ElumTools ®

Robust Lighting Calculations Inside Autodesk® Revit®!

Interior

Exterior

Emergency
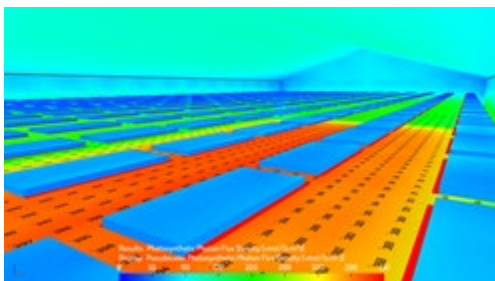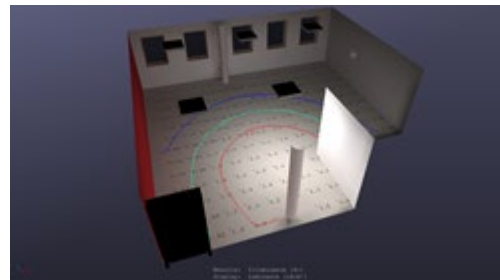
Horticulture

Daylight
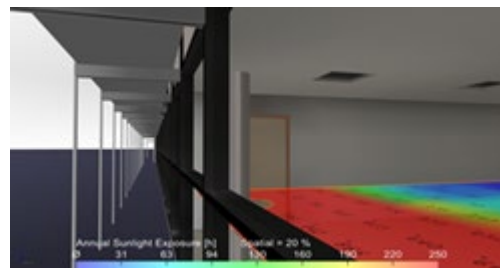
ElumTools

ElumTools is a lighting calculation Add-in for Autodesk® Revit®

Lighting Analysts
illumination engineering software

Prelude

The growth of BIM (Building Information Modeling) software is exploding, and in many architectural design and engineering firms, it is almost completely replacing CAD software for the purposes of architectural and building system design. To date, the industry standard illumination design software programs lack the ability to easily exchange information with models in the BIM environment. The reason for this is two-fold; current illumination software utilizes a complete environment approach to the calculation of illuminance which is burdened by the large size of the BIM model, and the complexity of exported geometry from BIM is beyond the needs of practical calculation of workplane or surface illuminance. With today's illumination design software not getting the job done, there exists a distinct need to quickly and accurately compute lighting results from electric and daylight sources within individual environments in a BIM model, and assimilate the results in a way consistent with the behavior of the BIM software.

Introducing ElumTools

ElumTools is a calculation Add-in used to predict the performance of electric lighting systems and daylight for any environment within an Autodesk® Revit® project. With ElumTools, the need to utilize external software to compute illuminance from light sources placed in Revit is completely obsolete.
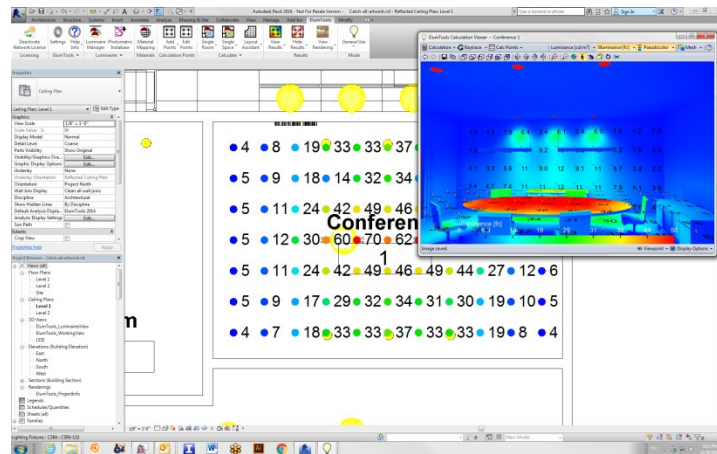
When ElumTools is installed in Revit, it appears with its own tab on the top menu bar. Selecting the ElumTools tab reveals the icons for the various ElumTools commands.
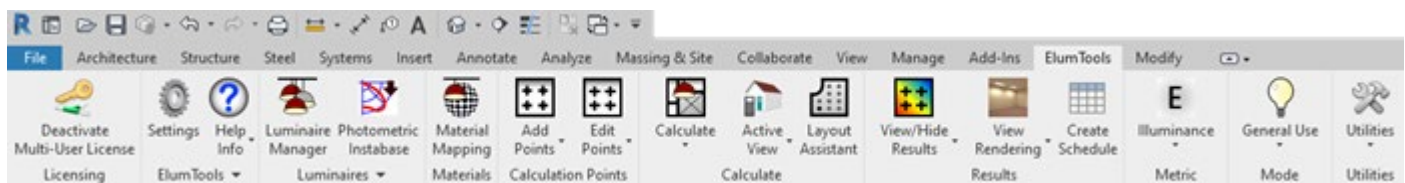
How does ElumTools work?

