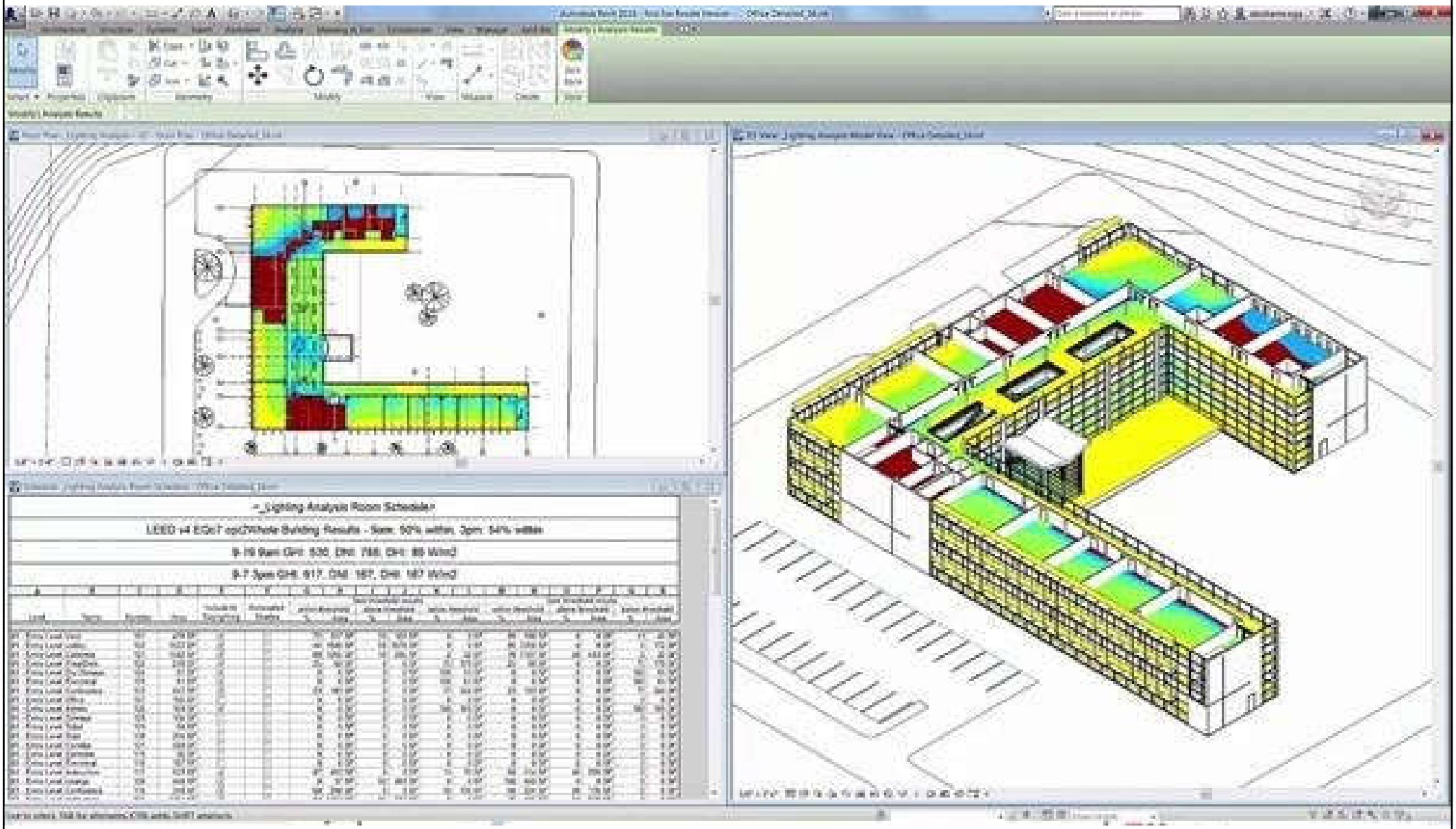
- Lighting & daylighting analysis with Revit
  - Applied to 3D & plan views of the BIM model
  - Use Autodesk A360 & Insight (in the cloud)
  - Types of analysis:
    - Illuminance analysis
    - Daylight factor
    - Spatial daylight autonomy (sDA)
    - Annual sunlight exposure (ASE)
    - LEED v4 EQc7 (sDA+ASE)
    - Solar access
  - 3D perspective illuminance rendering (in the cloud)





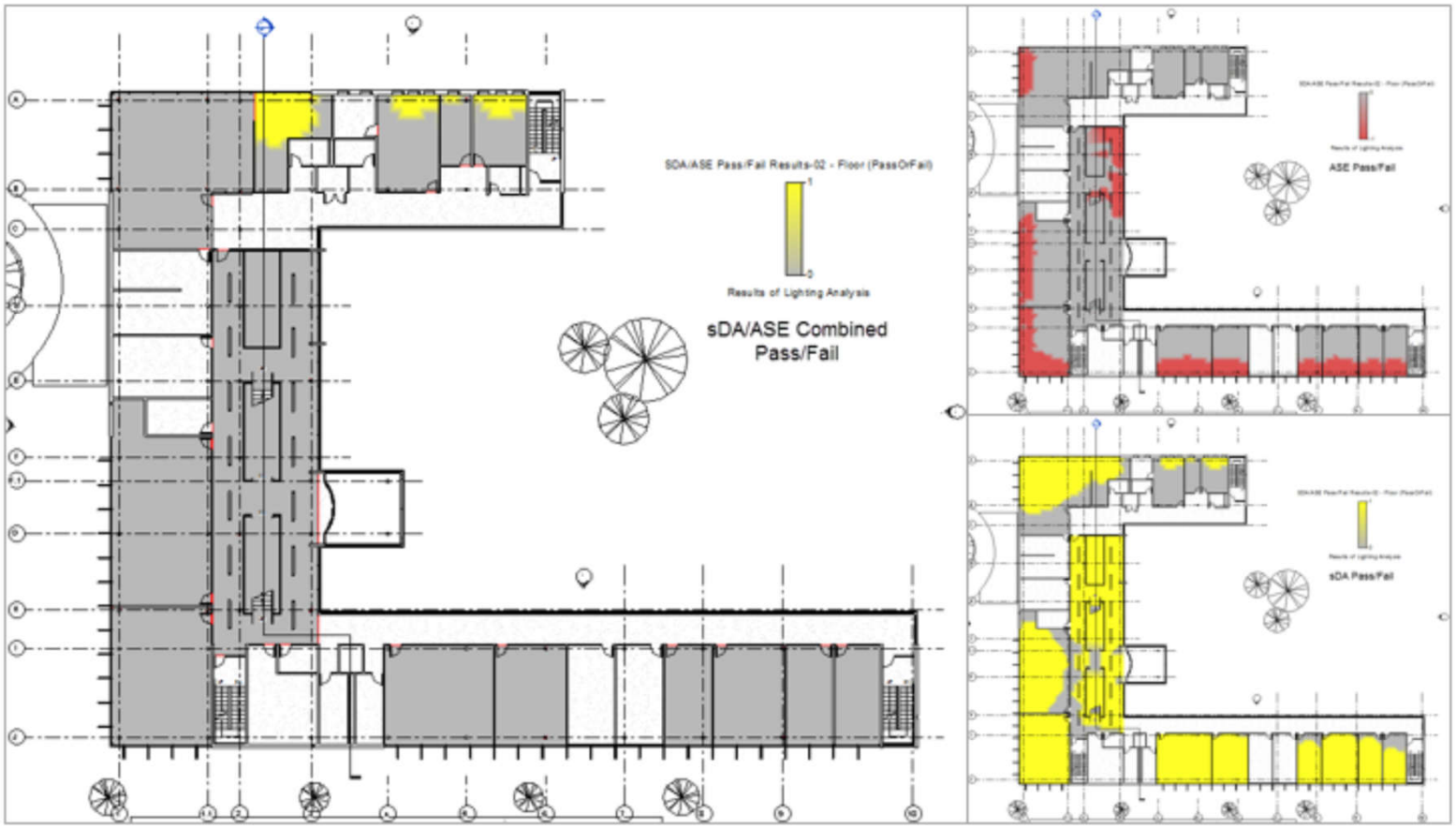
(Source: Insight lighting analysis https://parametricmonkey.com/2020/04/14/insight-lighting-analysis/)

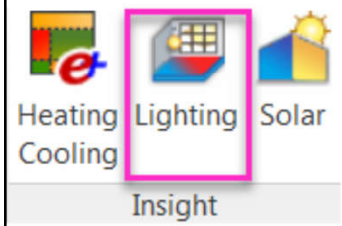
Daylighting analysis using Insight for Revit (cloud-based)



(Source: Autodesk)

Insight Lighting Analysis to produce spatial daylight autonomy (sDA) & annual sunlight exposure (ASE) results according to LEED v4 EQc7





<_Lighting Analysis Room Schedule>

LEED Daylight Autonomy Results Summary: Manchester, NH

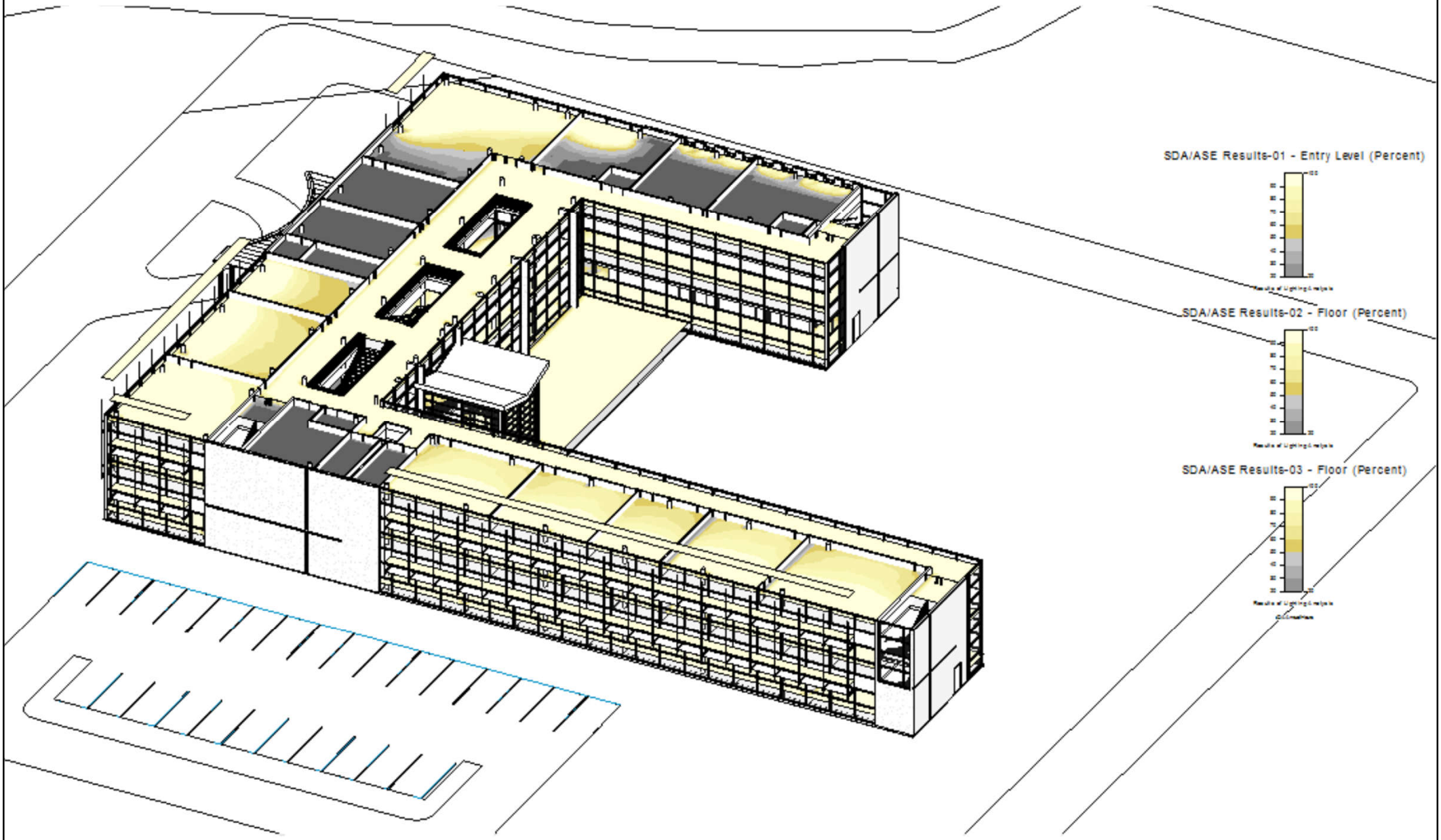
3% of Building Area meets sDA & ASE for 8:00am - 6:00pm, January 1 - December 31

LEED points for % Building Area >sDA300/50 in Rooms with ASE1000/250 < 10% of Room area - 55% (2 pts) or 75% (3 pts)

A	B	C	D	E	F	G	H	I	J	K
					sDA 300/50		ASE 1000/250		sDA/ASE	
Level	Name	Number	Area	Include In Daylighting	%	Points	%	Pass	%	Points
02 - Floor	Stair	201	19 m²	☐						
02 - Floor	Instruction	202	31 m²	☑	68	2 pt	33	No	0	none
02 - Floor	Computer Lab	203	32 m²	☑	88	3 pt	32	No	0	none
02 - Floor	Instruction	204	48 m²	☑	97	3 pt	34	No	0	none
02 - Floor	Instruction	205	32 m²	☑	82	3 pt	32	No	0	none
02 - Floor	Corridor	235	138 m²	☐						

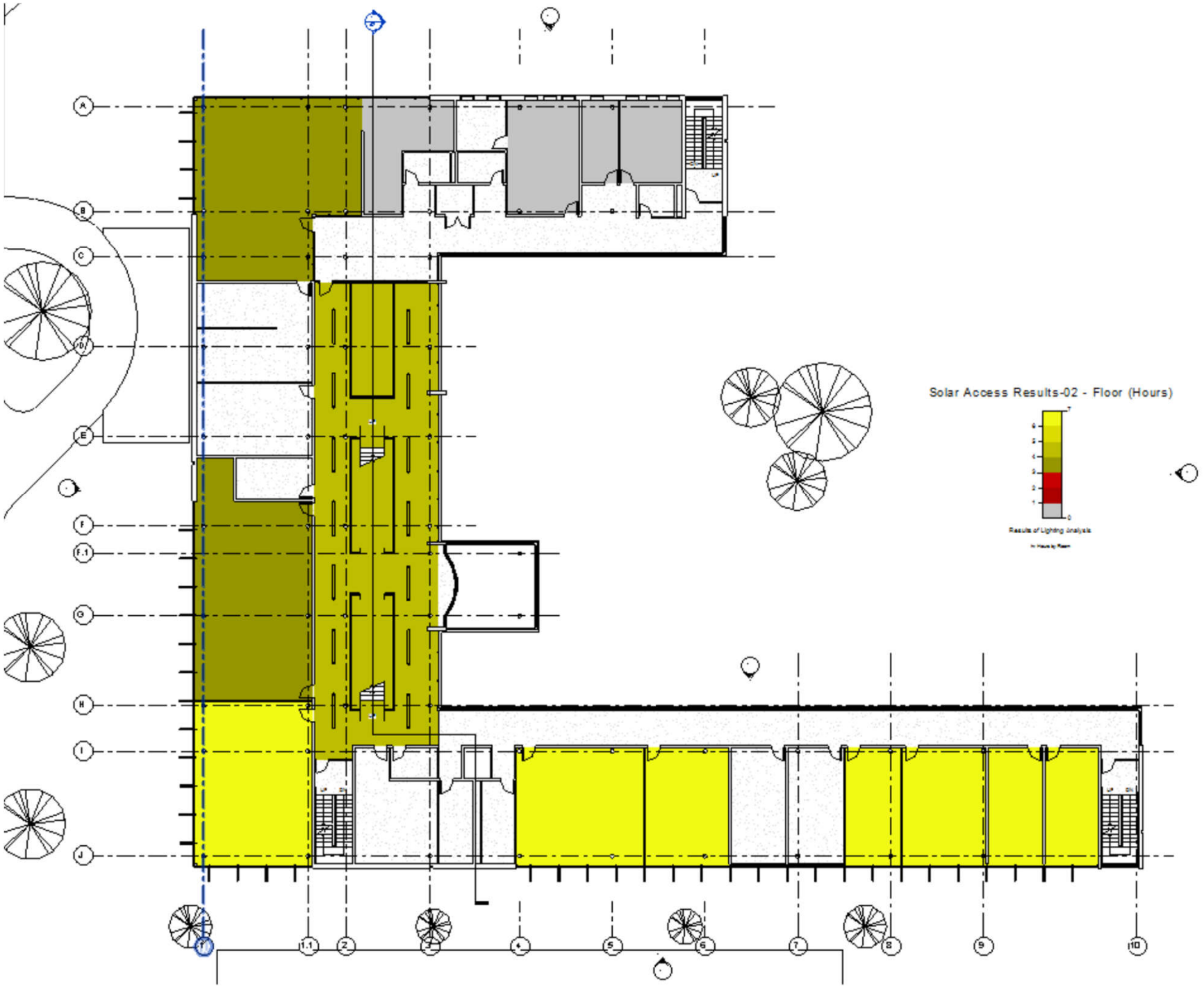
(Source: https://adskinsight.gitbooks.io/insight-lighting-analysis-help/content/leed-sda-ase-studies.html)

Insight Lighting Analysis to produce spatial daylight autonomy (sDA) & annual sunlight exposure (ASE) results according to LEED v4 EQc7



(Source: https://adskinsight.gitbooks.io/insight-lighting-analysis-help/content/leed-sda-ase-studies.html)

Insight Lighting Analysis to produce solar access results



(Source: https://adskinsight.gitbooks.io/insight-lighting-analysis-help/content/solar-access.html)

Insight Lighting Analysis to produce solar access results

<_Lighting Analysis Room Schedule>

Direct Solar Access Results Summary: Manchester, NH

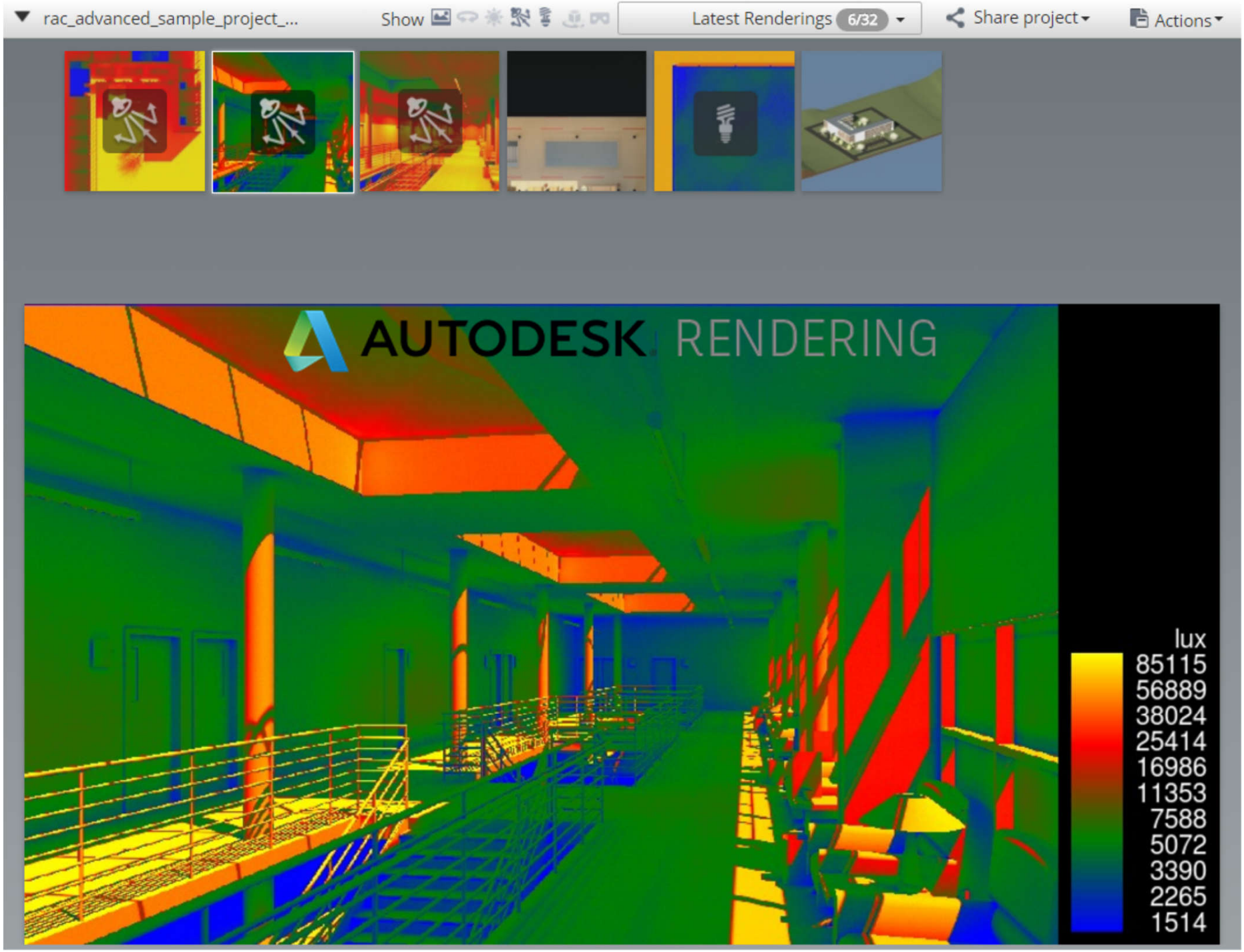
76% of Rooms Analyzed meet minimum number of hours of Direct Solar

Direct Solar - 9-21 9am to 3pm - minimum 3 hours

A	B	C	D	E	F	G
Level	Name	Number	Area	Include In Daylighting	Hours Direct Solar	
					Hours	Pass
01 - Entry Level	Vest.	101	41 m²	☑	0	No
01 - Entry Level	Lobby	102	327 m²	☑	4	Yes
01 - Entry Level	Cafeteria	121	147 m²	☑	3	Yes
01 - Entry Level	Prep/Dish	122	22 m²	☑	0	No
01 - Entry Level	Dry Storage	124	8 m²	☐		
01 - Entry Level	Electrical	125	6 m²	☐		
01 - Entry Level	Conference	123	42 m²	☑	0	No
01 - Entry Level	Office	127	15 m²	☐		
01 - Entry Level	Admin	126	16 m²	☐		
01 - Entry Level	Storage	128	10 m²	☐		
01 - Entry Level	Toilet	129	6 m²	☐		
01 - Entry Level	Stair	130	19 m²	☐		

(Source: https://adskinsight.gitbooks.io/insight-lighting-analysis-help/content/solar-access.html)