The entire concept of ElumTools as a Revit Add-in is based around the ability to leverage content that is already present in the Revit model. Utilizing existing content from Revit allows the lighting software functionality to be simplified to only those tasks necessary for the accurate modeling of light.

The accurate calculation of illuminance on a workplane or surface requires the following components: surface geometry, surface reflectance/color, luminaire locations and luminaire photometry. ElumTools is able to extract surface geometry from Revit using "Rooms", "Spaces", "Areas", "Filled Regions" and even "by View".

Surface reflectance and color can be interpreted from the Revit "Graphics Shading" property of the surface and "mapped" to a more suitable reflectance and/or color as necessary on a material basis, or by entire "Category" such as Ceilings, Walls and Floors.

Luminaire families already present in Revit are recognized by ElumTools, and photometric file associations are easily created if not already present.

The final step prior to computation is the assignment of calculation points to any surface or workplane to verify illuminance present from the Revit layout of luminaires. This is easily accomplished using ElumTools Calculation Points commands.

With these elements known, ElumTools has the information required to utilize the radiosity process to compute the selected geometry, present an interactive visualization depicting the luminance of all surfaces, and show the illuminance on the selected calculation point locations.

Revit defined boundary representations (Rooms, Spaces, Regions, Areas, Views) can be computed alone or as a group if they contribute light to one another. The computed results are presented in an interactive visualization window. The point-by-point illuminance results can be seen in the visualization as well as directly in the Revit model Views or Sheets of choice. All statistics are available to Revit's scheduling tools for summary and inclusion in the BIM model.
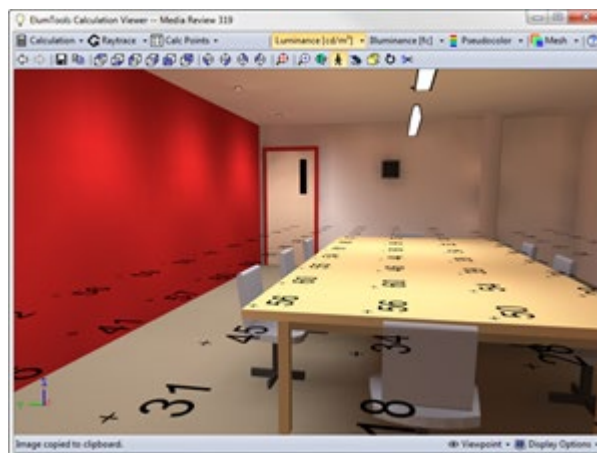
Anatomy of a typical workflow
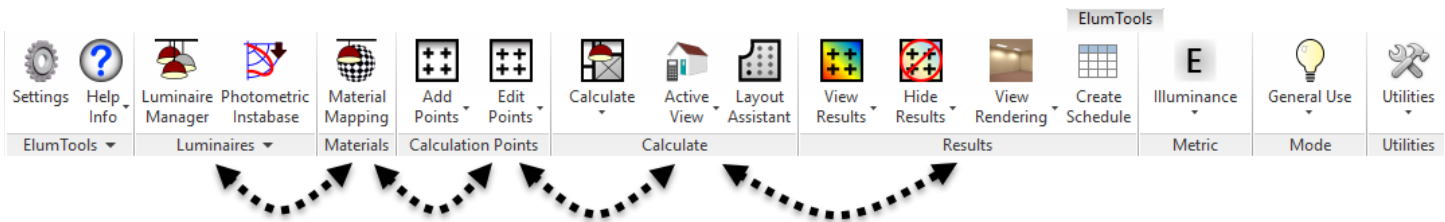
Manage luminaires

This is the process of validating each luminaire family within the Revit model that will be used for lighting calculations. All families must include: a photometric web source type, assignment of a valid photometric file in IES format (IES document LM-63), entry of a light loss factor if other than 1 (initial conditions), and a validity check on lumens, watts and photometric source positioning.