3D perspective illuminance rendering with Autodesk A360



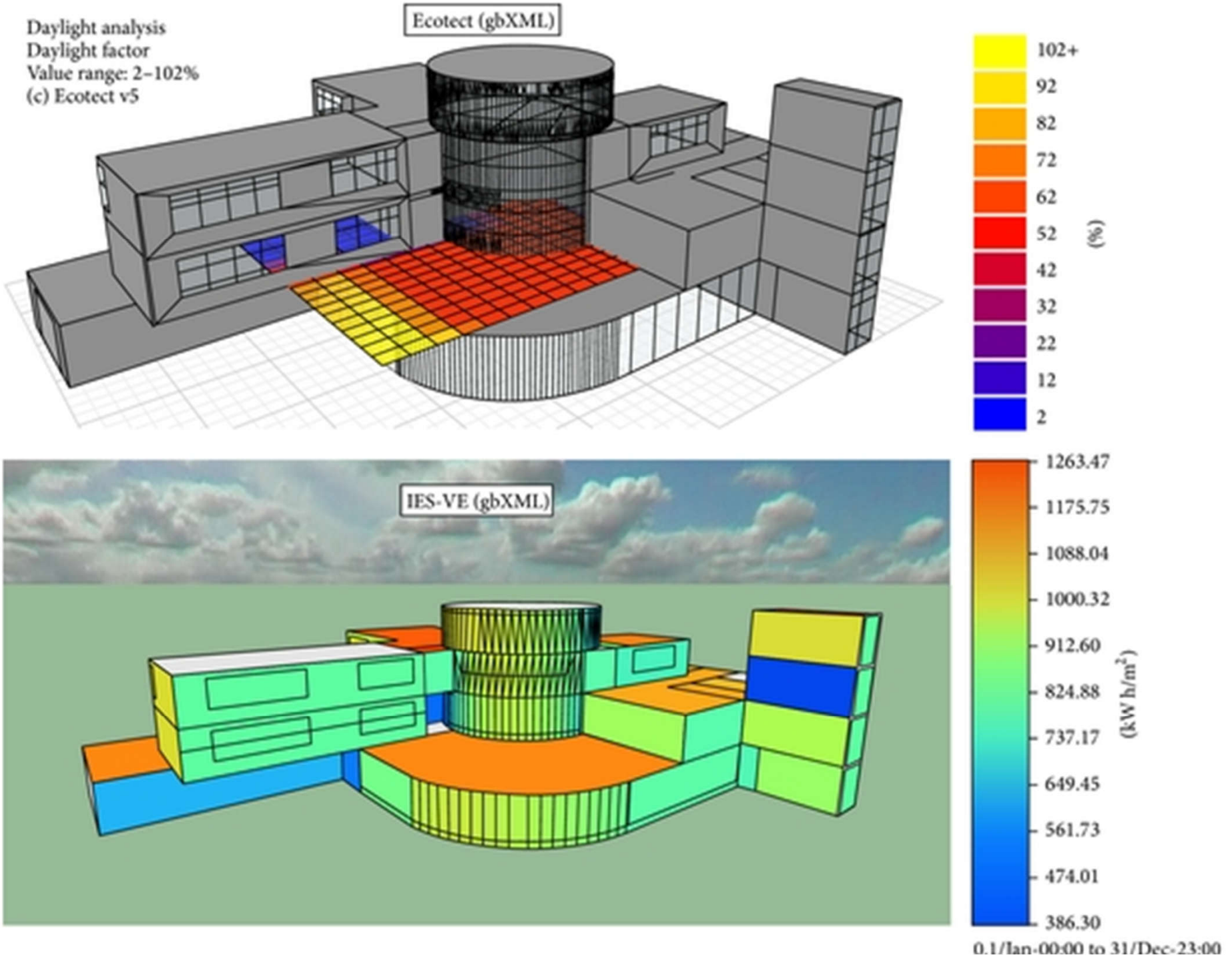
(Source: https://adskinsight.gitbooks.io/insight-lighting-analysis-help/content/perspective-illuminance-renderings.html)

Computer-aided design

- Daylight simulation & lighting design with IESVE
  - Daylight modelling & daylight autonomy
    - Daylight factor & useful daylight illuminance (UDI)
  - Daylight, sunlight & overshadowing analysis
    - Spatial daylight autonomy & annual sunlight exposure
  - Daylight harvesting & dimming control assessments
  - Daylight credits for LEED, BREEAM & WELL
  - Uniformity, luminance & glare prediction

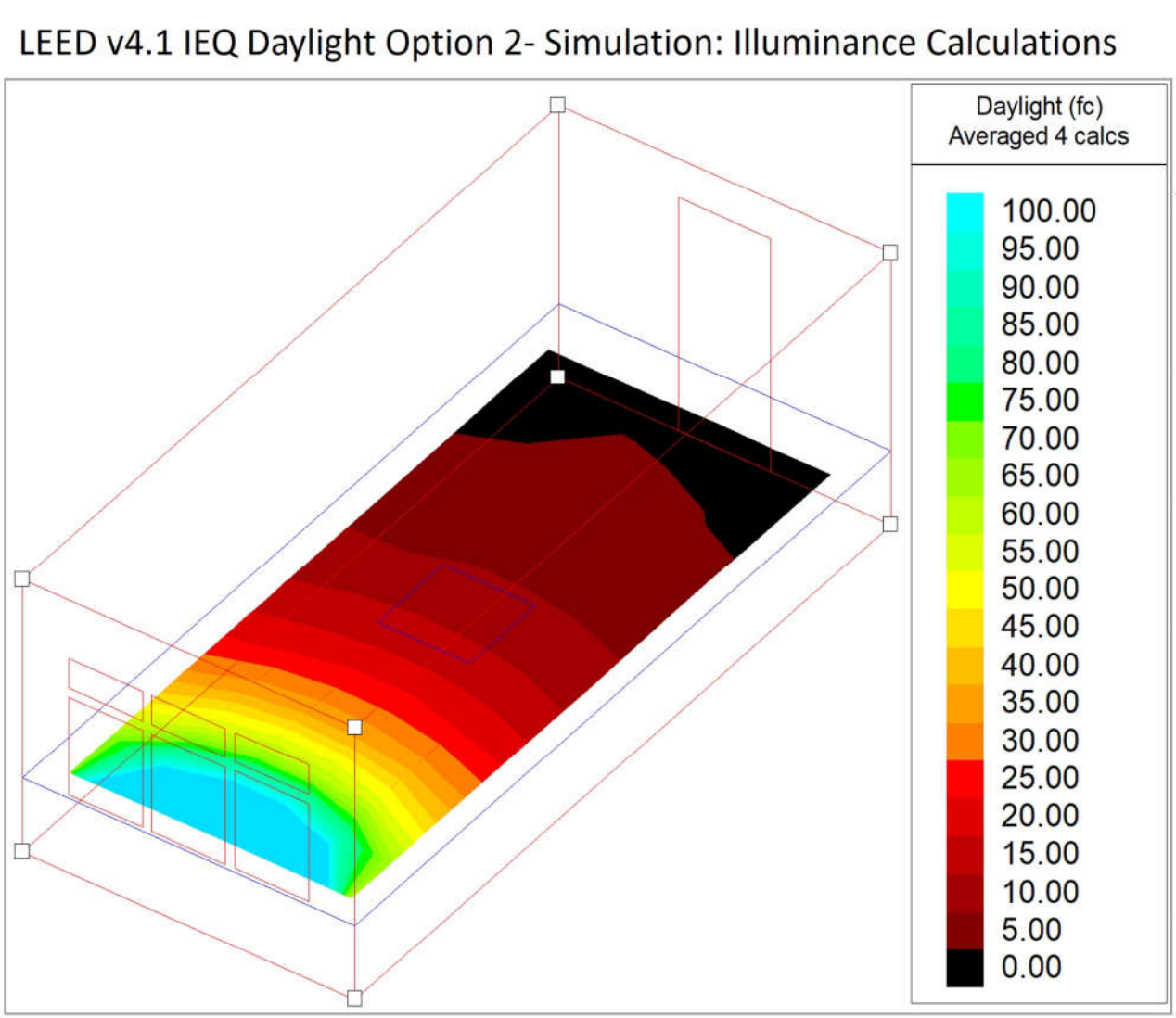
(Source: https://www.iesve.com/software/daylighting-and-lighting-design)

Snapshot of the daylighting simulation in Ecotect & IES-VE

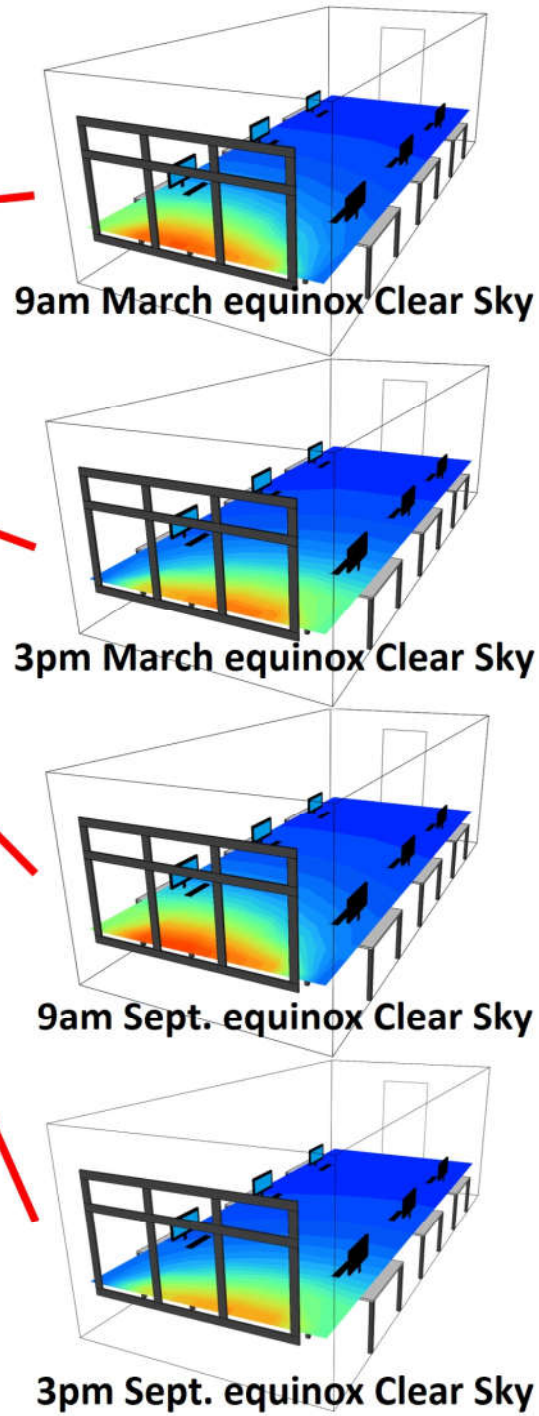


(Source: https://www.researchgate.net/figure/Snapshot-of-the-sample-daylighting-simulation-in-Ecotect-and-IES-VE_fig7_286297458)

LEED v4.1 IEQ Daylight (Option 2) simulation: illuminance calculations

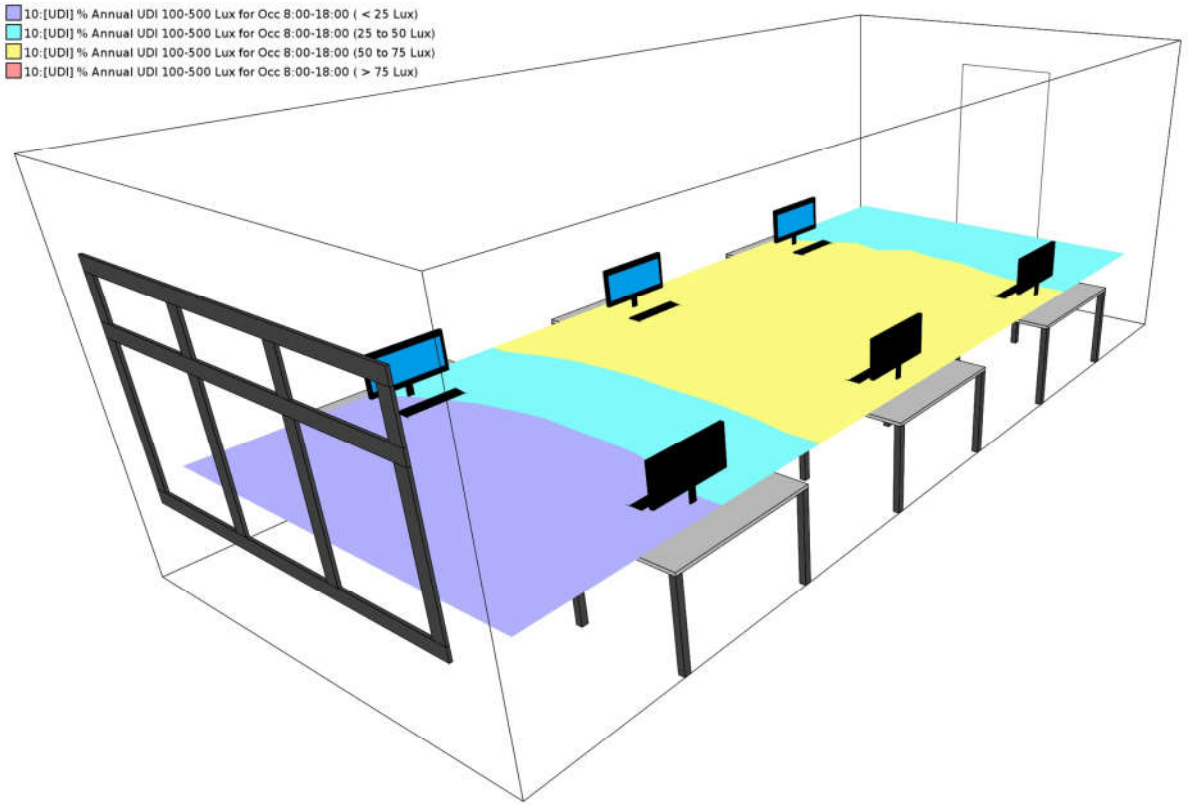


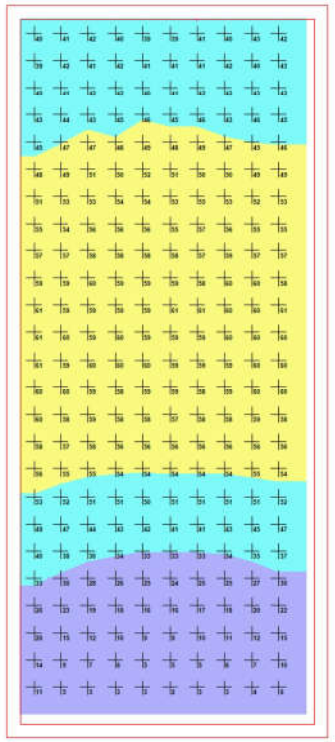
New Construction, Core and Shell, Schools, Retail, Data Centers, Warehouses and Distribution Centers, Hospitality		*Healthcare*	
Percentage of regularly occupied floor area	*Points*	*Percentage of regularly occupied floor area within perimeter area*	*Points*
55%	1	55%	1
75%	2	75%	2
90%	3	90%	Exemplary performance



(Source: https://www.iesve.com/discoveries/article/3813/ten-key-daylight-and-electric-metrics)

Useful daylight illuminance (UDI) simulations with IESVE



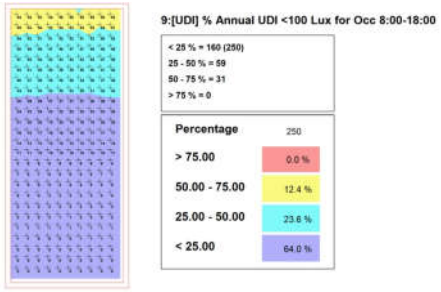


[UDI] % Annual UDI 100-500 Lux for Occ 8:00-18:00

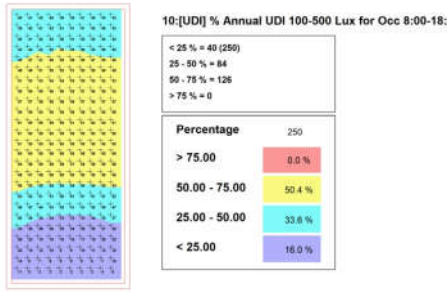
< 25 % = 40 (250)
25 - 50 % = 84
50 - 75 % = 126
> 75 % = 0

Percentage	250
> 75.00	0.0 %
50.00 - 75.00	50.4 %
25.00 - 50.00	33.6 %
< 25.00	16.0 %

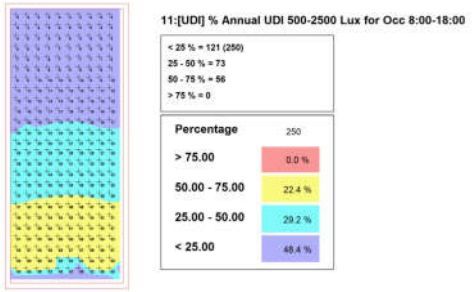
Insufficient UDI (< 100 lux)



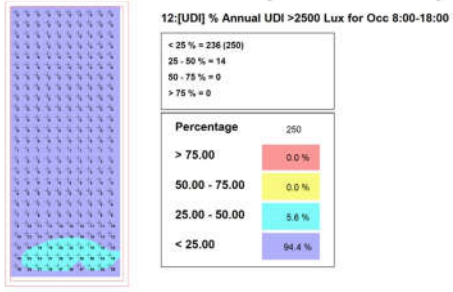
Supplementary UDI (100–500 lux)



Autonomous UDI (500–2,500 lux)

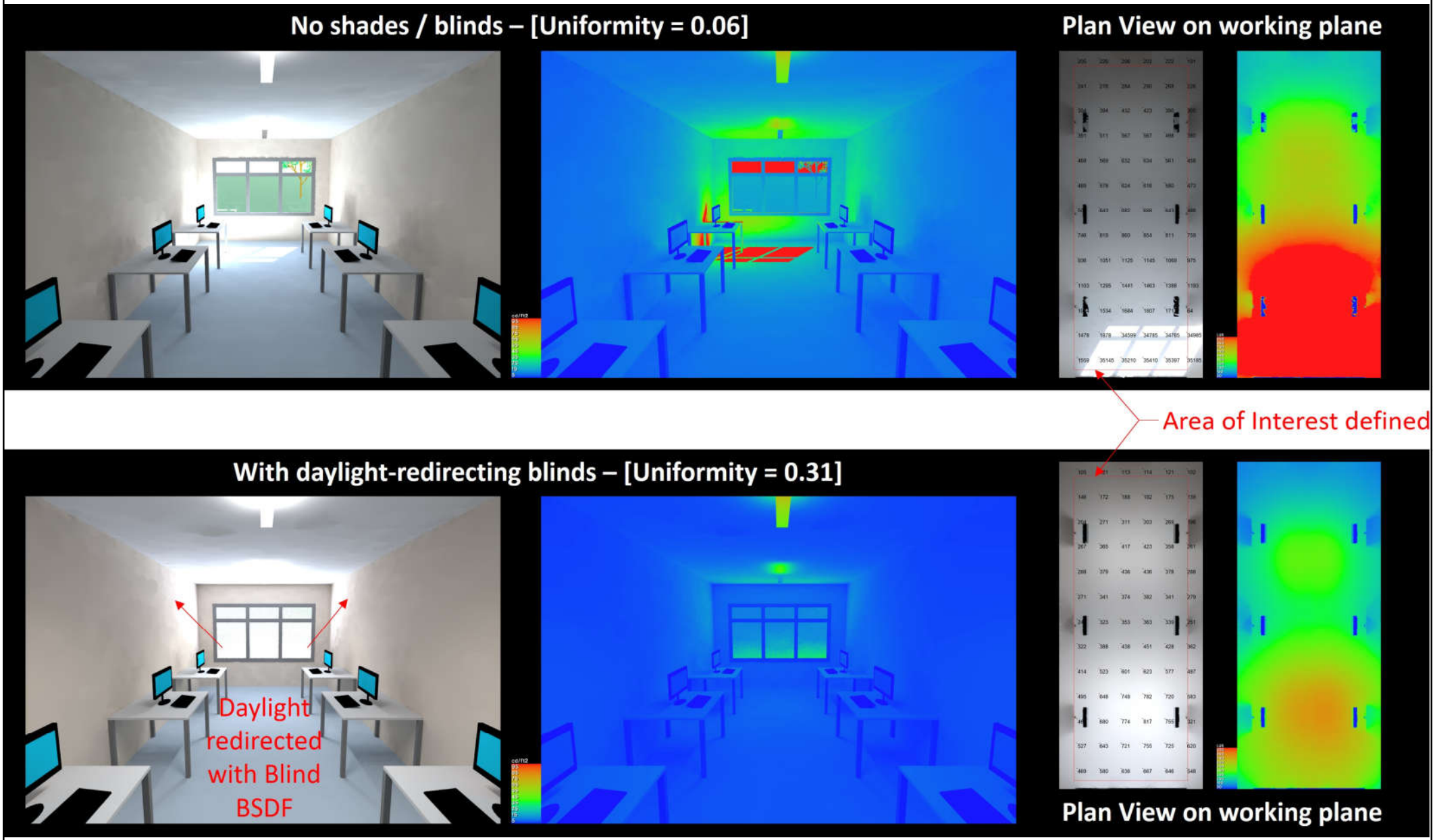


Exceedance UDI (> 2,500 lux)



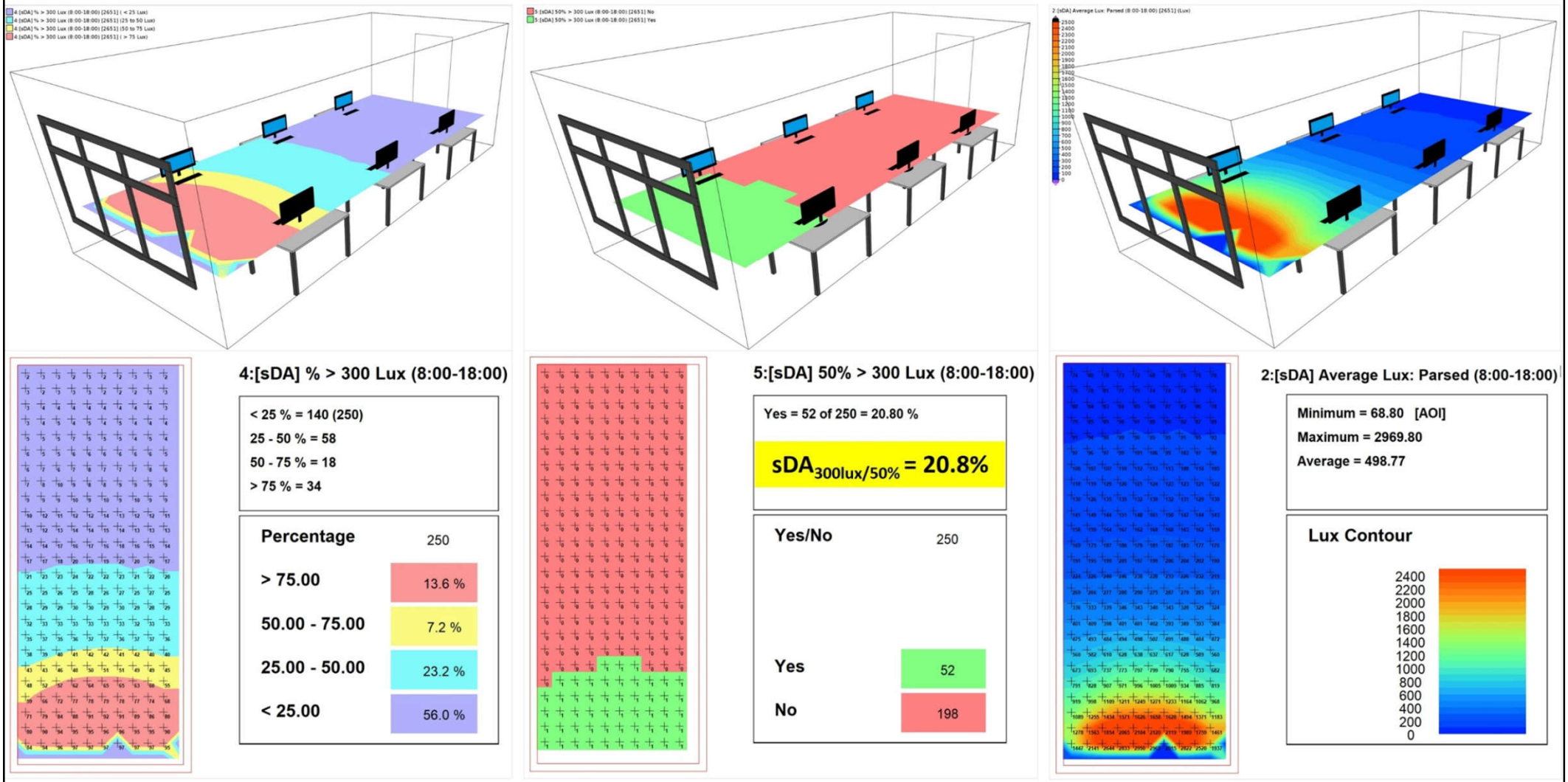
(Source: https://www.iesve.com/discoveries/article/3813/ten-key-daylight-and-electric-metrics)