The ElumTools Luminaire Manager provides simple access to most necessary inputs for your luminaire families. The luminaire list can be shortened to show only luminaire families currently in use in the Revit model if desired, and all luminaire instances can be seen from the Instances tab.
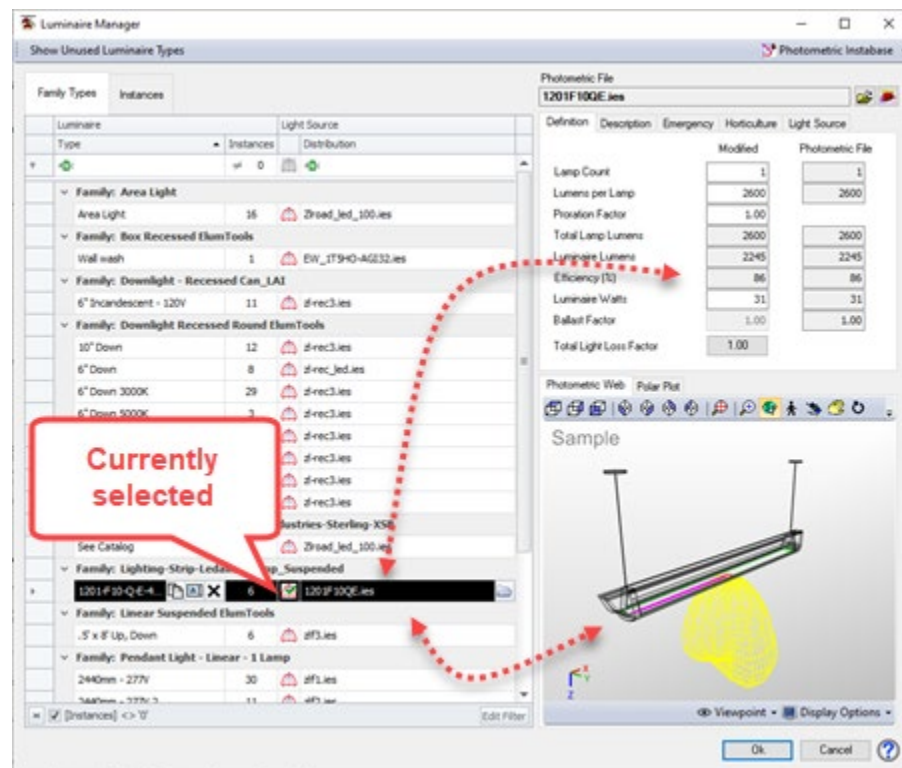

Map materials

In order to perform accurate calculations for the propagation of light within an interior environment it is extremely important to correctly consider the reflectance of the primary surfaces such as ceiling, walls and floors. Transparency is also required to correctly consider light passing through interior or exterior glass for accurate daylight and electric light calculations. ElumTools provides the Material Mapping command to cross reference Revit material properties with ElumTools material properties to ensure surface reflectances and transparencies are set correctly.

The detailed approach is to map all surface properties by material. This is done by setting the dialog in the "View Project Materials" mode. ElumTools has access to the "Graphics Shading" color in Revit for all

materials in the model. This provides a starting point for the calculation of surface reflectance from the RGB color. If the Revit graphics color is not an accurate color from which to calculate reflectance, it is necessary to map that surface to a different and more appropriate color, and hence, a more suitable reflectance. Glass and other translucent or transparent materials must also be mapped to the appropriate surface type in ElumTools for accurate daylighting calculations.

ElumTools also provides the ability to override the materials mapping process and assign reflectances to Revit Categories. This can collectively assign a reflectance to all materials within a category such as "Walls". Using Category overrides you can easily simplify the task of verifying your surface reflectances. Often it is useful to assign some material properties using the detailed method and others using categories.
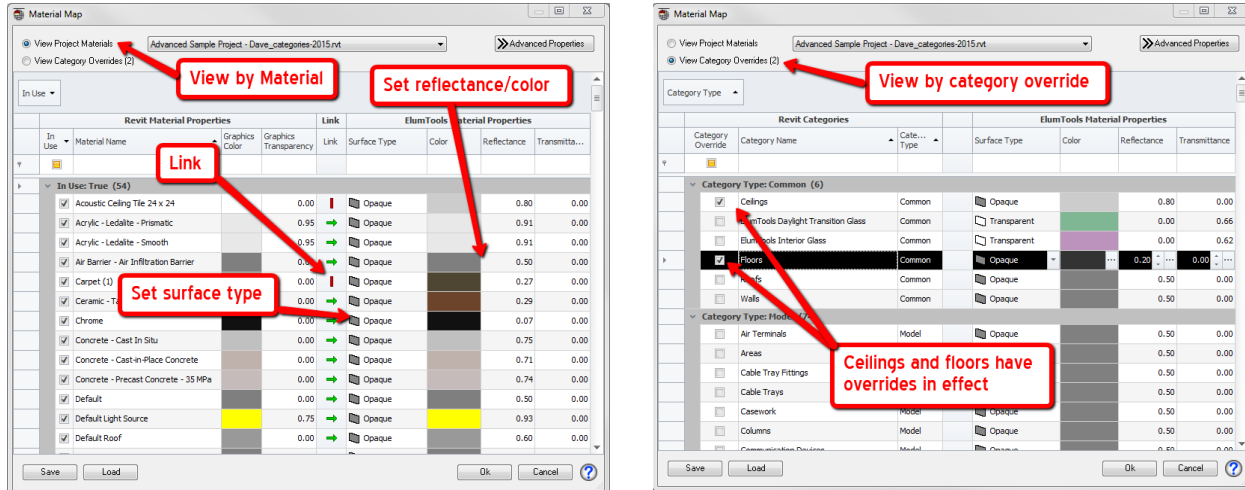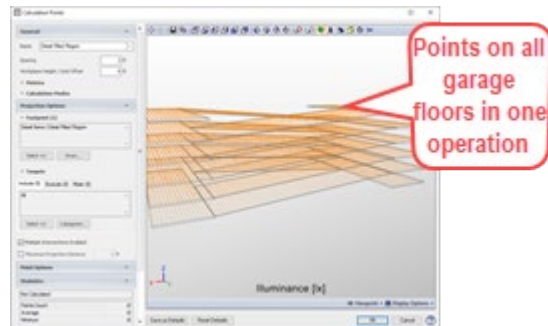