Uniformity calculations & daylight factor simulations with IESVE



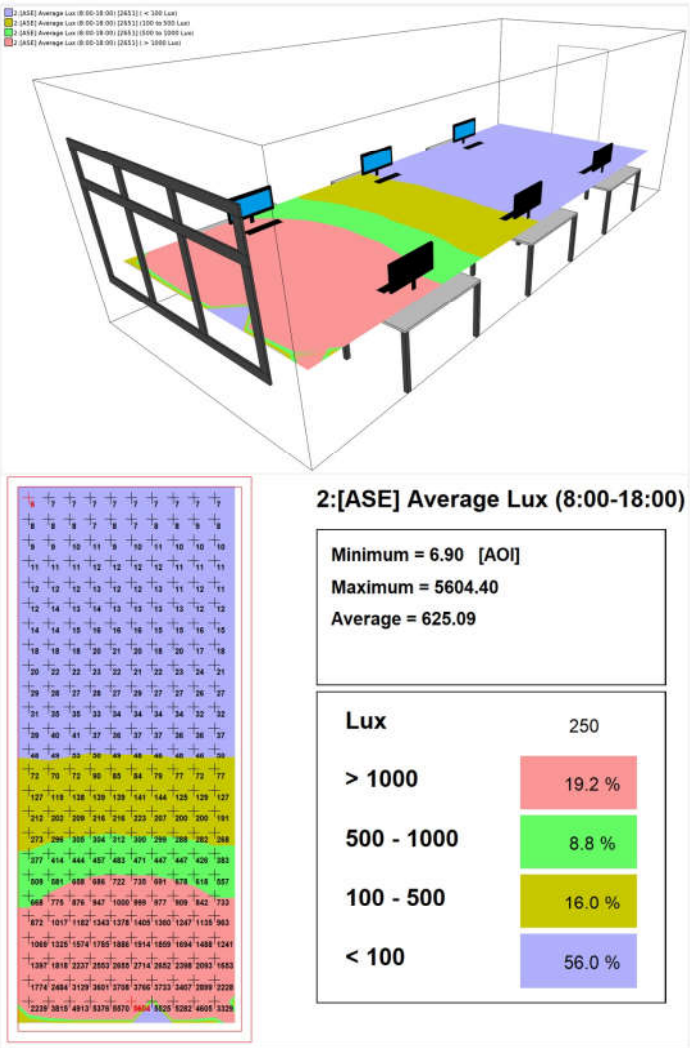
(Source: https://www.iesve.com/discoveries/article/3813/ten-key-daylight-and-electric-metrics)

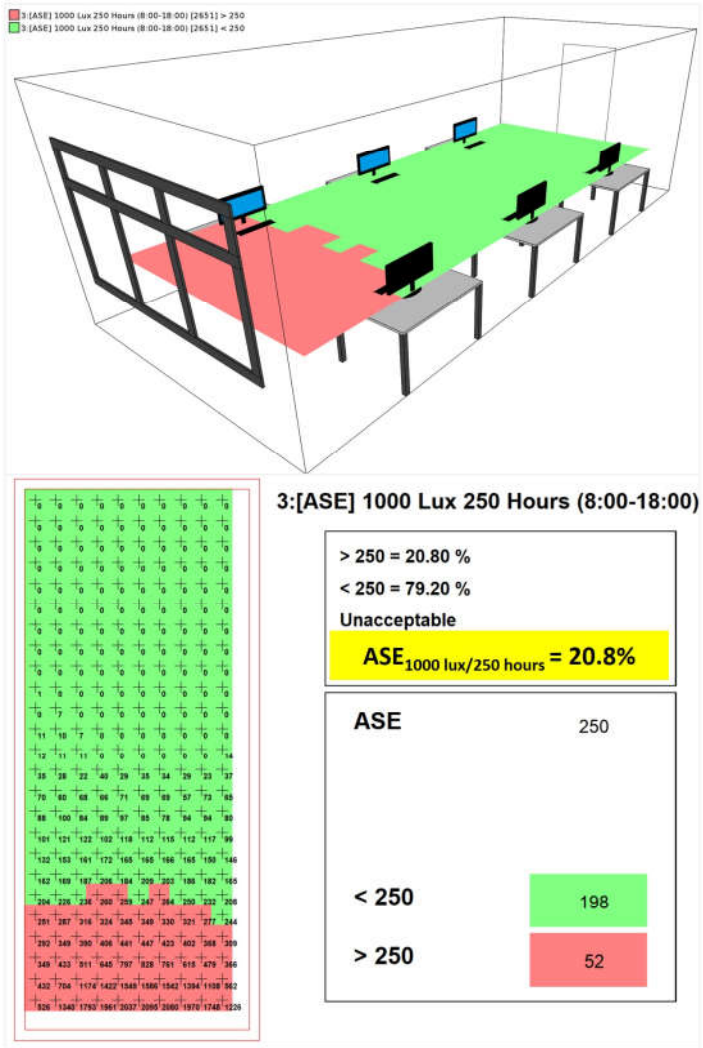
Spatial daylight autonomy (sDA) analysis with IESVE

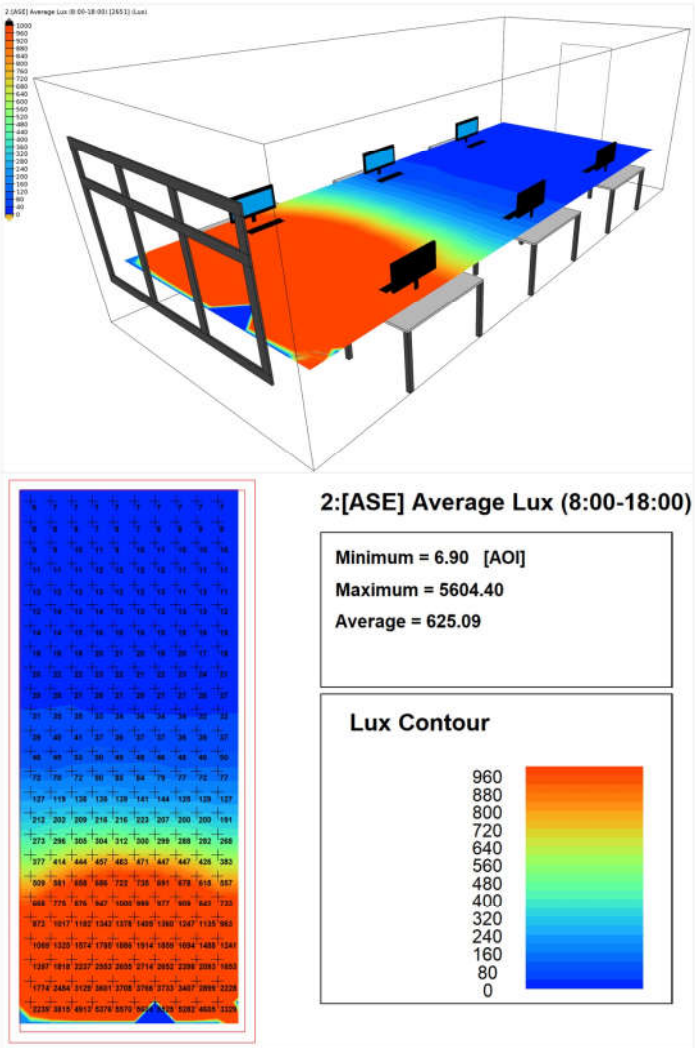


(Source: https://www.iesve.com/discoveries/article/3813/ten-key-daylight-and-electric-metrics)

Annual sunlight exposure (ASE) analysis with IESVE





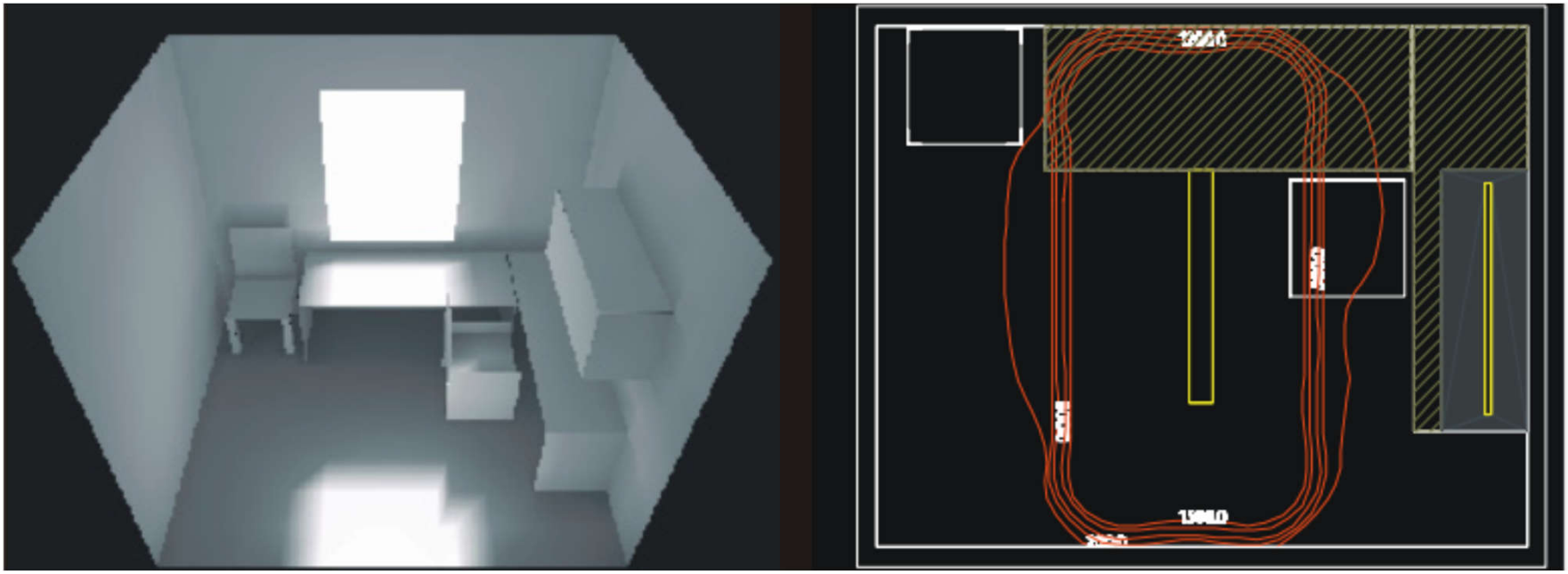


(Source: https://www.iesve.com/discoveries/article/3813/ten-key-daylight-and-electric-metrics)

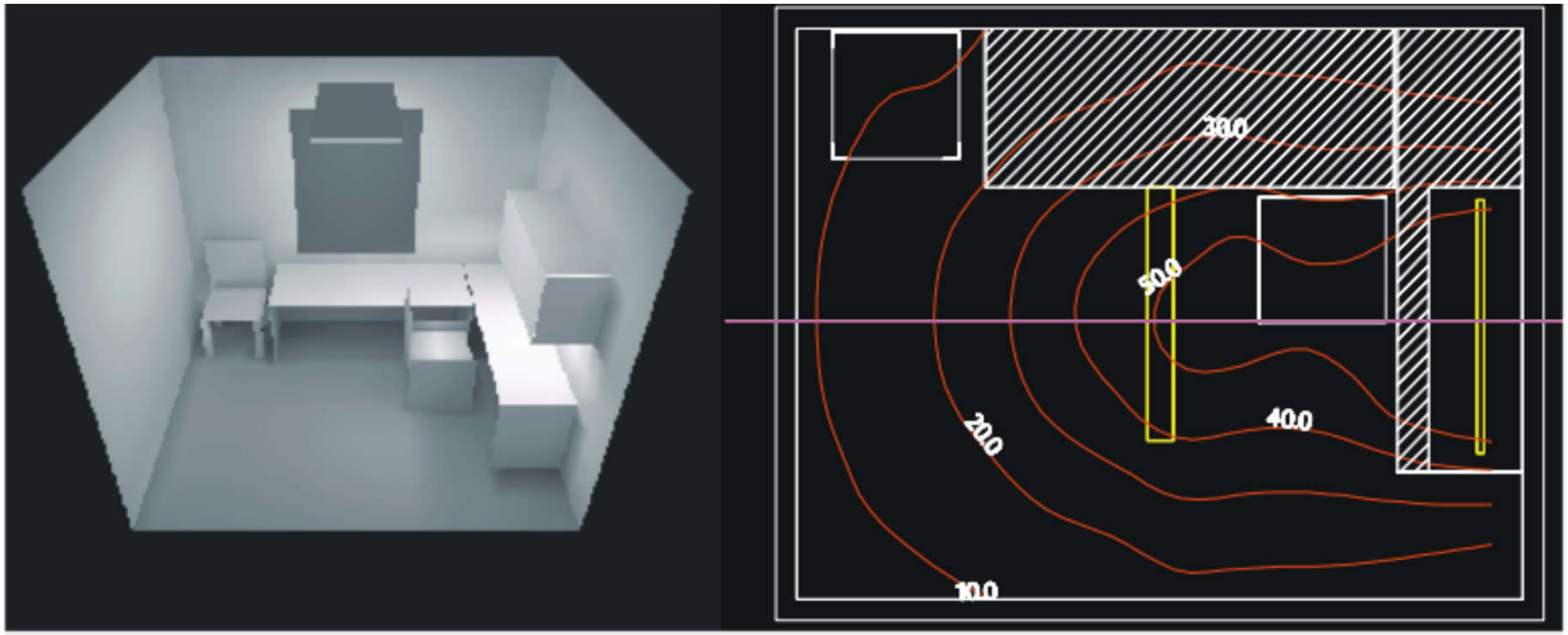
Practical examples

- 1. Private office & small work rooms
  - With a window for admitting daylight
  - General lighting (on ceiling): recessed indirect luminaire, two F32 T8 lamps
  - Task light: under cabinet, one F25 T8 lamp
  - Analyse light distribution at daytime & nighttime
- 2. Open office plan areas
  - Gray-scale rendering: daytime, daylight + electric light; evaluate the design & control strategies

Daylighting distribution, private office at daytime

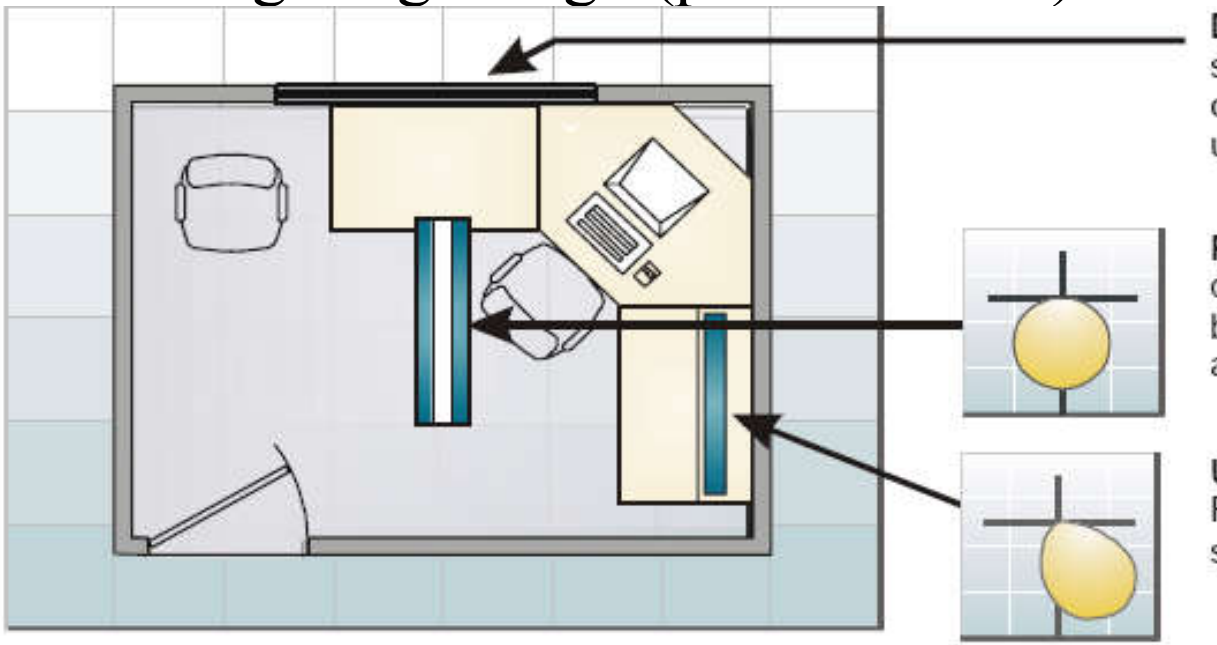


Electric lighting distribution, private office at night



(Source: Advanced Lighting Guidelines 2003)

Lighting design (private office) with one luminaire in ceiling

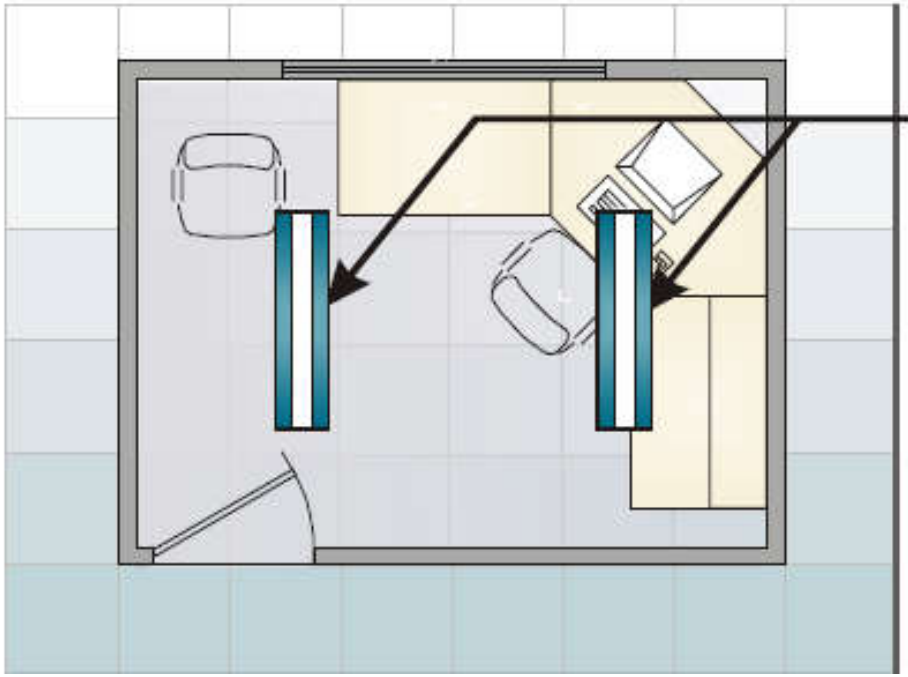


Daylight, from window with horizontal blinds, provides sufficient ambient light in space for part of the day and controls direct glare by directing direct beam sunlight upwards towards ceiling.

Recessed "indirect" basket luminaire produces direct light using two F32 T8 lamps and NLO/EE ballast. Dimming electronic ballasts allow for user and automatic photosensor control of light levels.

Under-cabinet task light, with one F25T8 lamp and RLO/EE ballast allows high illumination levels at task surface. User control or occupancy sensor.

Lighting design (private office) – alternate design with two luminaires



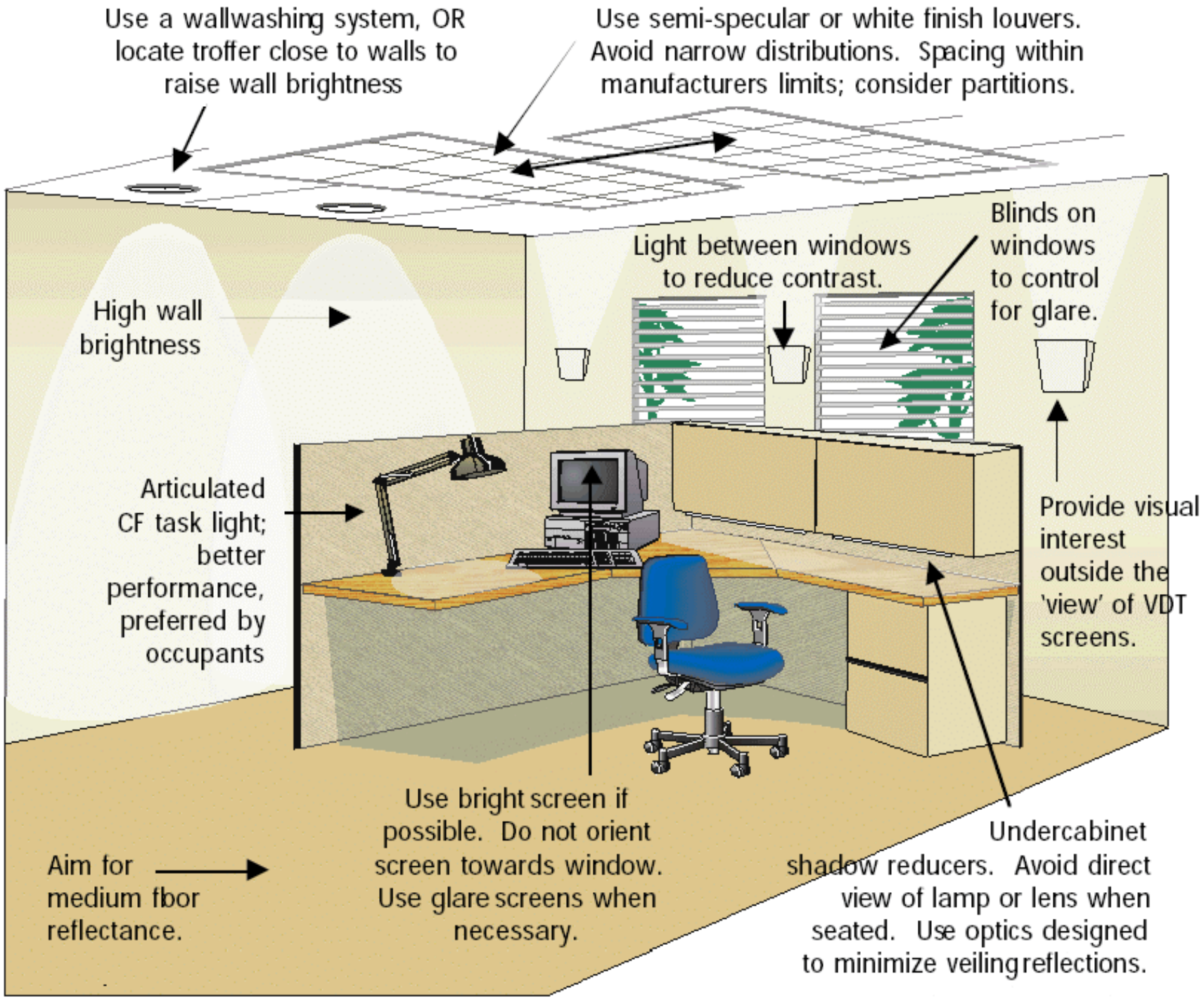
Alternate design using two recessed "indirect" basket luminaires, spaced about 6' apart, each with a single F32 T8 lamp and wired in tandem to a single NLO/EE ballast, distributes light more evenly over entire area but costs more.