Assign calculation areas

ElumTools makes it easy to assign a grid of calculation points to your choice of surfaces, work planes, Regions or Areas in the Revit environment. Simply select the Calculation Points command followed by the Revit boundary representation of interest to place points on a work plane or surface (this can be done in reverse as well). ElumTools can place points in Revit Rooms, Spaces, Areas, Filled Regions, on Lines and most recently, project points to a system of irregular surfaces such as stairs, facades and even topography.

This command will drop an instance of the ElumTools calculation points family within the selected boundary as required. The points will automatically be limited to the Revit boundary. Openings such as windows, doors or holes (Regions) would not be included and could be covered with another instance of the point family if necessary.
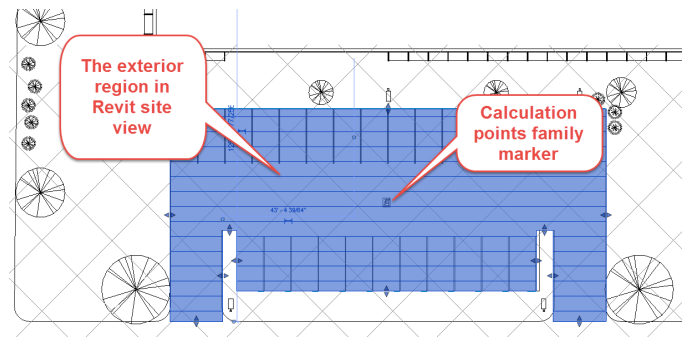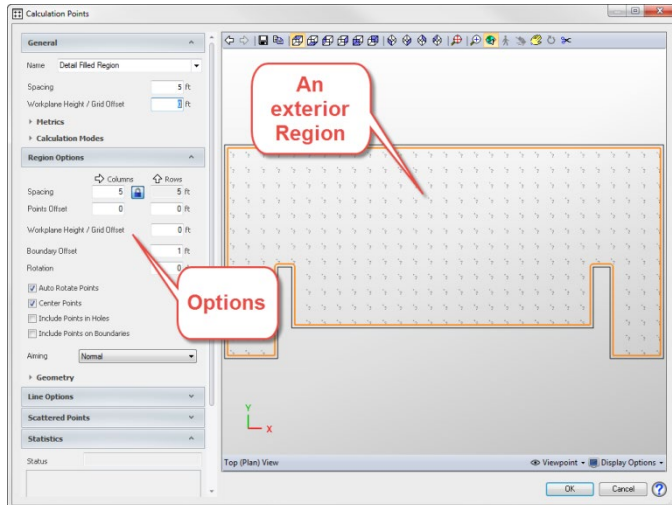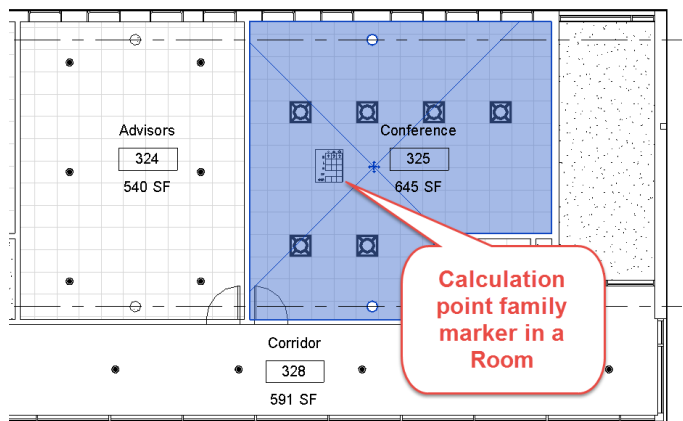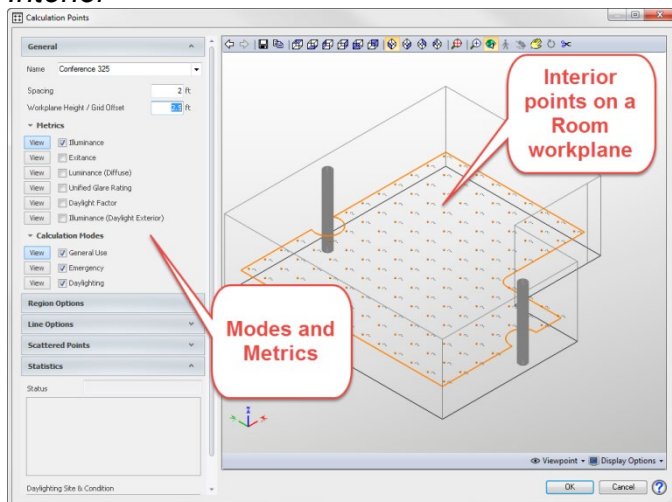
Projected points