(Source: Advanced Lighting Guidelines 2003)

Example of lighting design (open plan office)

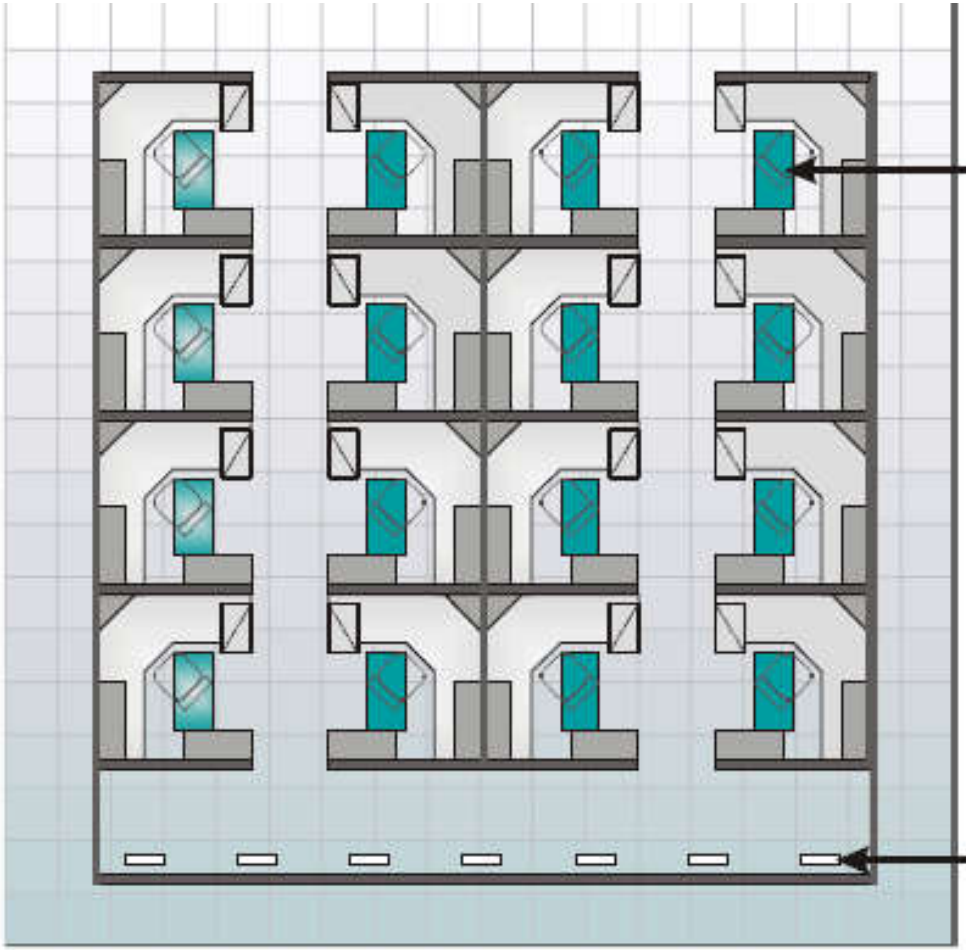
(Source: Advanced Lighting Guidelines 2003)

Lighting quality recommendations for open plan spaces



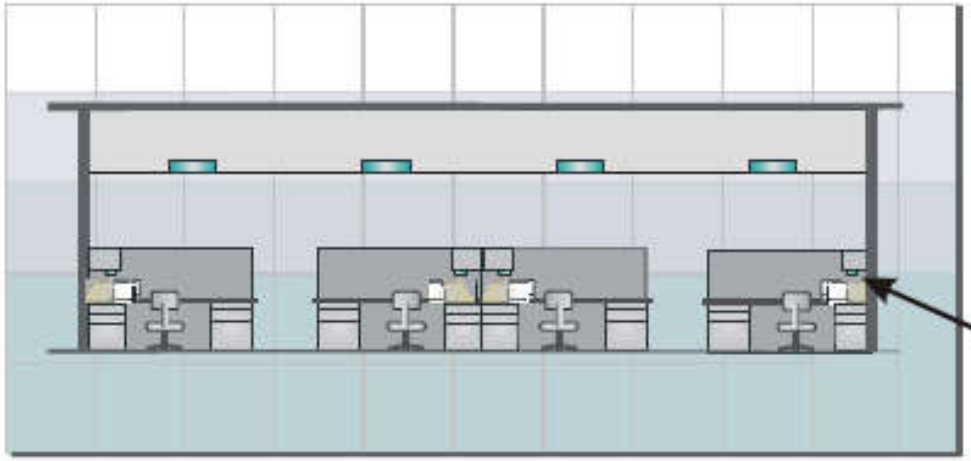
(Source: *Federal Lighting Guide*, USDOE, June 1998)

Lighting design for open plan office



Recessed parabolic 2x4 louver troffers with F32T8 lamps direct light downward over each workstation. Individual dimming ballasts allow worker control of task area light levels.

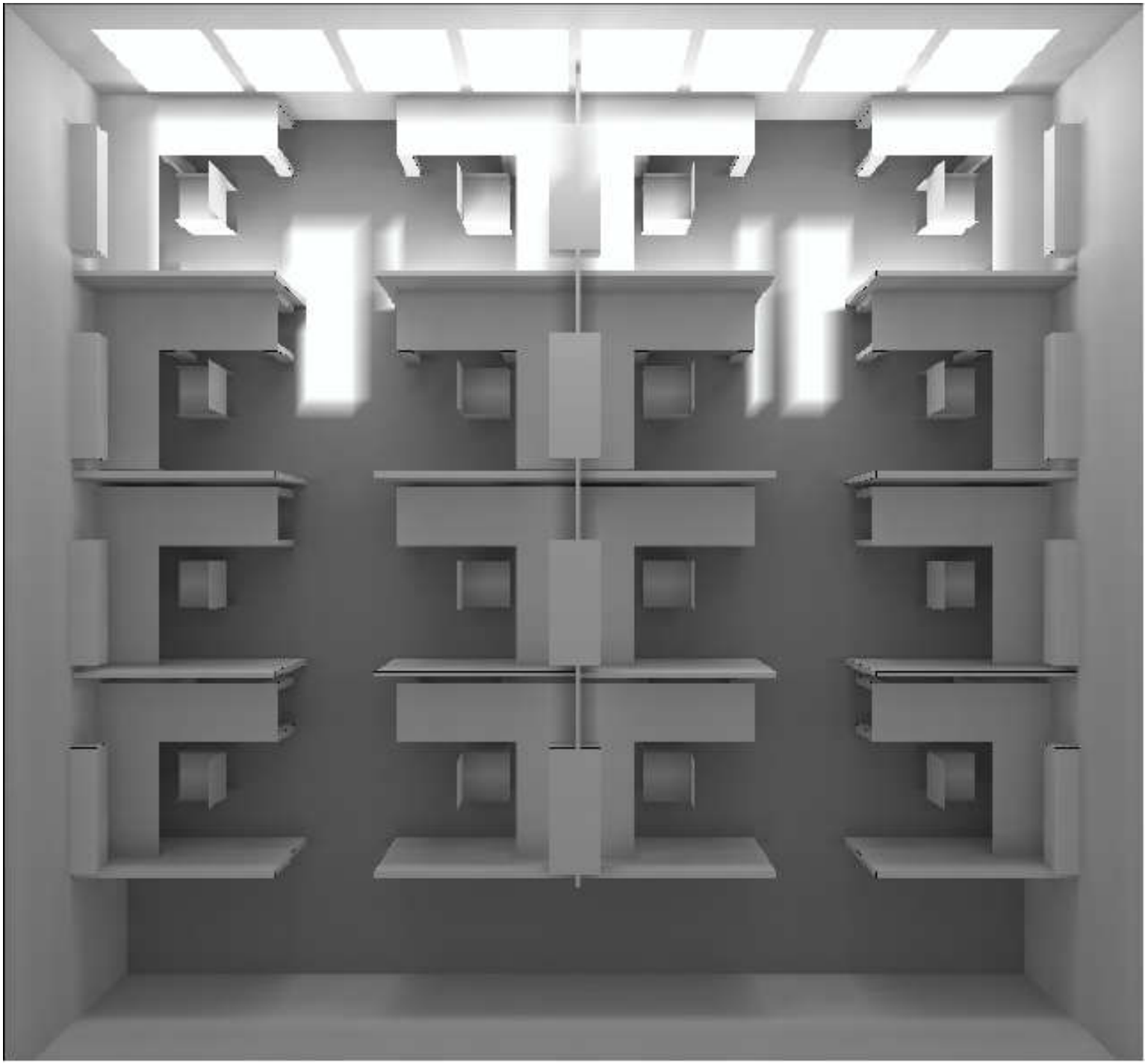
Recessed linear wallwashers, each with one CF40T5 lamp, allow a uniform wash of light from top to bottom. Control with dimming ballasts and an adaptive compensation system that dims overhead lighting at night.



Undercounter task light, with one F25T8 lamp allows high illumination levels at task surface. User control or occupancy sensor.

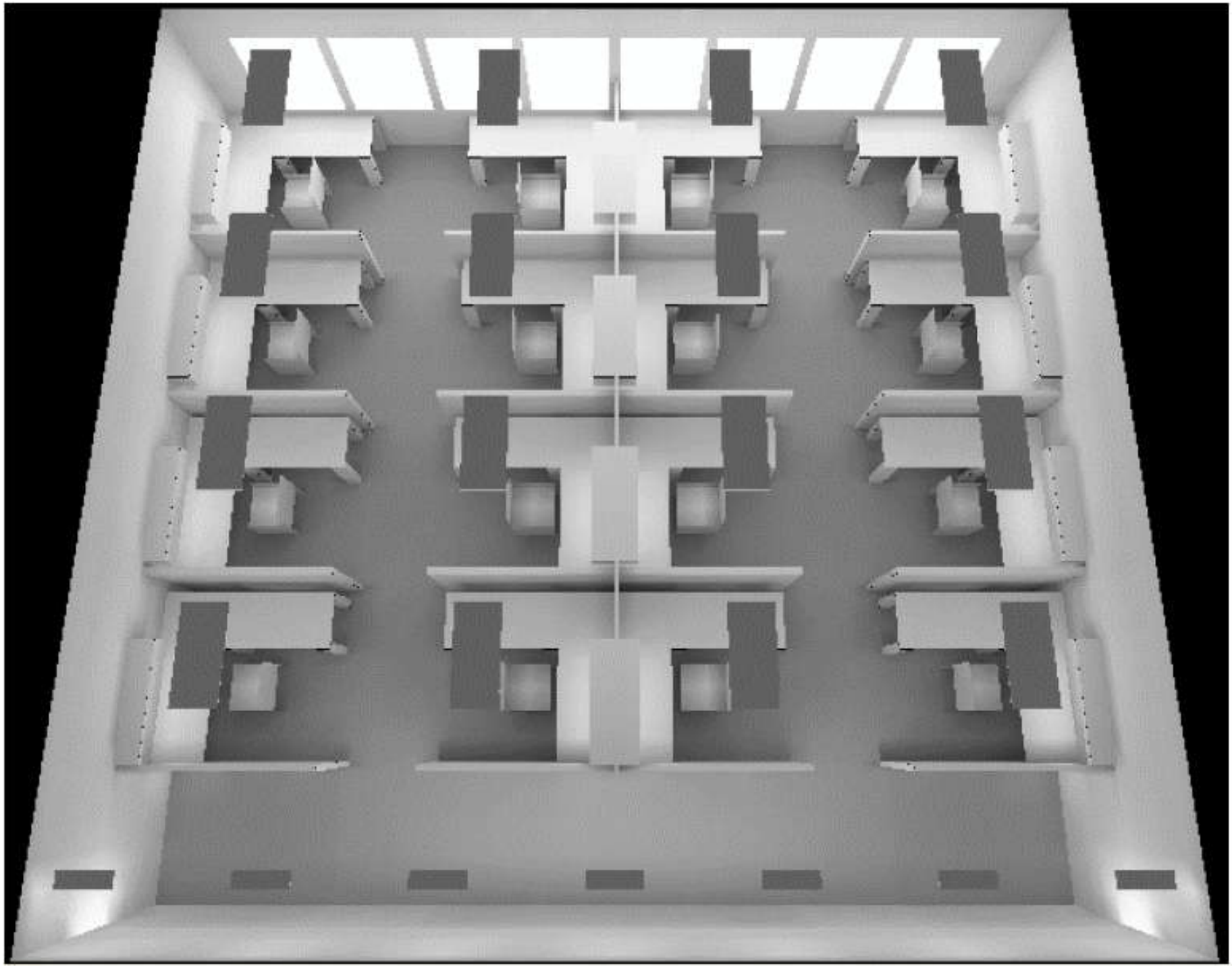
(Source: Advanced Lighting Guidelines 2003)

Gray scale rendering, open plan office (daytime)



(Source: Advanced Lighting Guidelines 2003)

Gray scale rendering, open plan office (daylight + electric light)



(Source: Advanced Lighting Guidelines 2003)

Lighting Strategies: Open Office 1

Strategy	Performance	Issues
Electric Lighting: (16) Parabolic 2x4 troffers with two F32T8 lamps, 48 W each. Task lighting using (16) undercabinet 25-W lights. Circulation areas illuminated by (7) wallwashers with CF40T5 lamps, 38 W each.	Using non-dimming, efficient electronic reduced light output (RLO) ballasts BF = 0.74–0.78, the LPD = 0.93 W/ft². The connected load is 1,418 W.	Assumes 2,700 hrs/yr use = 2.6 kWh/f2 per year, annual energy cost is about $0.25/ft² for lighting plus an amount for HVAC up to about $0.08/ft². Task lighting may be T-8, T-5, or T-2.
Minimal control: Separate manual switching near window areas. Local zone override switches or overhead occupancy sensors. "Sweep" system automatic shutoff at night.	Daylit zone switching can reduce lighting power by 50% in the space if used.	The suggested 2,700 hour annual use assumes motion sensing. Manual daylight control has been shown to be predictable, but savings will be modest.
Good control: Manual controls with automatic shutoff. Automatic daylight dimming for luminaires near windows.	The connected load will rise slightly because dimming ballasts tend to be 1.00 BF. The new connected load with all dimming ballasts will be 1,716 W, LPD = 1.12 W/ft²	Automatic balancing of light levels near windows when daylighting is abundant. With daylight zone dimming only, energy reduction will be about 25% annually compared to not dimming. Annual energy is estimated at about 0.65 (2,700 hours x 1.12 W) = 1.96 kWh per year per ft²
Optimal control: Manual controls with zone adaptive dimming and automatic shutoff on all troffers. Individual remote dimming control of overhead luminaires. Occupancy sensor for task lights, plug strip control in each workstation	As above.	Progressive, multi-zone daylight dimming allows dimming of interior zone some portion of the time. Approximate energy reduction will be about 42% annually. Annual energy is estimated at about 0.50 (2,700 hours x 1.12 W) = 1.96 kWh per year per ft² Including plug strip controls, the impact is estimated at 40% for 22% of the lighting load, making the total energy savings about 50% annually compared to the base design.

(Source: Advanced Lighting Guidelines 2003)

Lighting software

- Many of the lighting calculations can be carried out using a computer software, spreadsheet or online tools
- Common software for lighting designers:
  - 1. Manufacturers' programmes, normally linked to detailed databases of their own equipment
  - 2. General design programmes without links to any particular lighting manufacturer
  - 3. Advanced programmes with simulation & visualisation (rendering) techniques

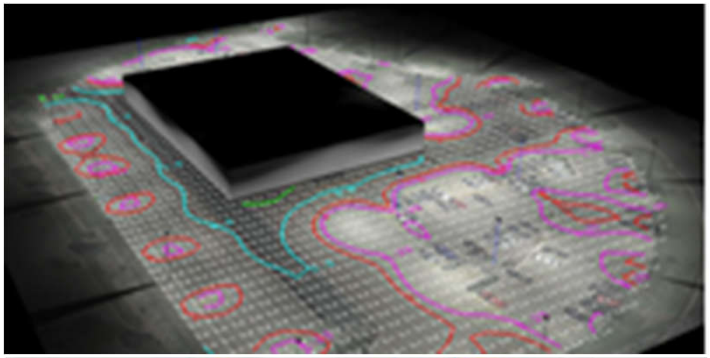
Lighting software

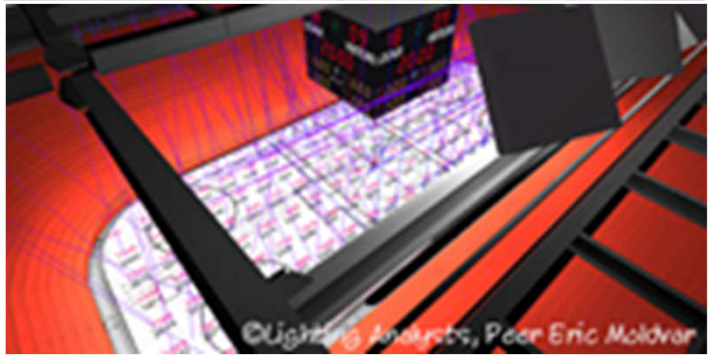
- Types of lighting related software:
  - 1. Lighting design software (e.g. AGi32, Calculux, DIALux, Radiance, Relux, Visual3D)
  - 2. Modelling & rendering software (e.g. Autodesk Maya, Blender, Houdini, Modo, Zbrush)
  - 3. Software for graphic resources (e.g. Adobe Photoshop, Adobe Illustrator, Autodesk 3ds Max, Paintshop Pro, SketchUp)
  - 4. Other tools (e.g. economic analysis, code compliance, photometric viewer)

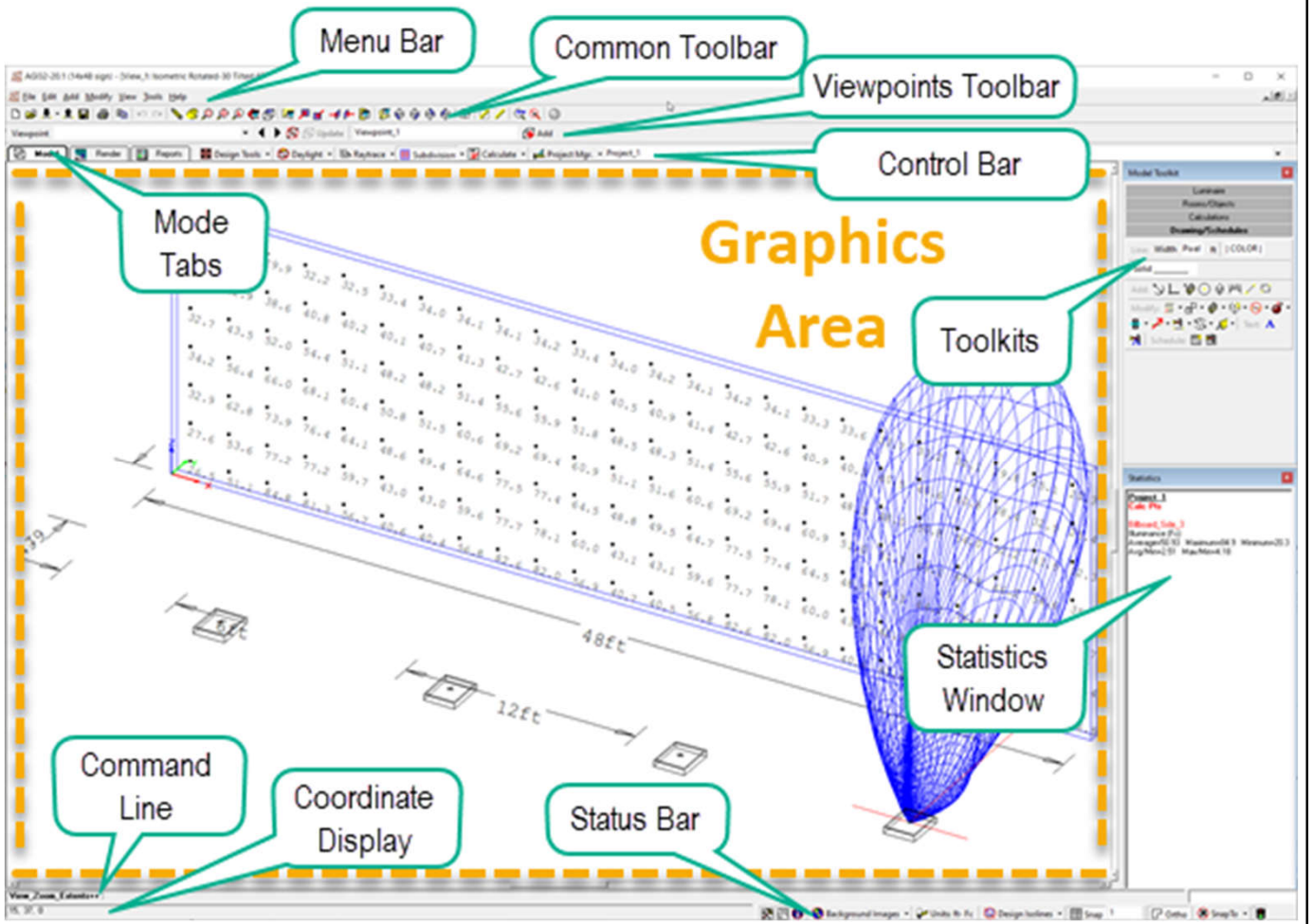
Lighting software

- Typical lighting design software:
  - AGi32 (from Lighting Analysts)
    - https://lightinganalysts.com/software-products/agi32/
  - Calculux (from Philips Lighting)
    - http://www.lighting.philips.cz/podpora/podpora-vyrobku/calculux
  - DIALux http://www.dial.de/
  - Radiance http://www.radiance-online.org/
  - Relux http://relux.com
  - Visual Lighting http://www.visual-3d.com/

AGi32 (Advanced Graphical Illumination/Interface)







(Source: https://lightinganalysts.com/software-products/agi32/; https://docs.agi32.com/AGi32/)

Lighting software

- Selected examples for study:
  - Calculux (from Philips Lighting)
    - “Calculux Indoor”: indoor lighting
    - “Calculux Area”: outdoor lighting
  - DIALux
    - Professional lighting software
    - For calculating lighting layout
    - Perform simple rendering
  - Visual Lighting (from Lightolier)
    - Basic & Professional versions
    - Simple lighting design & modelling

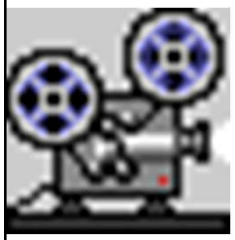
CLX

DIALux

VISUAL

Lighting software

- Calculux (from Philips Lighting)
  - Download at:
    - http://www.lighting.philips.cz/podpora/podpora-vyrobku/calculux
  - Calculux Indoor, version 5.0: indoor lighting
    - Video: video tuto calculux (9:53)
      - https://youtu.be/muh8A68-Q2A
  - Calculux Area, version 5.0/6.6 : outdoor lighting
    - Video: Calculux demonstration (2:06)
      - https://youtu.be/Am14Rs7ZXIM