On stairs

Parking garage

Exterior

An exterior Region

Options

The exterior region in Revit site view

Calculation points family marker

Interior

Interior points on a Room workplane

Modes and Metrics

Advisors 324 — 540 SF

Conference 325 — 645 SF

Corridor 328 — 591 SF

*Calculation point family marker in a Room*

ElumTools does more than just calculate illuminance (incident light in footcandles or lux). You can alternatively compute diffuse luminance, which is reflected light in cd/m^2 and is more indicative of what we actually observe. Luminous Exitance can also be selected, which is similar to diffuse luminance but differs in units. Daylight Factor (for overcast skies) and Unified Glare Rating (UGR) are also available.

Calculate selected boundary

Rooms, Spaces, Areas and Filled Regions created by Revit are used as spatial boundaries by ElumTools. If the Revit model does not contain these boundary designations, it is generally only a matter of a few clicks to add them. For exterior site analysis, it will be convenient to use Filled Regions to constrain the calculation points as desired. It is easy to mask areas by creating holes within the region boundary. This technique may also be useful in interiors.

ElumTools calculates boundaries using a single or multiple selection technique. When selecting multiple boundaries, ElumTools allows multiple calculations to be performed simultaneously, yet in separate windows. If environments may exchange light with one another, they can be computed as a single solution including all boundaries. The example shown here is selecting multiple Rooms to be computed individually.
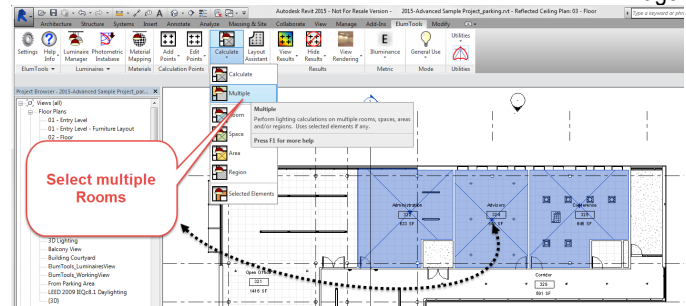

Calculate by Revit view

ElumTools can also compute only the entities that are visible in a selected 3D view or set of 3D views. This simplifies complex calculations by allowing certain geometric elements to be hidden and not considered in the calculations. This also facilitates the consideration of exterior geometry such as shades, light shelves and other structures in the computation of daylight illuminance. ElumTools can automatically create interior and exterior views which can be user customized, and then combined at the time of calculation. Any number of 3D views can be combined into a calculation set and computed using the Calculate Multiple Views command.
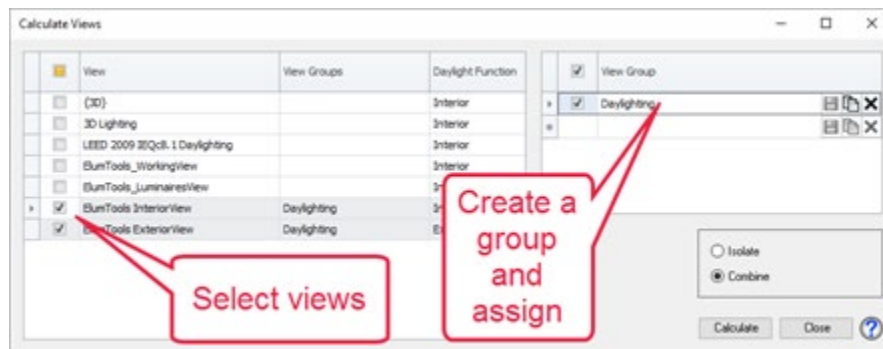

Interactive visualization

ElumTools provides a fully interactive visualization in a pop-up window as a by-product of every calculation. This rendering is designed to allow validation of lighting results (ex: are all my luminaires included?) and a verification of the behavior of light and surface (ex: scalloping from downlights on an adjacent wall). The visualizations are fully navigable and can be reopened when necessary using the Rendering Manager. Lighting designers will appreciate the valuable evaluation tools available such as scaled pseudo-color analysis, isolines, spatial maps, radiosity mesh, calculation points visibility and the ability to visualize direct and reflected light separately.