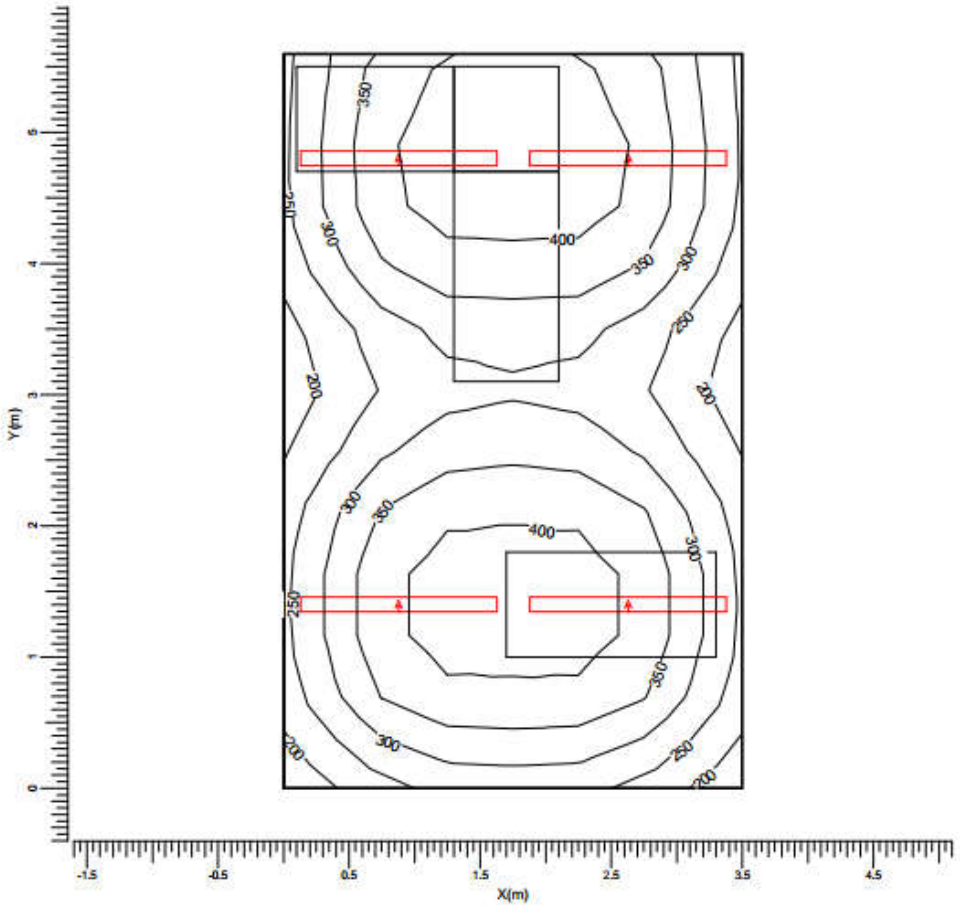


Lighting design analysis report using Calculux Indoor

3.2 Working Plane: Iso Contour

General Lighting

Grid : Working Plane at Z = 0.80 m
Calculation : Surface Illuminance (lux)
Result Type : Total



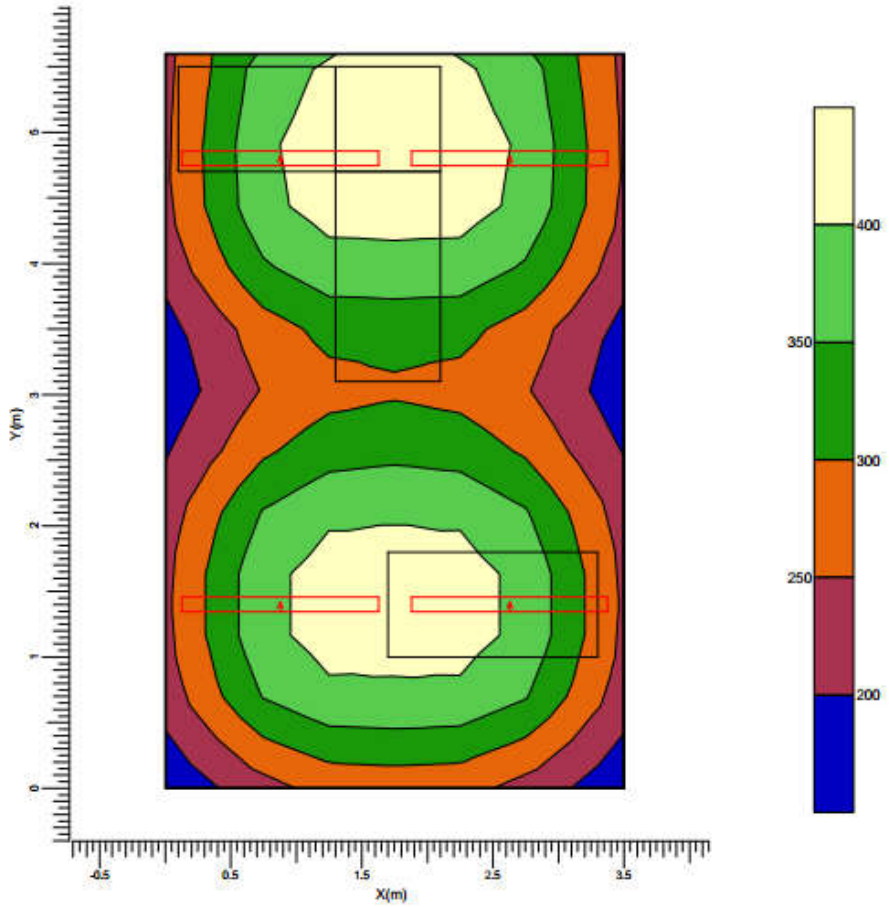
A : TBS 600/135 C7-60

Average	Min/Ave	Min/Max	Project maintenance factor	Scale
331	0.60	0.47	0.80	1:40

3.3 Working Plane: Filled Iso Contour

General Lighting

Grid : Working Plane at Z = 0.80 m
Calculation : Surface Illuminance (lux)
Result Type : Total



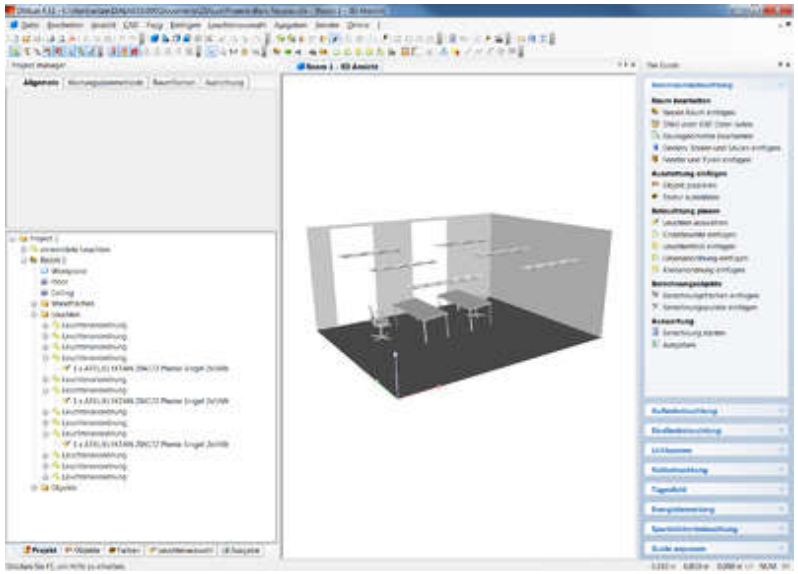
A : TBS 600/135 C7-60

Average	Min/Ave	Min/Max	Project maintenance factor	Scale
331	0.60	0.47	0.80	1:40

(Source: Philips Lighting)

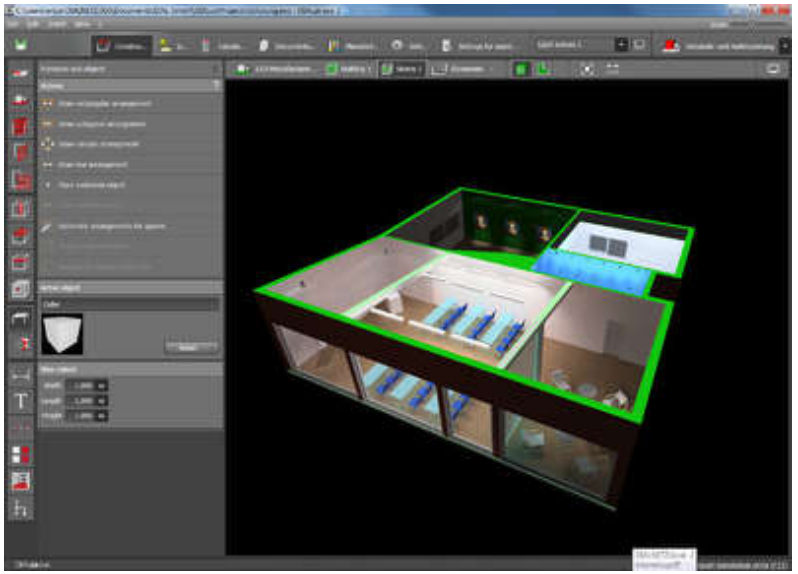
Lighting software

- DIALux (http://www.dial.de/)
  - Plan, calculate & visualize lighting for indoor & outdoor areas (latest version: DIALux evo 10)
  - Learning resources:
    - DIALux video tutorials http://www.youtube.com/user/TheDIALux



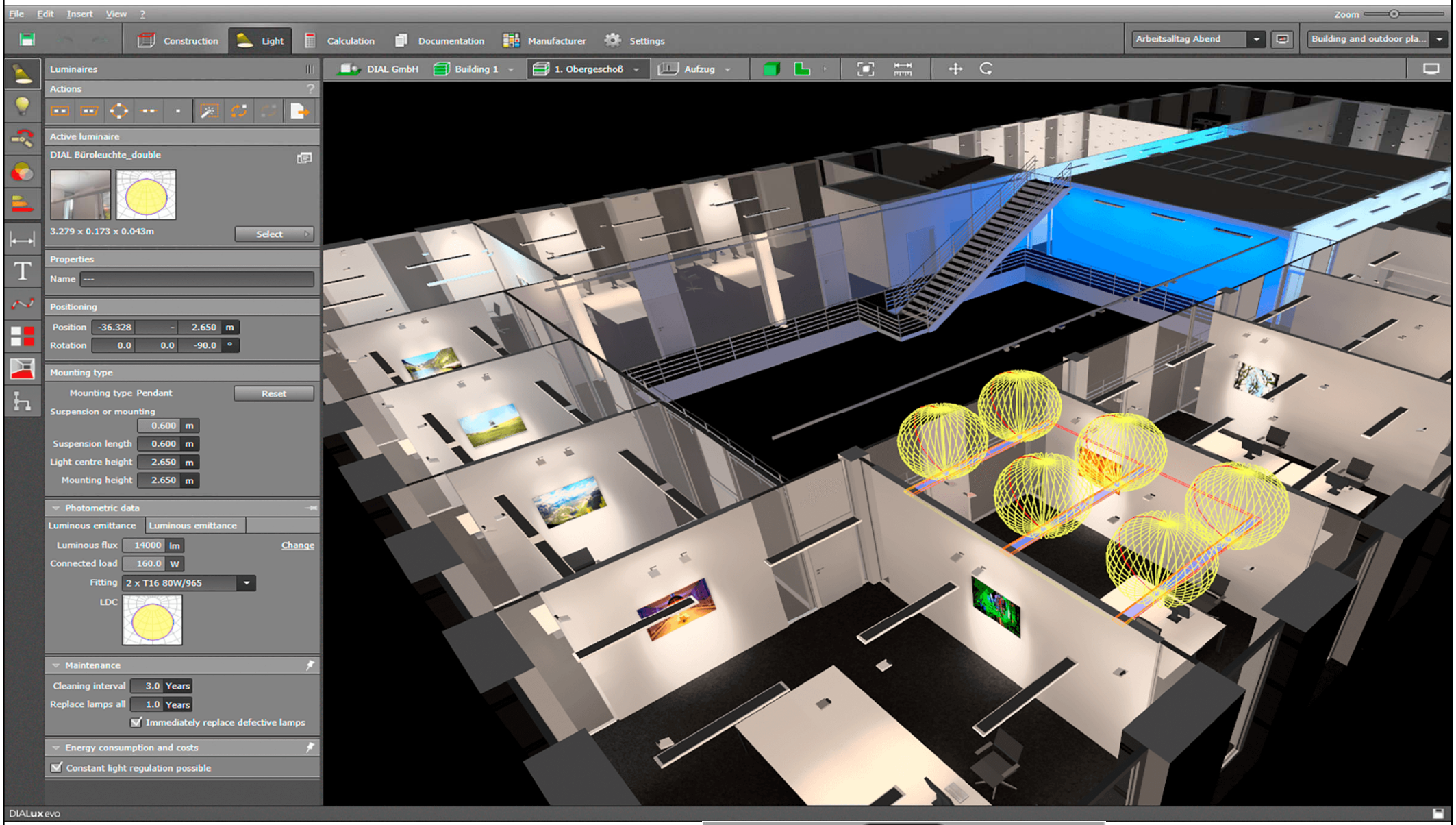
DIALux 4.13 (no more update)

DIALux



DIALux evo (new successor)

Interface of DIALux evo & DIALux Mobile app

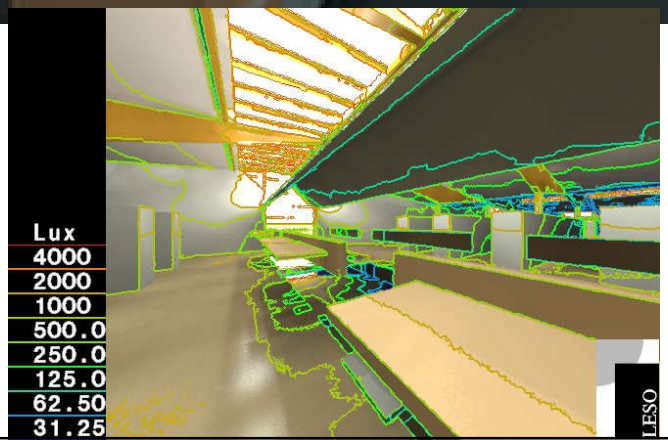


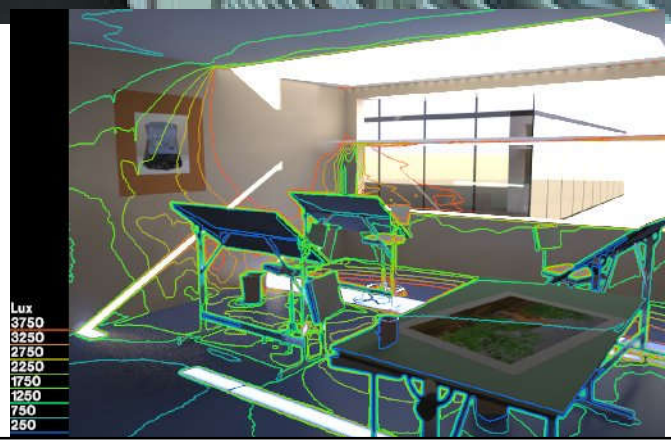
(Source: DIALux http://www.dial.de/)

Lighting software

- Radiance (http://www.radiance-online.org/)
  - https://floyd.lbl.gov/radiance/
  - Analysis & visualization of lighting in design
  - Daylight calculations & rendering
  - Synthetic imaging system (ray-tracing)
    - Calculated values include spectral radiance (luminance + colour), irradiance (illuminance + colour) & glare indices
    - Simulation results may be displayed as colour images, numerical values & contour plots

Radiance lighting simulation & visualization tool





(Source: https://floyd.lbl.gov/radiance/)

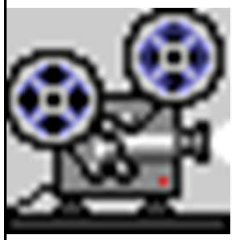
Lighting software

- Relux (http://relux.com)

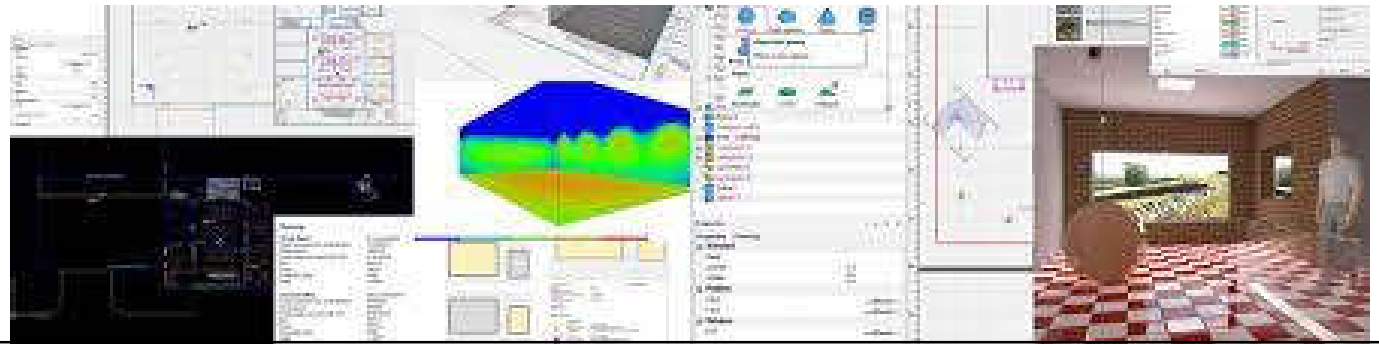
RELUX®

- ReluxDesktop https://relux.com/en/relux-desktop.html
  - Training Tutorials http://relux.com/en/tutorials.html

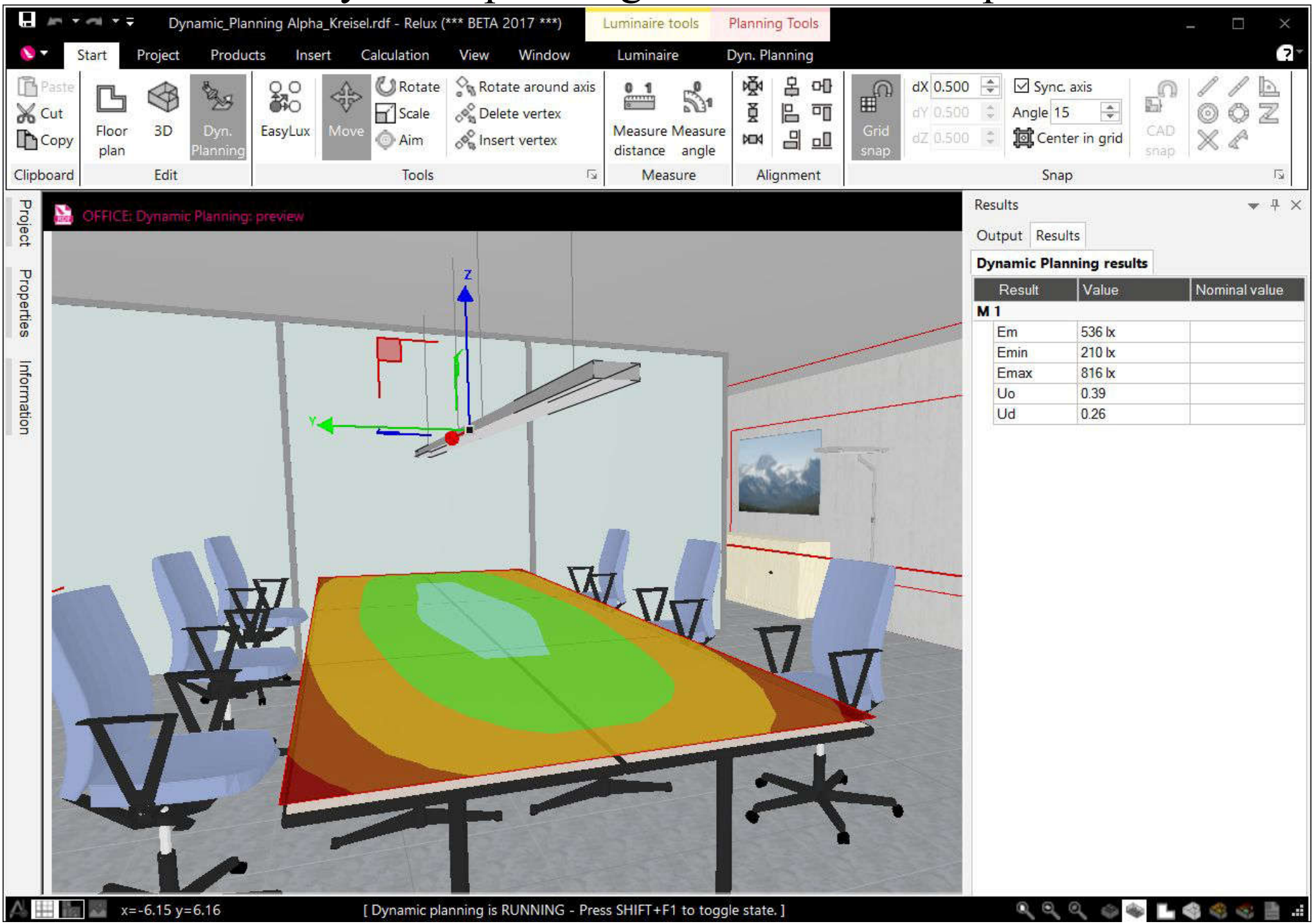
- ReluxCAD for Revit https://relux.com/en/reluxcad-revit.html



- Video: What is new in ReluxDesktop - 2021.1.0.0 (36:00) https://youtu.be/FJ95rllp-ag



Dynamic planning with ReluxDesktop



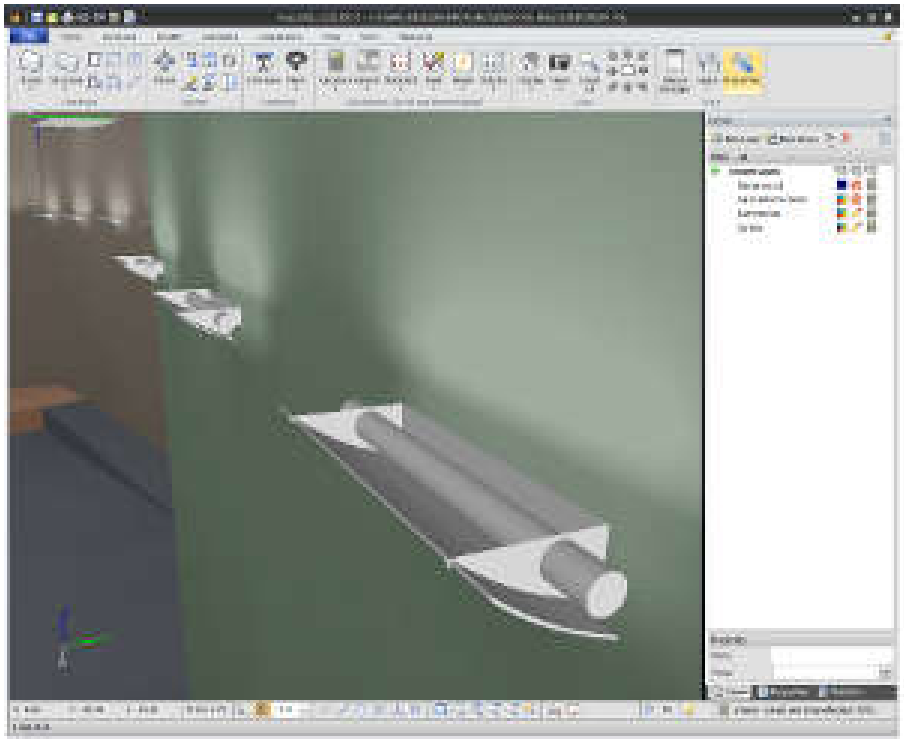
(Source: https://live-erp.relux.com/forum/dynamic-planning-46/question/dynamic-planning-1444)