Pseudocolor

Points on topography

Rendering direct light only

Rendering only reflected light

Spatial map

Isolines
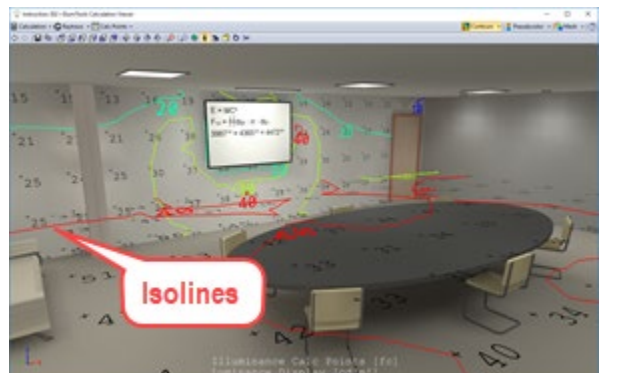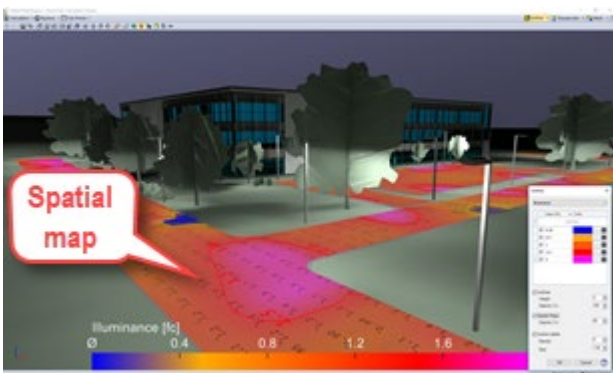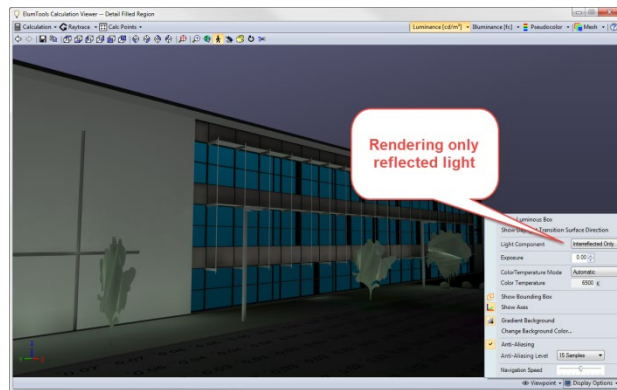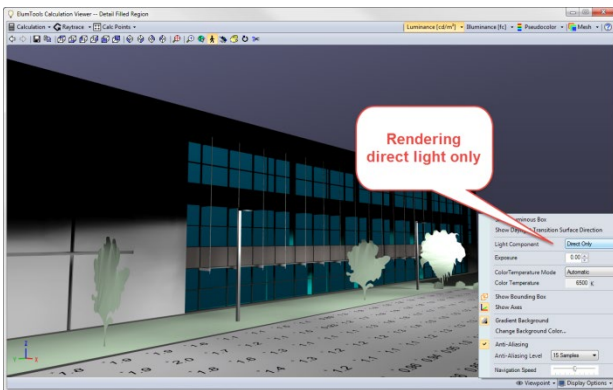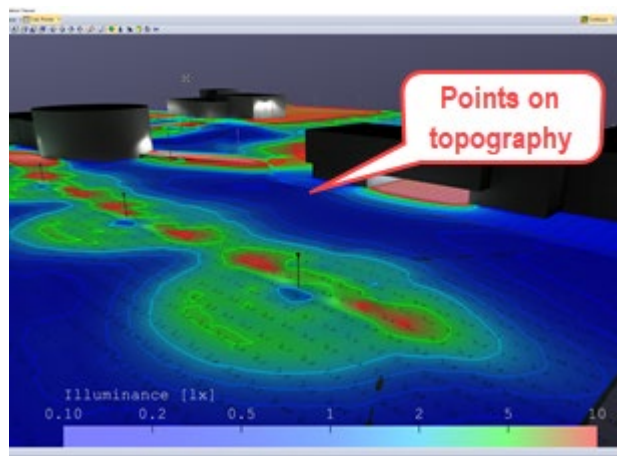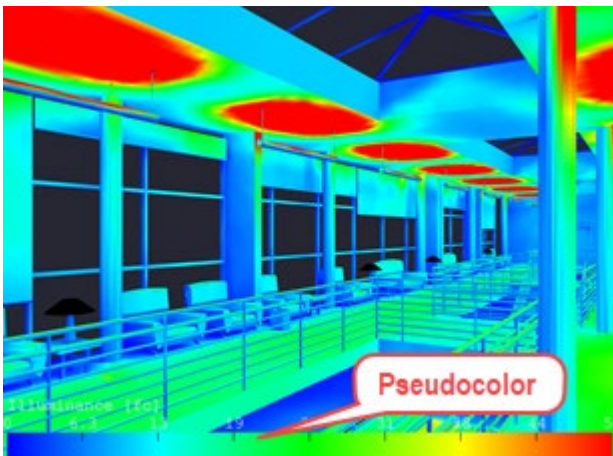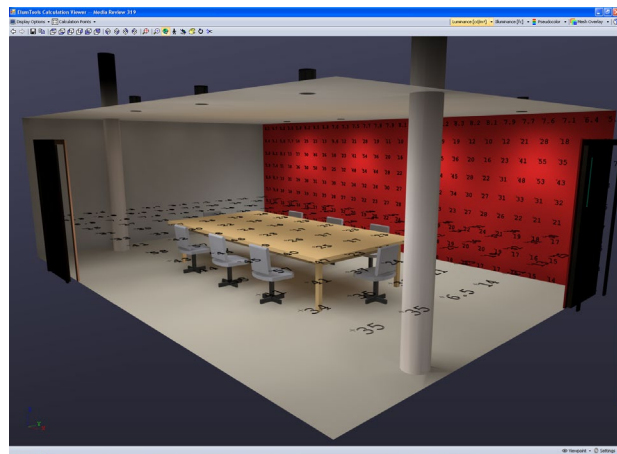
View point-by-point results in Revit