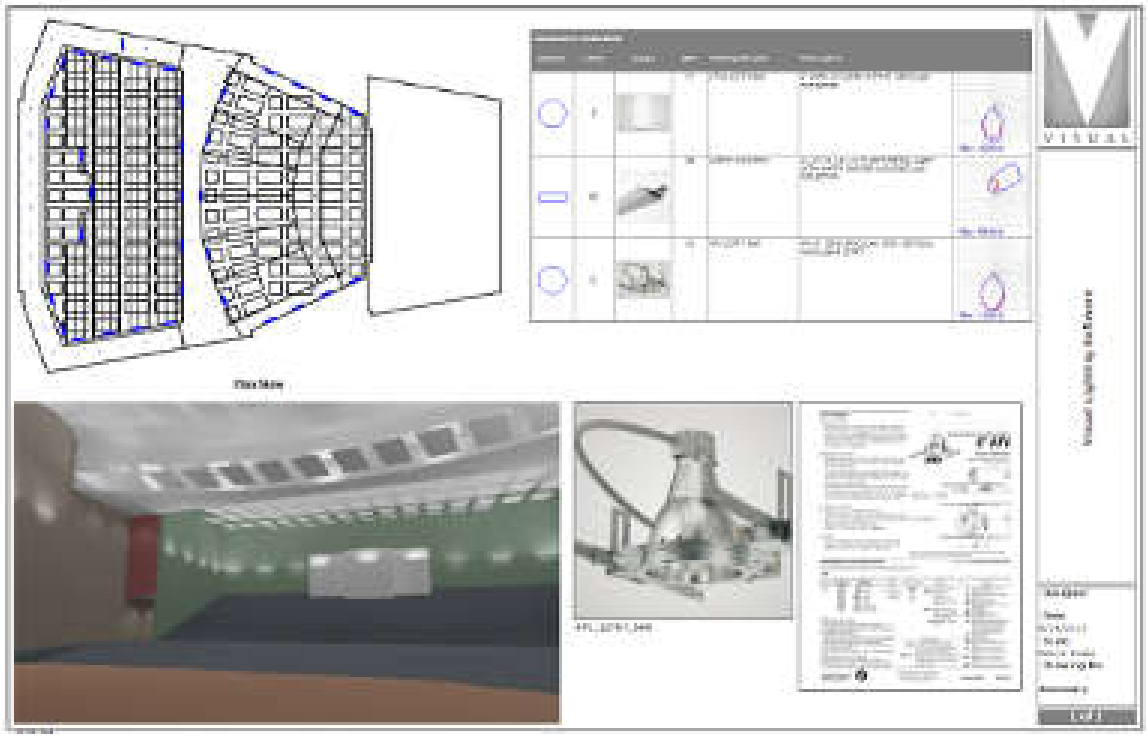
Lighting software

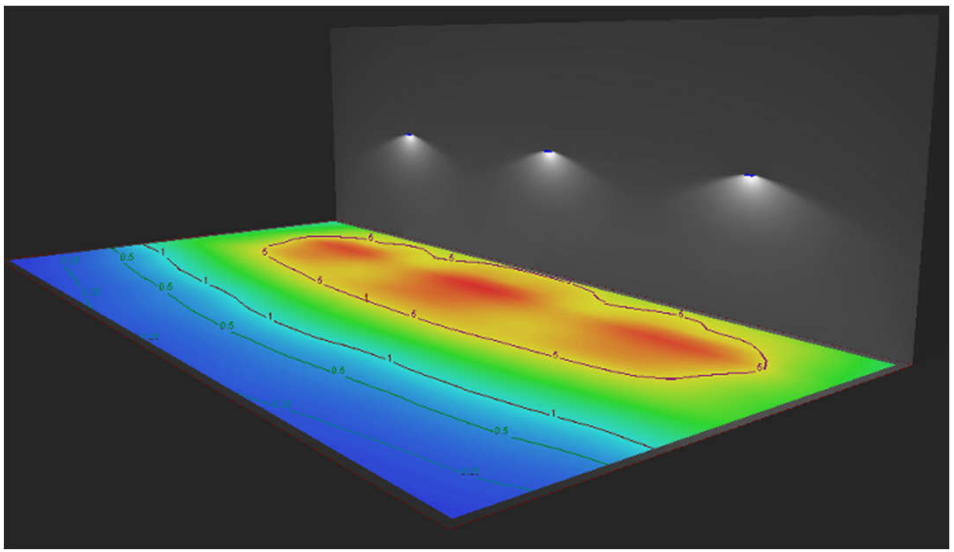
- Visual Lighting (http://www.visual-3d.com/)
  - Training Videos
    - http://www.visual-3d.com/support/trainingvideos/2012.aspx
  - Tutorial Projects
    - http://www.visual-3d.com/support/tutorials.aspx
  - Visual 2012 Documentation
    - http://www.visual-3d.com/support/documentation.aspx
  - Online Design Tools
    - http://www.visual-3d.com/software/designtools.aspx

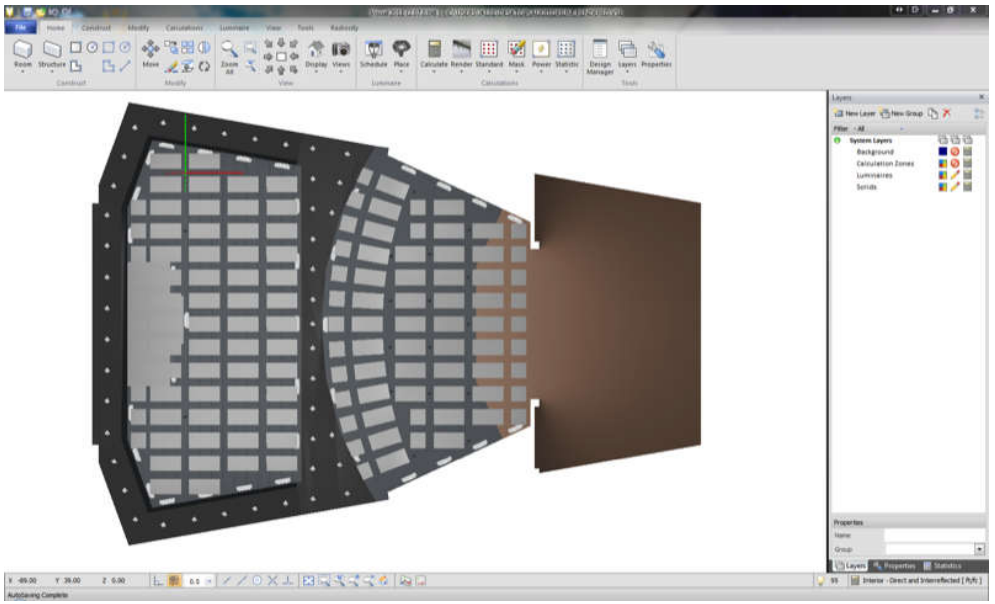
VISUAL

Visual Lighting software (from Acuity Brands)





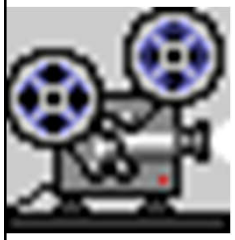




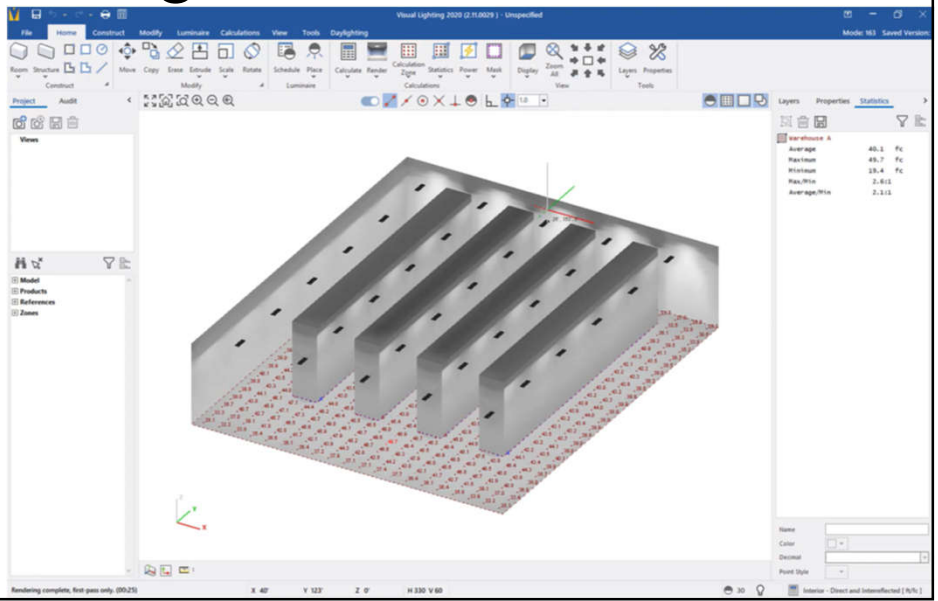
(Source: http://www.acuitybrands.com/resources/tools-and-documents/visual-lighting-software)

Lighting software

- The process of designing a warehouse using a lighting design software (Visual Lighting)

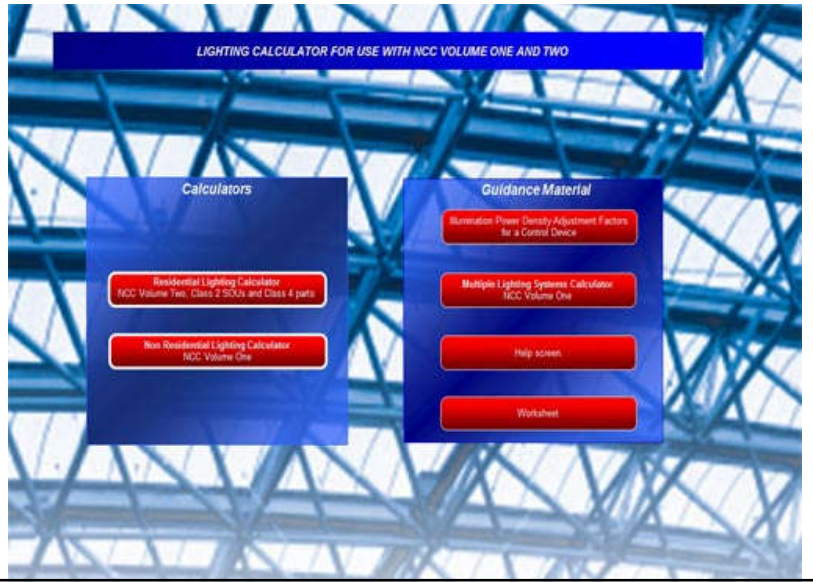


  - Visual Lighting - Warehouse Design (13:11) https://youtu.be/pKm-RoXNVII
    - Building the warehouse & creating the racks
    - Inserting a calculation zone
    - Schedule
    - Inserting luminaires
    - Masking
    - Comparing designs



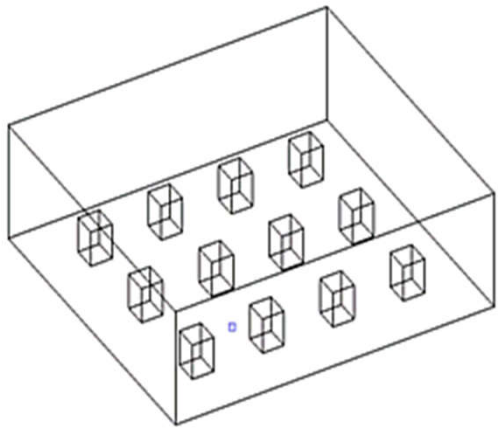
Lighting software

- Lighting Calculator, Excel spreadsheet (for checking compliance with National Construction Code in Australia)
  - http://www.abcb.gov.au/Resources/Tools-Calculators/Lighting-Calculator



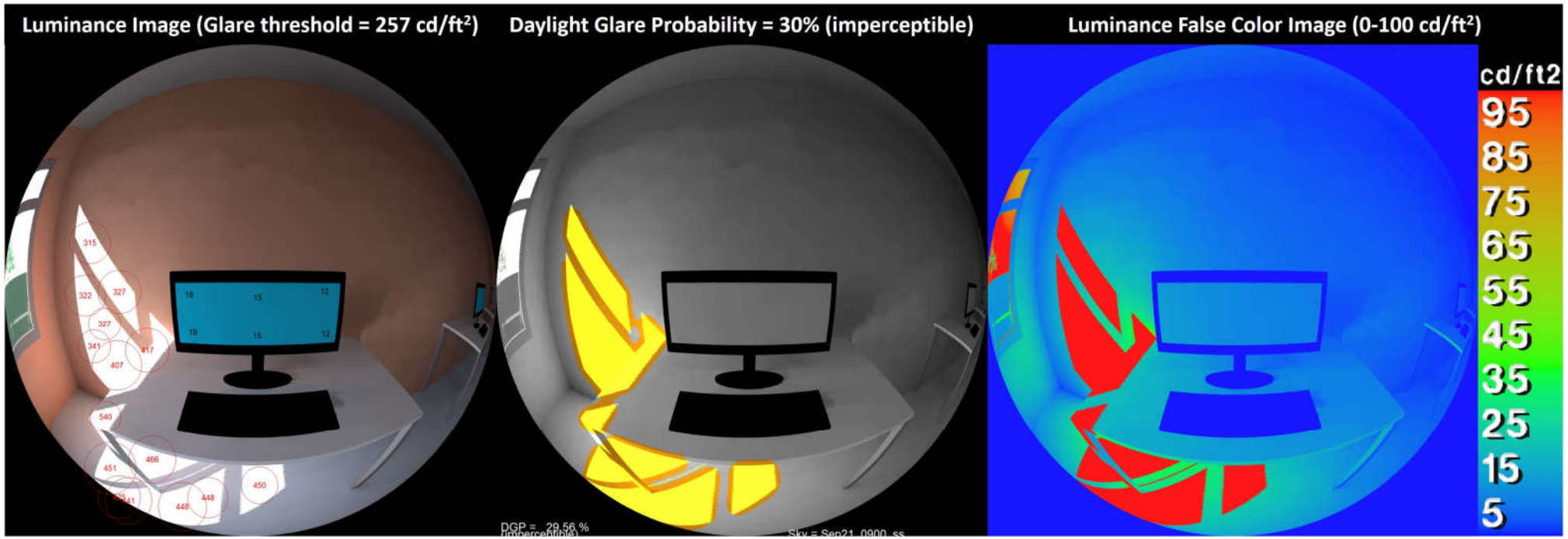
Lighting simulation

- Qualitative & quantitative output of lighting simulation
  - https://iarc.uncg.edu/elight/learn/qualitative/sc.html
  - Global illumination, photometric analysis, photorealistic display, exposure controls
- Lighting simulation (or rendering) examples
  - http://iarc.uncg.edu/elight/learn/qualitative/la_sub/examples.html
  - Horizontal illuminance
  - Vertical illuminance
  - Isolux diagrams
  - Daylight factor
  - False colour rendering



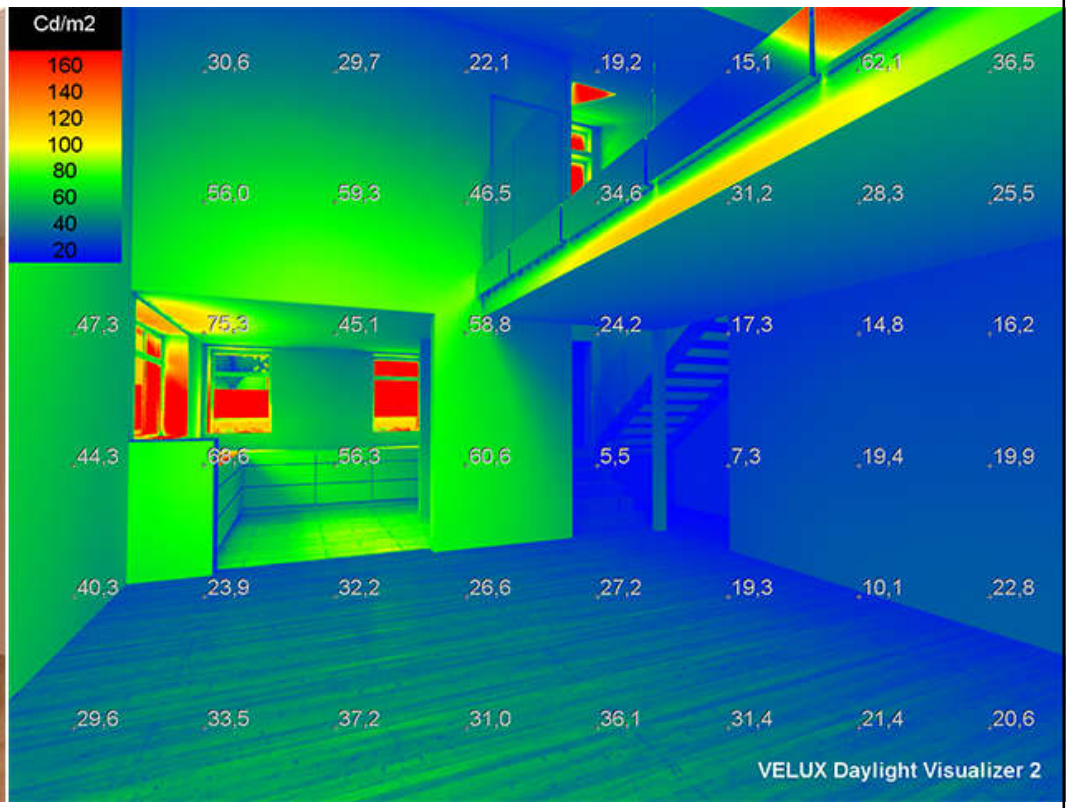
Lighting simulation

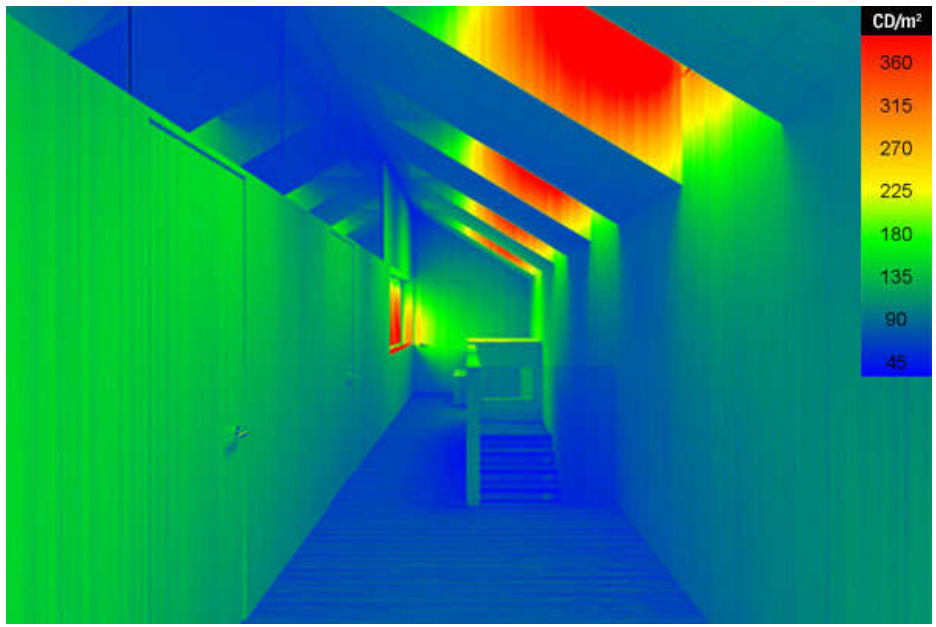
- Photo-realistic & false colour visualisation
  - Visualise the appearance of daylight with photo-realistic images, and quantify the amount & distribution of daylight with false colour images



(Source: https://www.velux.com/what-we-do/research-and-knowledge/deic-basic-book/daylight/parameters-influencing-daylighting-performance)

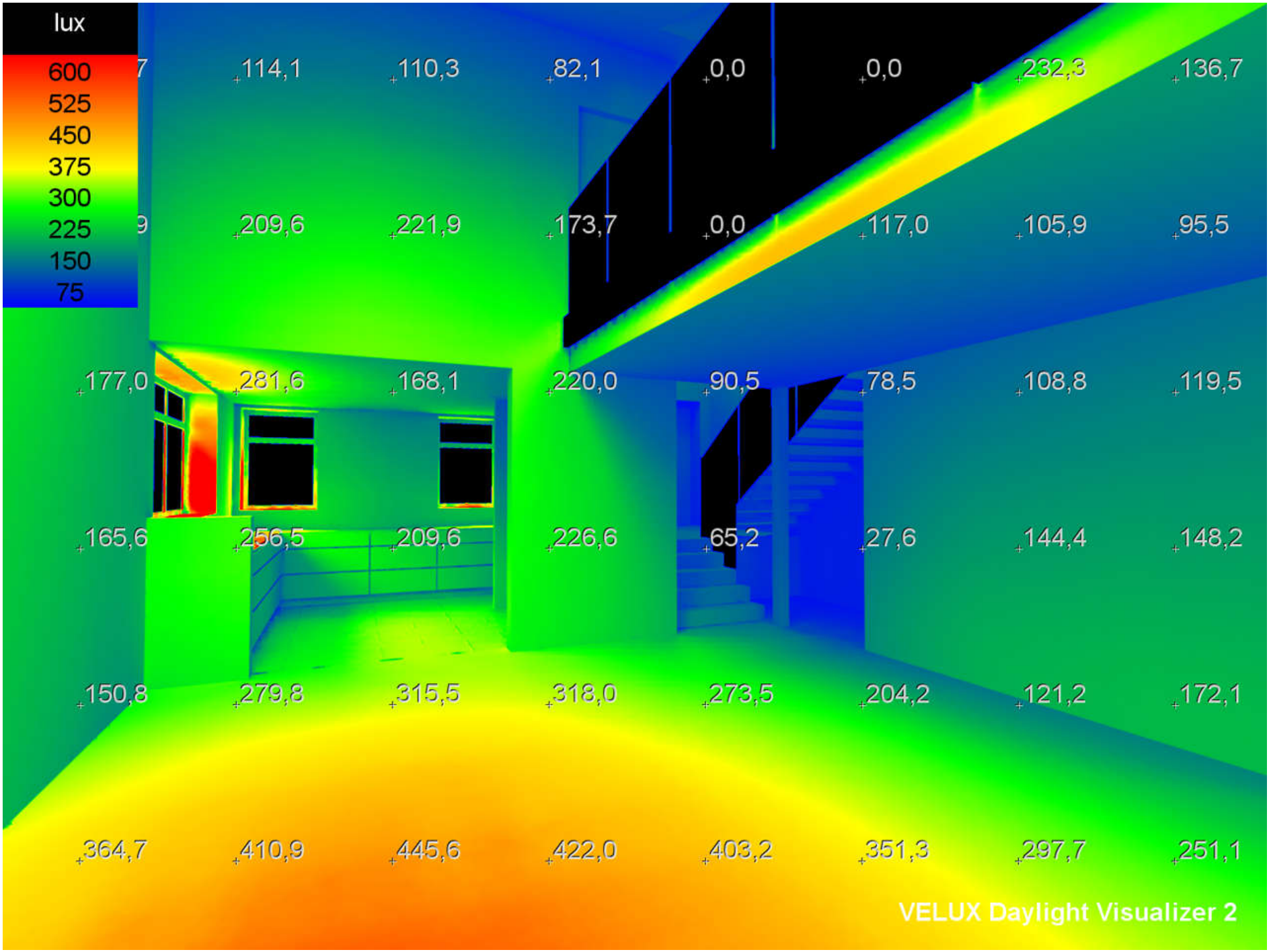
Luminance rendering using VELUX Daylight Visualizer 2





(Source: https://www.velux.com/what-we-do/research-and-knowledge/deic-basic-book/daylight/daylight-calculations-and-measurements)

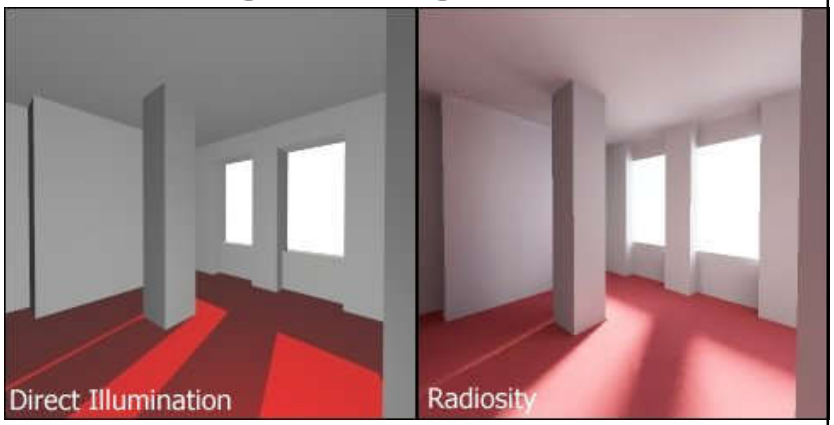
Illuminance rendering using VELUX Daylight Visualizer 2



(Source: https://www.velux.com/what-we-do/research-and-knowledge/deic-basic-book/daylight/daylight-calculations-and-measurements)

Lighting simulation

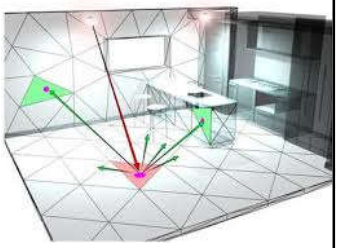
- Lighting simulation software depends on two important components to produce accurate calculations:
  - The selected light sources
  - The surfaces within the model
- Three methods of calculation for lighting simulation or rendering:
  - 1. Radiosity 輻射度演算法
  - 2. Raytracing 光線追蹤
  - 3. Photon mapping 光子映射



(Source: https://www.erco.com/en/guide/simulation-and-calculation/rendering-2685/)

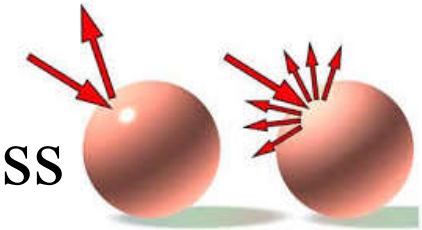
Lighting simulation

- Radiosity 輻射度演算法
  - Divides each surface into small pieces (patches)
  - Each patch is calculated individually for the amount of light that enters or leaves that surface
  - Solves the system of equations in the model by determining the quantity of light on each patch as a result of the total sum of all the patches
  - This method works well for all matte model surfaces (perfectly diffusing), and it cannot include translucent, transparent & specular (shiny) surfaces

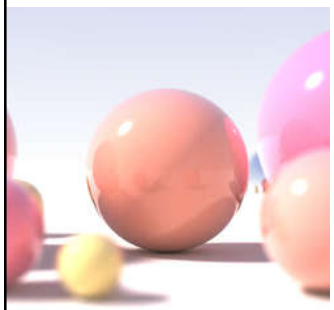


Lighting simulation

- Raytracing 光線追蹤

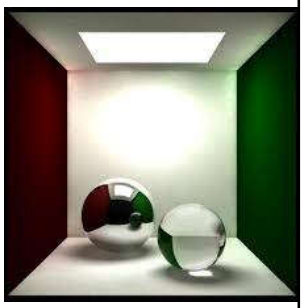


  - A point-specific lighting calculation process
  - Calculation rays are sent outward from a particular viewpoint and the program follows each ray as it hits & reflects off different surfaces and divides into more rays
  - This method works for all object types including transparent, translucent & specular surfaces

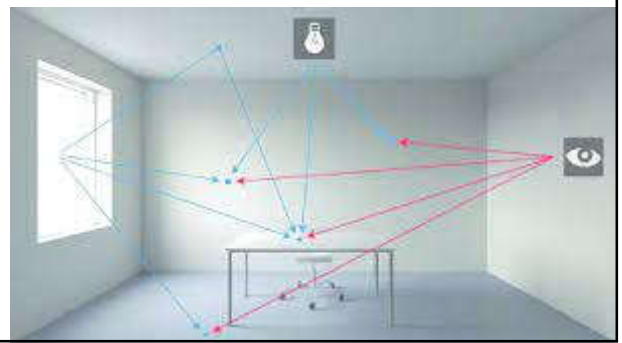


  - Creates beautiful renderings & presentation-quality images (e.g. sparkle on specular materials)
  - View dependent & greater computational cost

Lighting simulation



- Photon mapping 光子映射
  - Similar to the ray tracing process
  - While ray tracing is based on rays from the observers/camera position, photon mapping is based on rays emitted from the light source
  - Virtual “photons” radiating light into the room. When they hit a surface, they are reflected back & the luminance values are summated. The photon outputs are stored in a photon map
  - Render the image using the map
  - Can be combined with ray tracing



Online tools

- GE Lighting Tools (for simple estimating)
  - https://www.gecurrent.com/lighting-tools
  - Cost of Waiting Estimator
  - LED Retrofit Tool (Excel file)
  - Lighting Layout Estimator
  - Simple Life Cycle Cost Estimator
  - Simple Lighting Energy Estimator
  - UVC LPU Calculator
  - Watts Per Square Foot Estimator

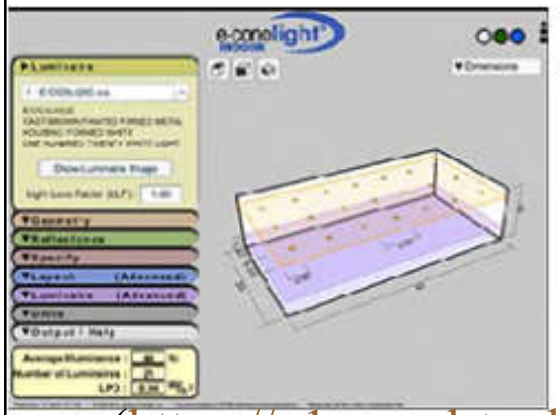
Online tools

TRY IT YOUR SELF!

- Indoor & Outdoor Lighting layout Tools
  - https://www.e-conolight.com/lighting-layout-tool

INDOOR LIGHTING LAYOUT TOOL

- Model a fixture's light output in a custom-sized room
- Calculate the number & layout of fixtures needed to reach a target level of illumination
- Generate a clean, detailed & printable summary



STEP-BY-STEP GUIDES

PRINTABLE >

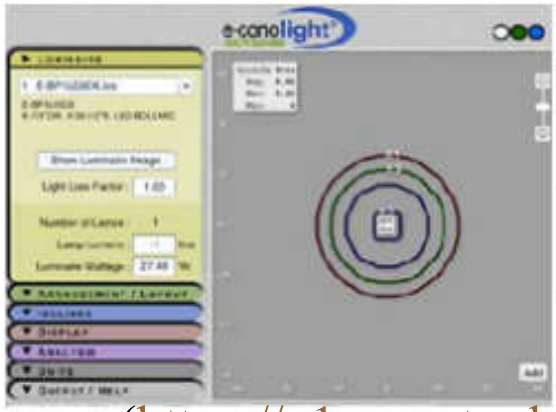
VIDEO >

(https://v1-zonal-tools.luxiflux.com/)

INDOOR CALCULATOR

OUTDOOR LIGHTING LAYOUT TOOL

- Model a fixture's light output based on mounting height, orientation, placement & tilt
- Create a photometric layout for the selected fixture
- Generate a clean, detailed & printable summary



STEP-BY-STEP GUIDES

PRINTABLE >

VIDEO >

(https://v1-area-tools.luxiflux.com/)

OUTDOOR CALCULATOR

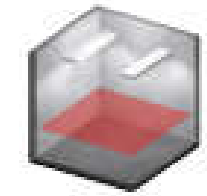
Online tools

- The Visual Lighting Design Tools
  - http://www.visual-3d.com/software/designtools.aspx
  - A set of web based tools that allow users to analyze many common lighting scenarios & view photometric files
  - Can be used to quickly calculate scenarios with simple geometries
  - Complex lighting designs & geometries should be studied by professional software tools

Online tools

- The Visual Lighting Design Tools
  - 1. Interior design tools
    - Interior Tool
    - Wallwash Tool
  - 2. Exterior design tools
    - Area Tool
    - Floodlight Tool
    - Template Tool
    - Roadway Tool
  - 3. Report tool
    - Photometric Tool
    - Economic Tool & Simple Economic Tool

TRY IT YOUR SELF!


Interior Tool


Roadway Tool

Photometric Tool


Floodlight Tool


Area Tool


Economic Tool


Wallwash Tool


Template Tool


Simple Economic Tool

Online tools

- The Visual Lighting Design Tools
  - http://www.visual-3d.com/software/designtools.aspx
  - Learning the Interior Tool

    - Lighting Design Calculations by Using On-line Tools
      - http://www.electrical-knowhow.com/2013/01/lighting-design-calculations-by-using_16.html

    - Tutorial Video (4:01):
      - http://www.visual-3d.com/tools/interior/helpvideos/video.html
  - Learning the Area Tool

    - Tutorial Video (3:52):
      - http://www.visual-3d.com/tools/area/HelpVideos/Video.html

File Help Tools

Visual Interior Tool™

AcuityBrands.

Settings

Units: Meters - Lux

Room Dimensions

Length [X]	10	m
Width [Y]	8	m
Height [Z]	3.5	m
Workplane	1	m
Ceiling Type	2x2	

Room Reflectances

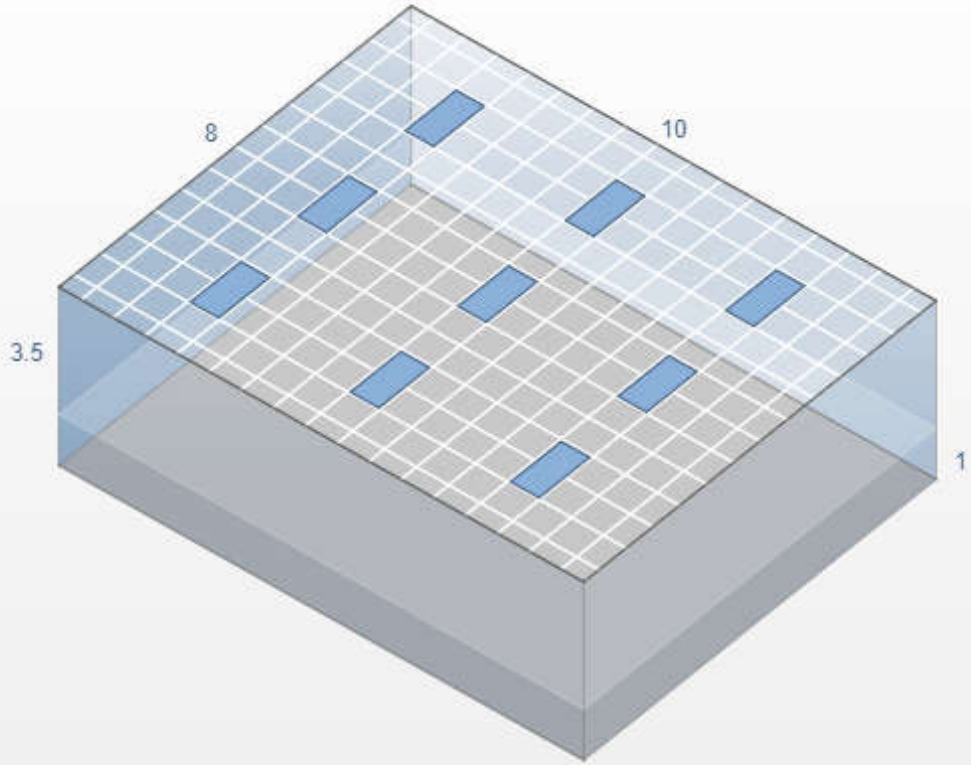
Ceiling	80	%
Walls	50	%
Floor	20	%

Criteria

Illuminance	500	lux
Power Density		W/m²
Quantity		

Constraints

Spacing X [SC=3.6]		m
Spacing Y [SC=3.1]		m
Rows		
Columns		



Calculation Results [A]

Illuminance	462 lux
Power Density	6.52 W/m²
Quantity	9

Spacing Results [A]

Spacing	3.05 x 2.44 m
Arrangement	3 x 3
Outside Spacing X	1.68 m
Outside Spacing Y	0.99 m

Display

Dimensions Room ☑ Layout ☐

Show Zonal Cavity Info [+]

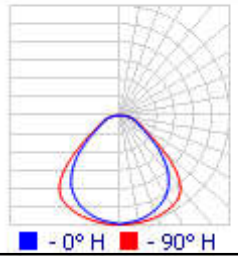
Project Information

A

Holophane

[A] - HT24 2 32 A12 GEB10IS

Light Loss Factor	1	Symbol Shape	Rectangular	Lamp Quantity	2
Suspension Length	0	Symbol Length	.54	Lumens Per Lamp	2850
Orientation	0	Symbol Width	1.15	Wattage	58



File Help Tools

Visual Area Tool ™

AcuityBrands.

Settings

Units: Meters - Lux

Precision: 0.00

Criteria

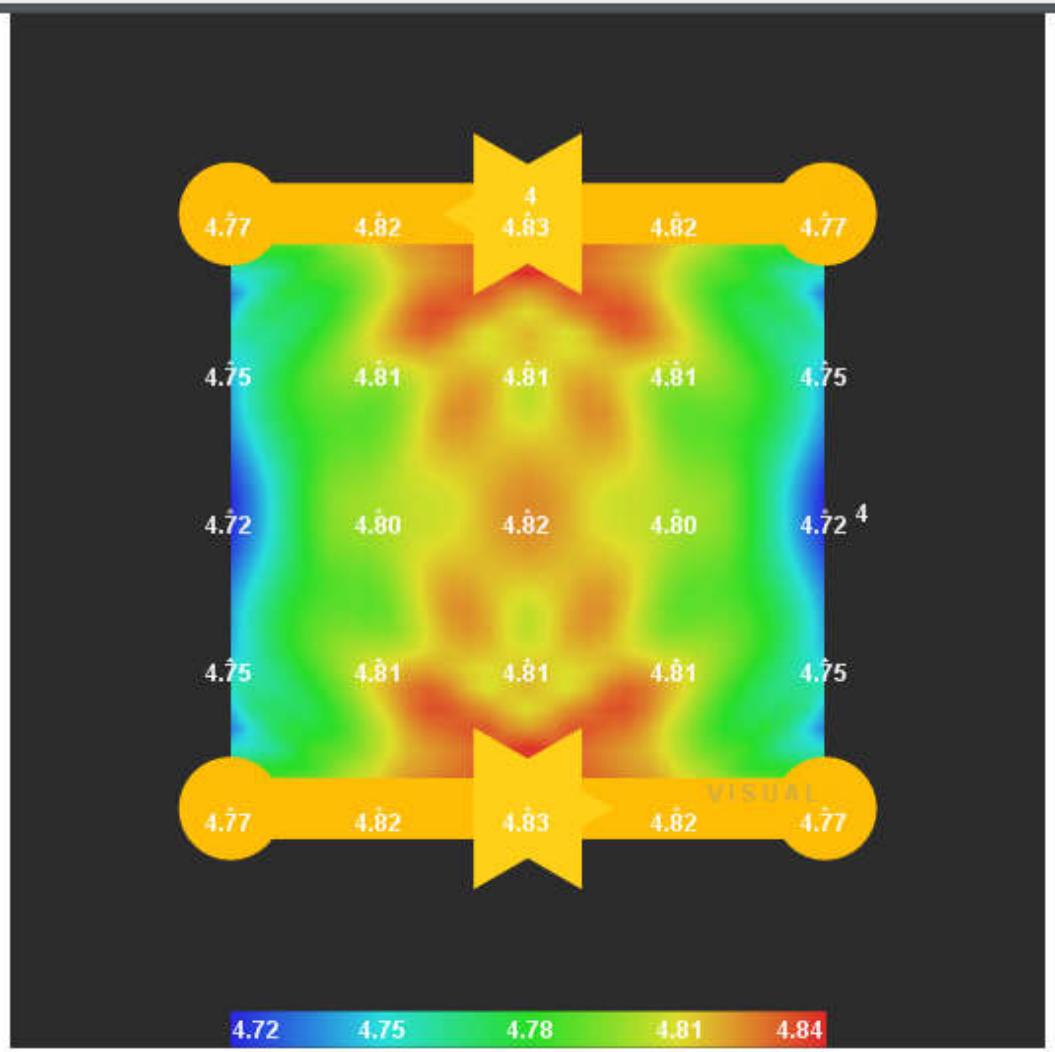
Minimum	10	lux
Average		lux
Max / Min		lux
Parking Lanes	60	m
Pole Arrangement		

Constraints

Spacing X	4	m
Spacing Y	4	m

Calculation Points

Point Spacing X	1	m
Point Spacing Y	1	m



Spacing Results [A]

Spacing	4 x 4 m
Area Between Poles	16 m²
Wattage / Area	15.75 W/m²
Optional Spacing	

Calculation Results [A]

Minimum	4.72 lux
Average	4.79 lux
Maximum	4.83 lux
Max/ Min	1.02
Ave/ Min	1.01
Point Spacing	1.00 x 1.00 m
iterations	1
Points Calculated	986

Display

Points

[A]

0.1	lux
0.2	lux
0.5	lux
1	lux

View Grid Detail

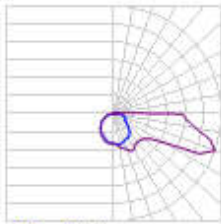
Project Information

A

Holophane

[A] - PK050HP00CXA

Configuration	Single	Light Loss Factor	1	Lamp Quantity	1
Mounting Height	20	Orientation	0	Lumens Per Lamp	4000
Support Length	.3	Tilt	0	Wattage	63



- 0° H
- Max Cd: 65° H

Open File Settings Tools

Visual Photometric Tool™

AcuityBrands.

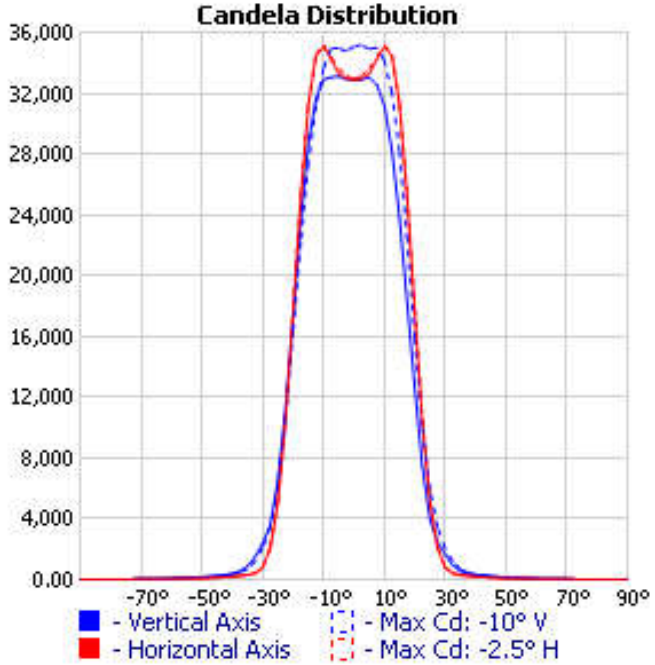
TEST #:	107267P22
TEST LAB:	SCALED PHOTOMETRY
TEST NOTES:	SCALED FROM ABSOLUTE TEST: 107267
TEST DATE:	4/11/2016
CATALOG:	HPFL 7 4K 07A 44
DESCRIPTION:	HAZARDOUS PREDATOR LARGE LED WITH 7 COBS, 4000K COLOR TEMPERATURE , 700MA DRIVE CURRENT , 4X4 DISTRIBUTION
SERIES:	PREDATOR HPFL LARGE LED
LAMP CATALOG:	C0B
LAMP:	LED
LAMP OUTPUT:	TOTAL LUMINAIRE LUMENS: 16852, ABSOLUTE PHOTOMETRY *
BALLAST / DRIVER:	LED DRIVER
INPUT WATTAGE:	185
LUMINOUS OPENING:	POINT
NEMA TYPE:	4 X 4
MAX CD:	35,189.3 AT HORIZONTAL: -10°, VERTICAL: -2.5°

HOLOPHANE

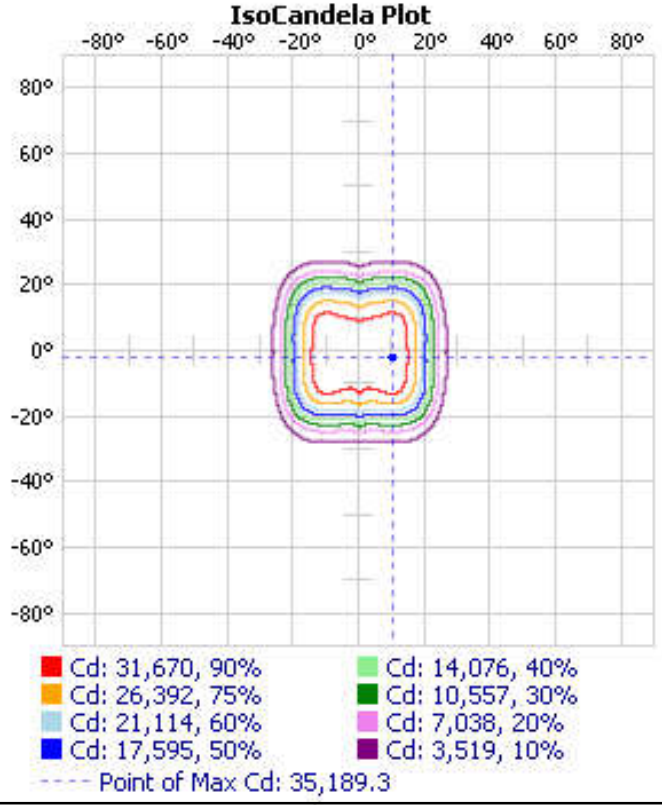
PRODUCT LINKS

IES LDT PDF RFA DWG

Candela Distribution



IsoCandela Plot



File Help Tools Design Spaces Luminaires Controls Results AcuityBrands

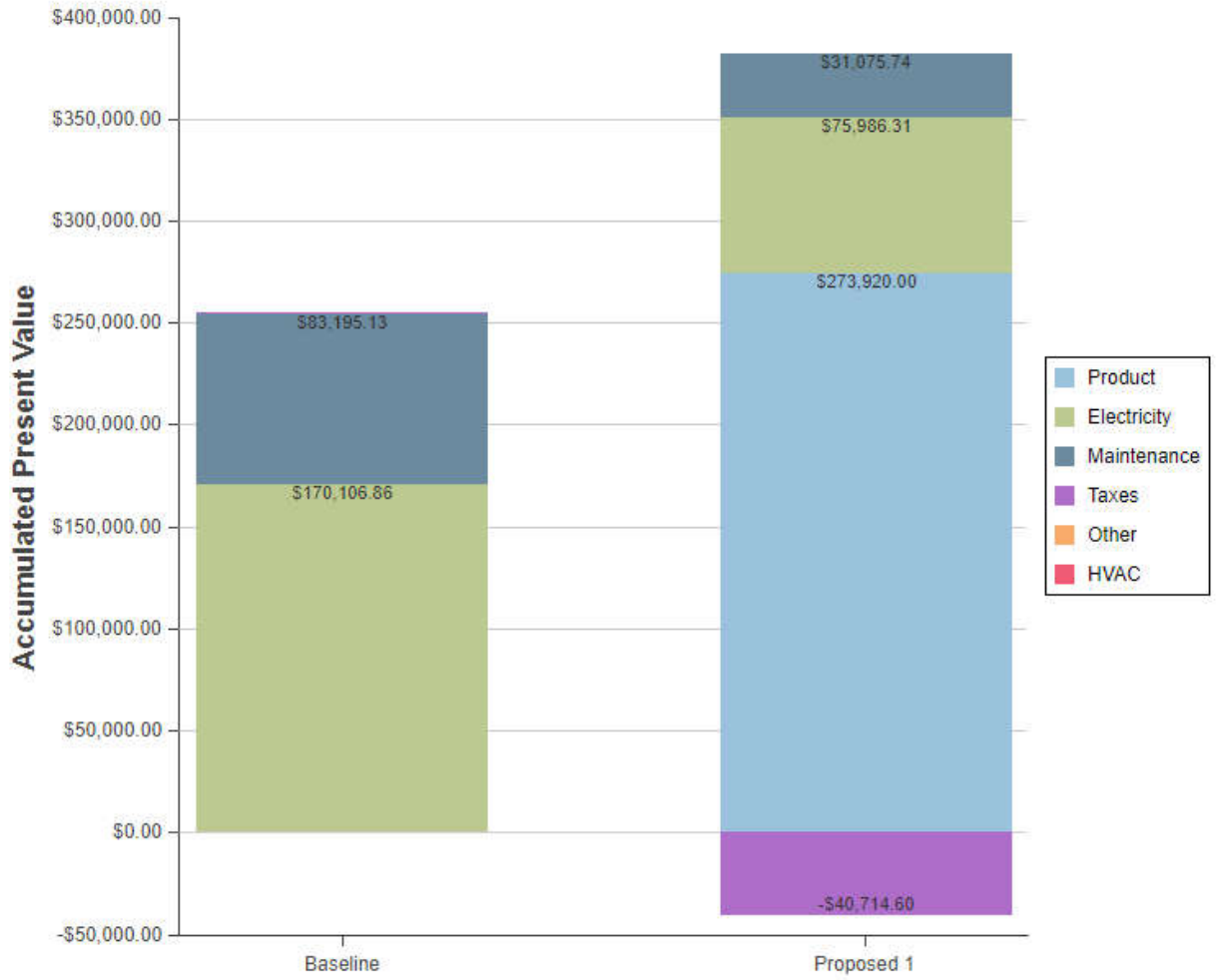
Assumptions

Life Cycle (years):	12
Discount Rate (%):	5
Electricity Rate (¢/kWh):	8
Electricity Escalation (%):	0
Reinvestment Rate (%):	0
Taxes	
Local Sales Tax (%):	6
Income Tax Rate (%):	30
Depreciation Years:	10