The calculated values for selected metrics (illuminance, luminance, etc.) can be seen directly in Revit. The appearance of the value color can be changed using Revit's Analysis Visualization Framework (AVF) to scale the gradient of values for improved readability.
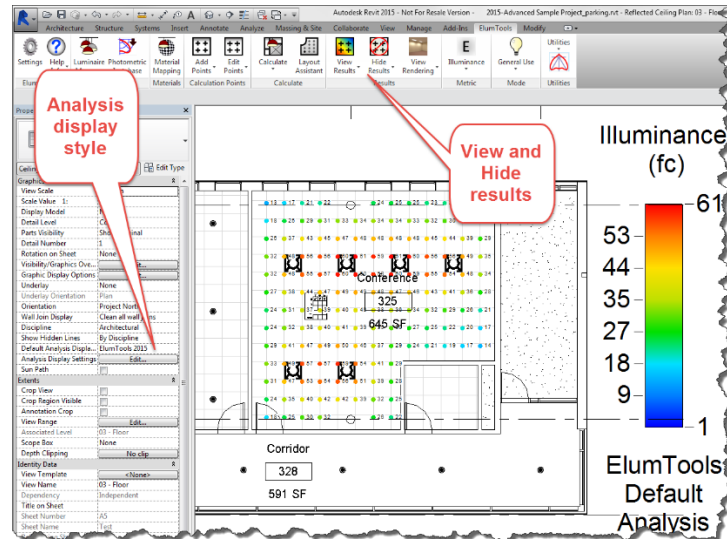

Schedule

ElumTools contains an automated schedule building tool which can build meaningful schedules for your lighting results instantly. Schedules can be easily modified with Revit's scheduling tools.

|	A	B	C	D	E	F
	Calculation Points	Average	Minimum	Maximum	Average / Minimum	Maximum / Minimum
	CalcPoints (Walls)	0 fc	0 fc	0 fc	0.00	0.00
	CalcPoints (Walls)	25 fc	8 fc	99 fc	3.20	12.57
	CalcPoints (Walls)	29 fc	19 fc	50 fc	1.54	2.65
	Instruction 302 (W	48 fc	19 fc	80 fc	2.59	4.29
	Instruction 303 (W	34 fc	9 fc	64 fc	3.58	6.87
	Instruction 304 (W	42 fc	16 fc	57 fc	2.63	3.55

<ElumTools General Use Illuminance Results>

Emergency Mode

ElumTools supports separate emergency lighting calculations by simply switching the program into "Emergency Mode." Selected boundaries can be recalculated for only the emergency lighting component. Luminaires can be designated for emergency use by instance parameter and dimmed if necessary, or the luminaire family type can be assigned emergency parameters in Luminaire Manager.
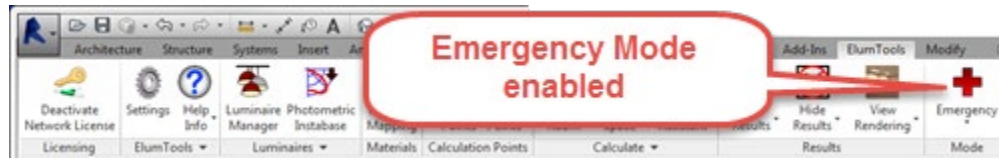
This provides two different workflows for handling the task of emergency calculations. Some will prefer using instance parameters; others will find using designated emergency types to be more efficient. Regardless, it is easy to switch back and forth between Emergency and General Use with a click on the button on the ribbon.