Summary results of the Economic Tool

Designs | Groups | Spaces | Annual Details | Luminaires | FV vs PV | Design Audit (5)

By Category | By Year



Design Summary

Category	Baseline	Proposed 1
Initial Cost	$0.00	$288,288.20
Ave. Operation Cost (FV)	$28,713.47/Year	$6,710.69/Year
Total Operation Cost (PV)	$254,494.74	$51,979.25
Life Cycle Cost	$254,494.74	$340,267.45
Net Present Value	--	($85,772.71)
Simple Payback	--	No Payback
Discounted Payback	--	No Payback
Internal Rate of Return	--	--

Analyze Calculate

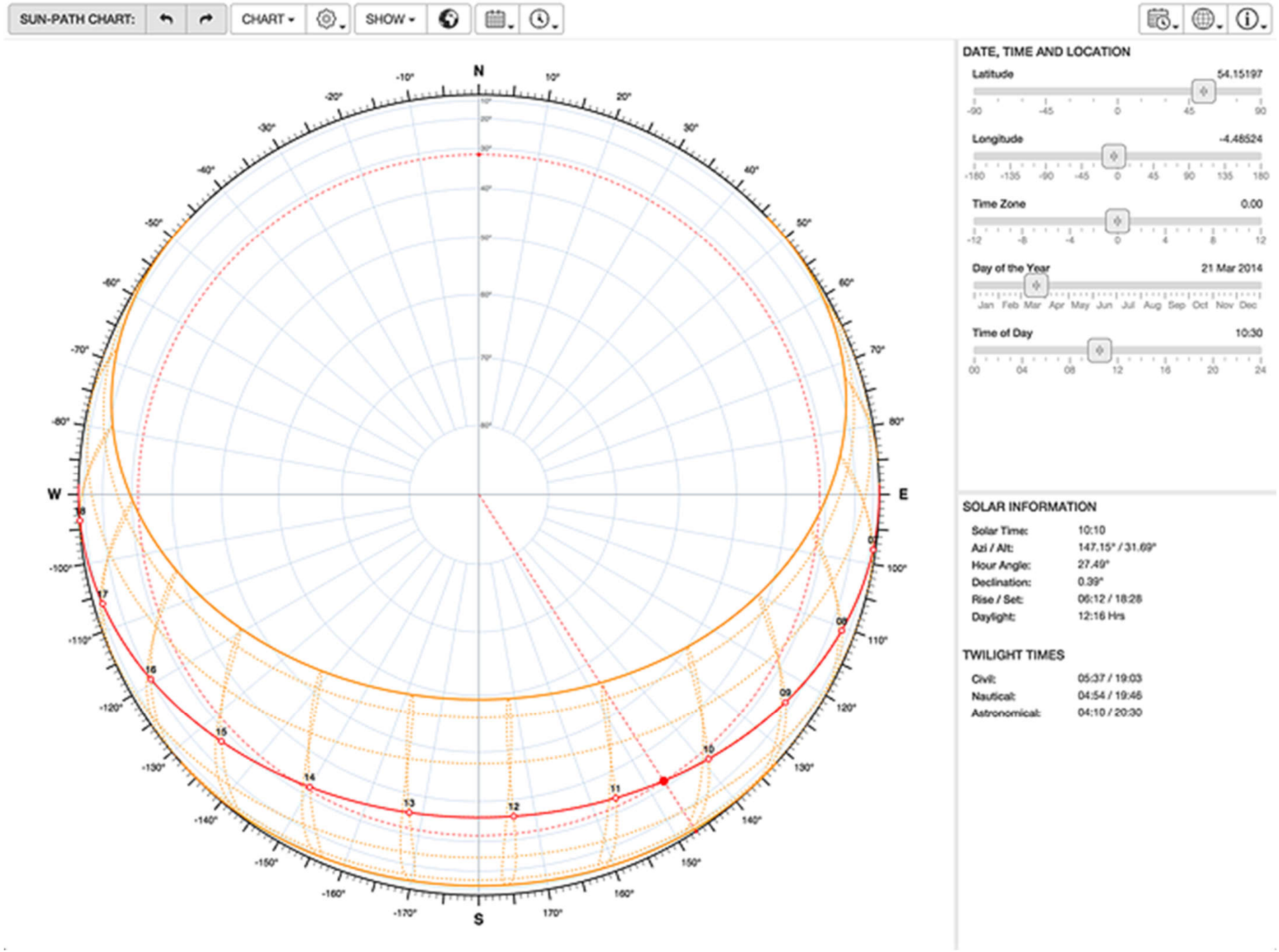
Online tools

- Daylighting analysis tools (by Dr. Andrew Marsh)

  - 2D Sun-Path http://andrewmarsh.com/software/sunpath2d-web/
  - 3D Sun-Path http://andrewmarsh.com/software/sunpath3d-web/
  - Dynamic Daylighting http://andrewmarsh.com/software/daylight-box-web/
  - Dynamic Overshadowing http://andrewmarsh.com/software/shading-box-web/
  - Dynamic Shadows http://andrewmarsh.com/software/shadows3d-web/

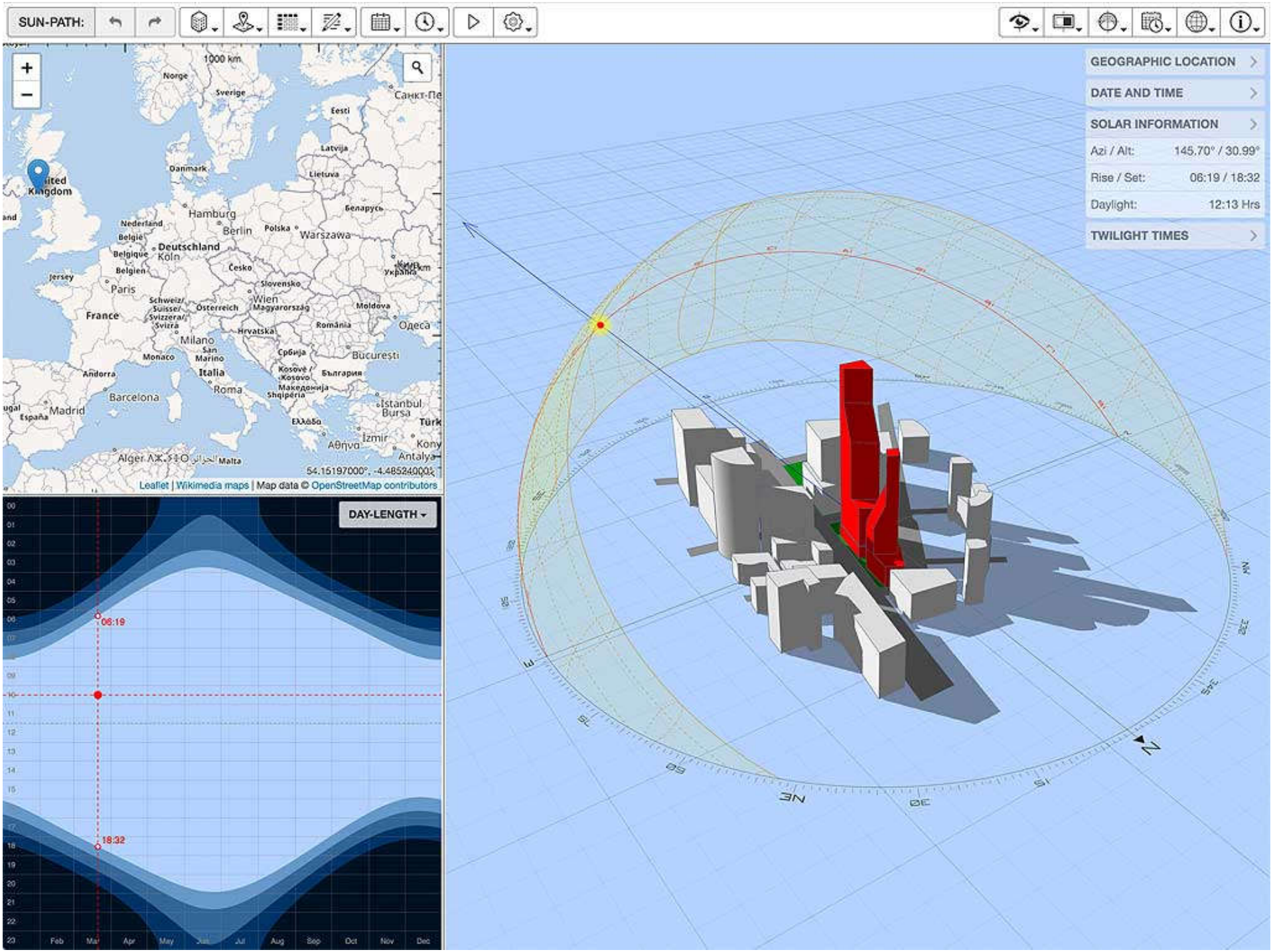
TRY IT YOUR SELF!

2D Sun-Path



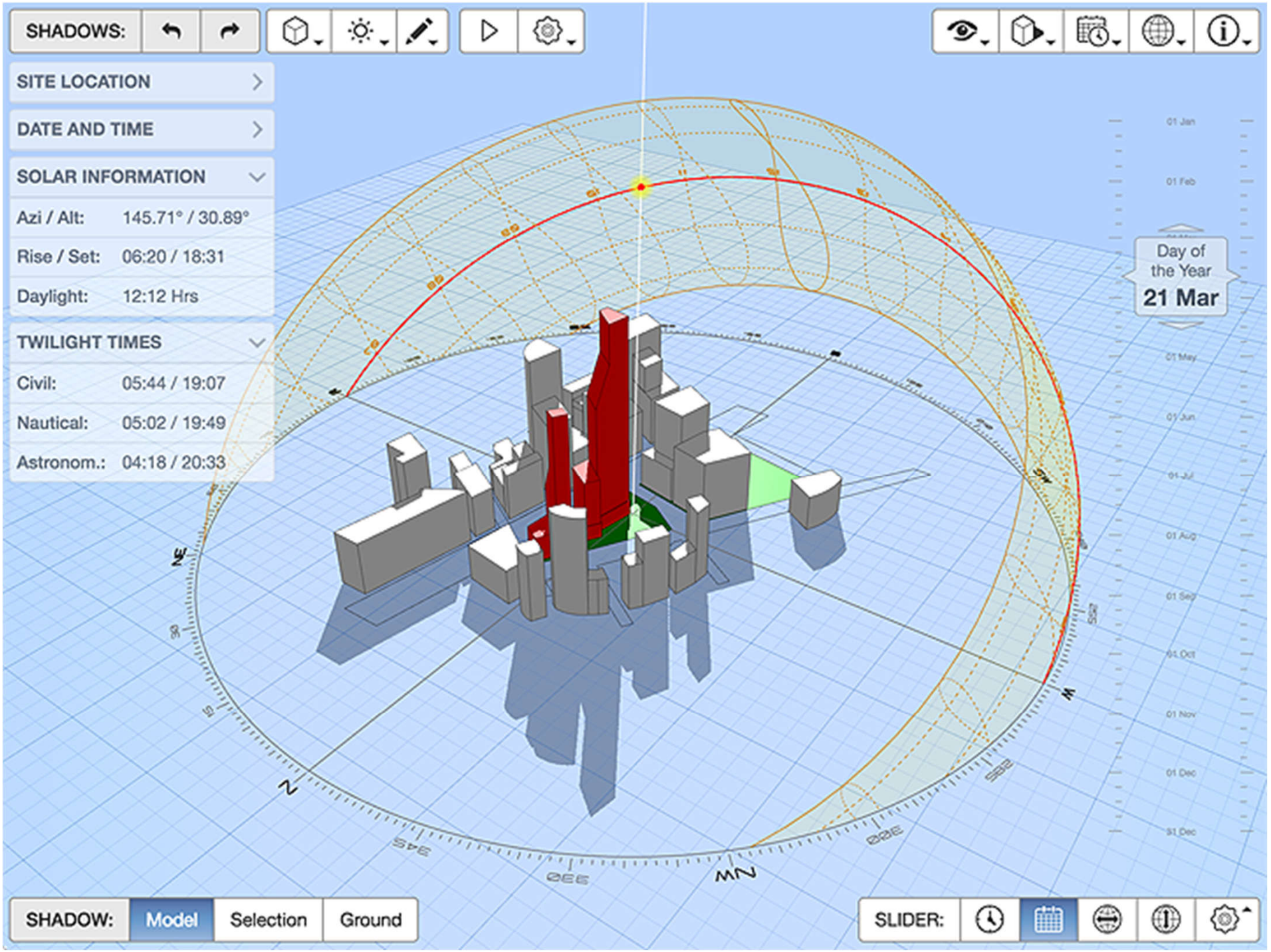
(Source: 2D Sun-Path http://andrewmarsh.com/software/sunpath2d-web/)

3D Sun-Path



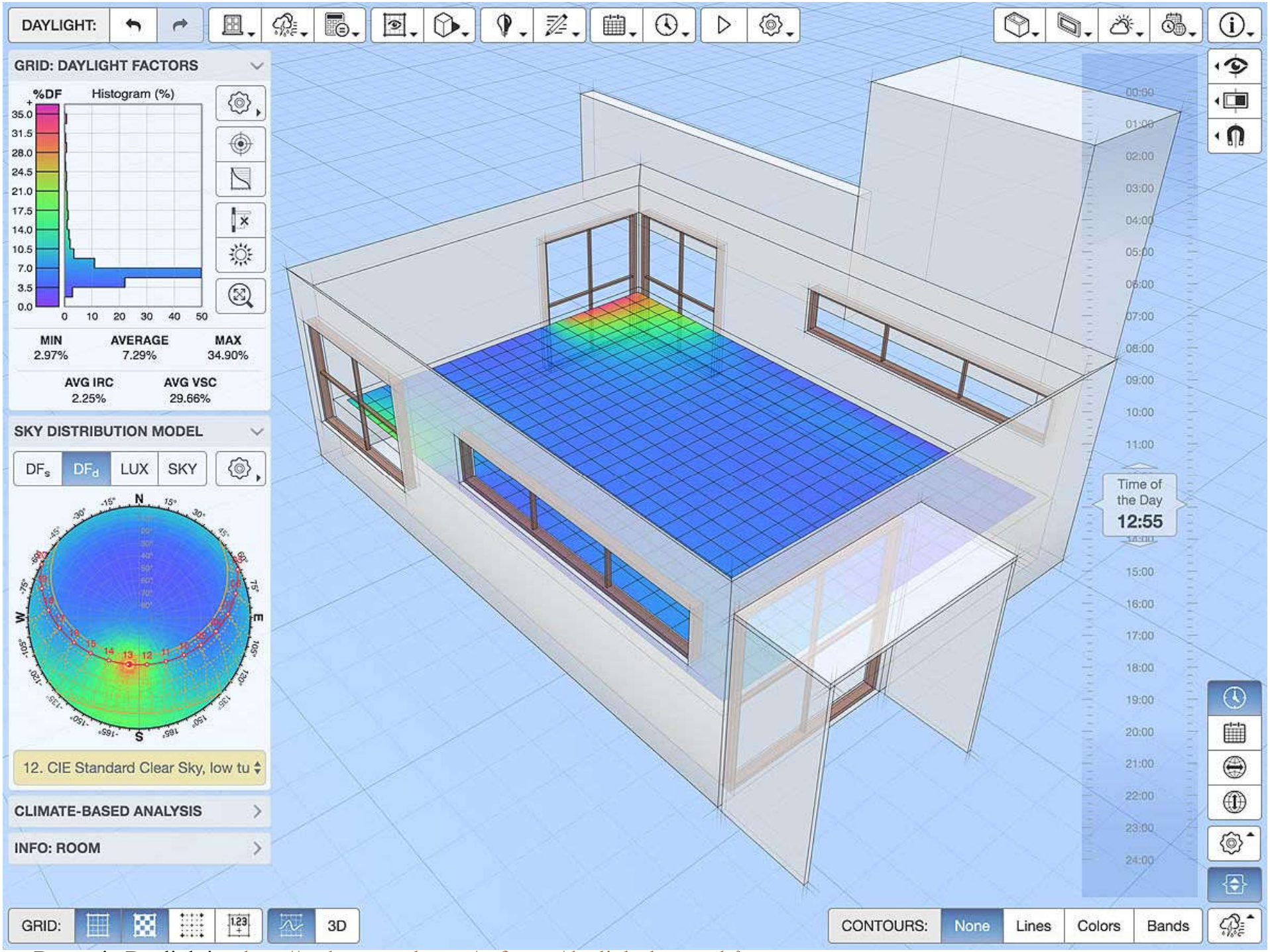
(Source: 3D Sun-Path http://andrewmarsh.com/software/sunpath3d-web/)

Dynamic Shadows



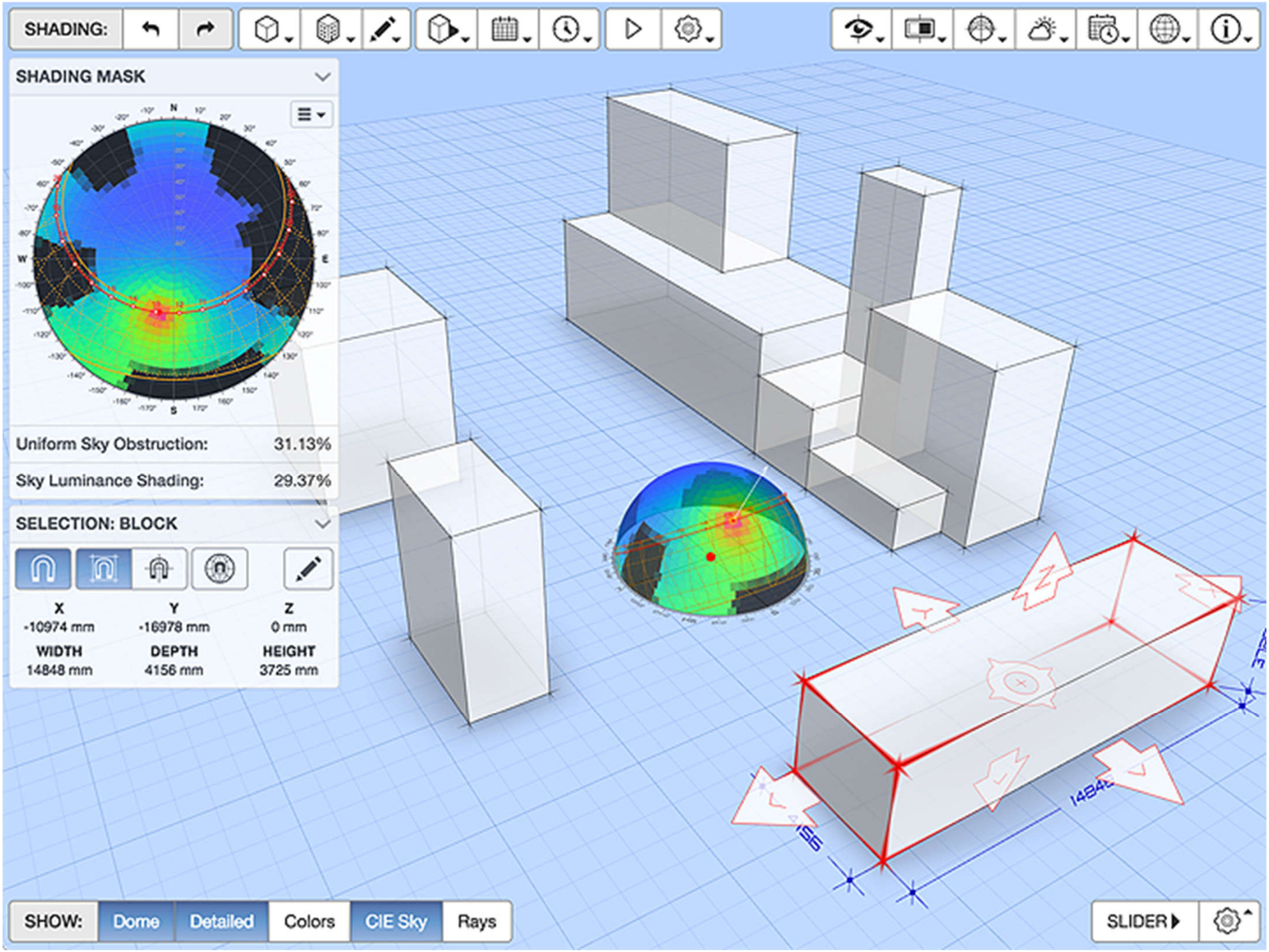
(Source: Dynamic Shadows http://andrewmarsh.com/software/shadows3d-web/)

Dynamic Daylighting



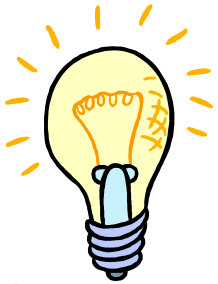
(Source: Dynamic Daylighting http://andrewmarsh.com/software/daylight-box-web/)

Dynamic Overshadowing



(Source: Dynamic Overshadowing http://andrewmarsh.com/software/shading-box-web/)

Further Reading



- LEARN (different stages of the lighting design process) by E-light https://iarc.uncg.edu/elight/learn/learn.html
- Lighting Layout Calculator Tool - Indoor & Outdoor https://www.e-conolight.com/lighting-layout-tool
- Visual Design Tools (online) http://www.visual-3d.com/software/designtools.aspx