The ElumTools calculation viewer shows an emergency mode calculation in the capture. Switching back to General Use will enable all luminaires, and statistics are tracked and can be scheduled separately.
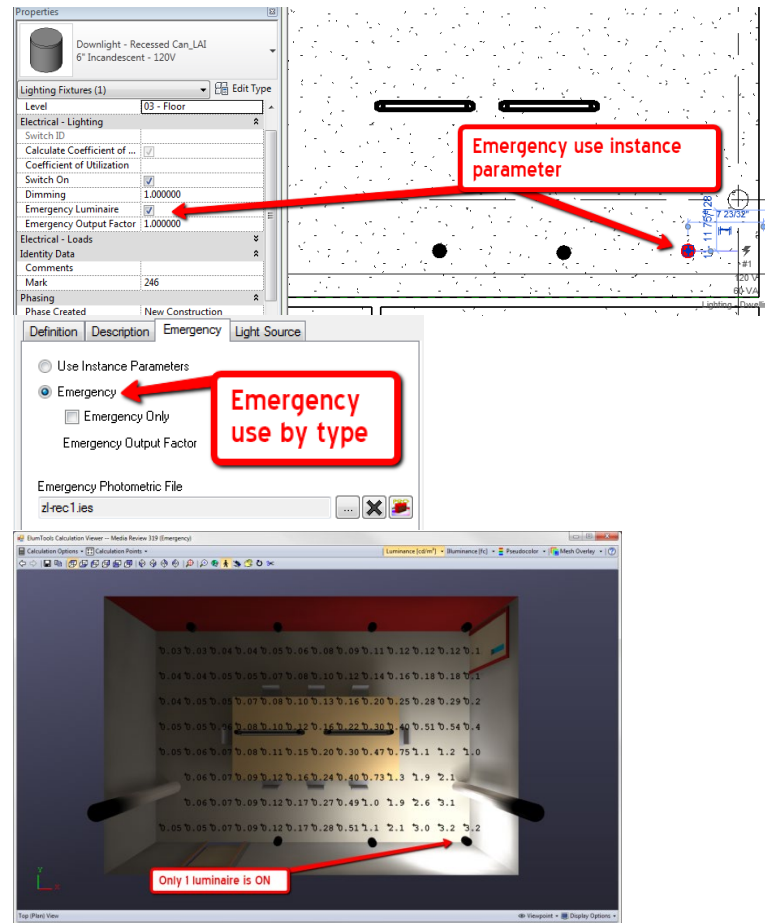
Horticulture Mode

ElumTools supports a separate and specific mode for horticultural lighting calculations. When the software is set in Horticulture Mode, luminaires can be assigned output in terms of PPF (Photosynthetic Photon Flux in μmol/s, typically provided by the luminaire manufacturer), or by PPF Factor (μmol/s/kilolumen) which can be computed from the spectral power distribution of the light source. All point-by-point calculations will then be expressed in terms of PPFD (Photosynthetic Photon Flux Density, $\mu mol/(s \cdot m^2)$). Rendered results are shown in pseudocolor (below).
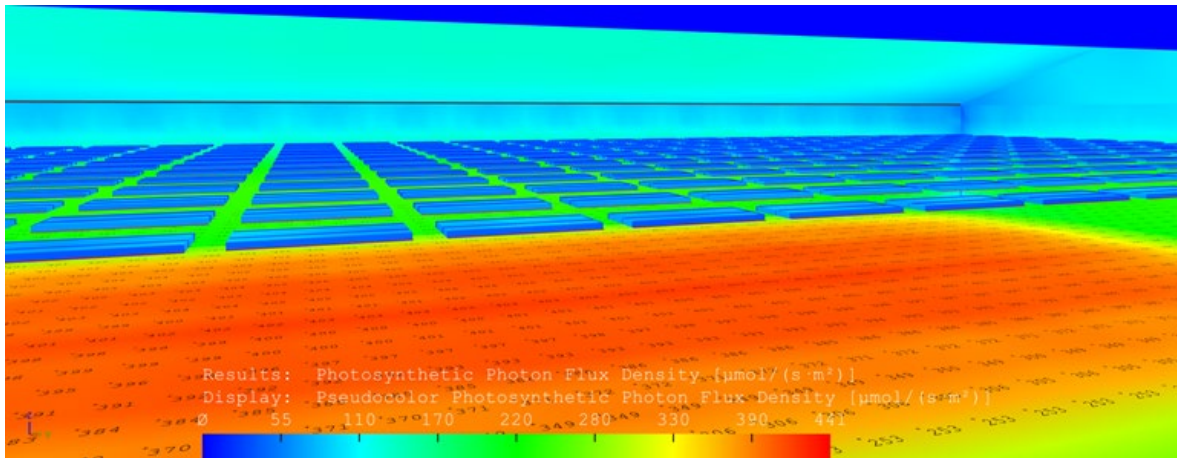
ElumTools Layout Assistant will also compute the luminaire quantity required to meet a specific PPFD average in the selected calculation zone (Room, Space, Region, etc.) for growing applications of any size and shape.

You can then calculate the PPFD at the individual points, or simply accept the estimate and automatically populate the area with the new luminaire locations in Revit. It does not get any easier to accurately predict lighting results.
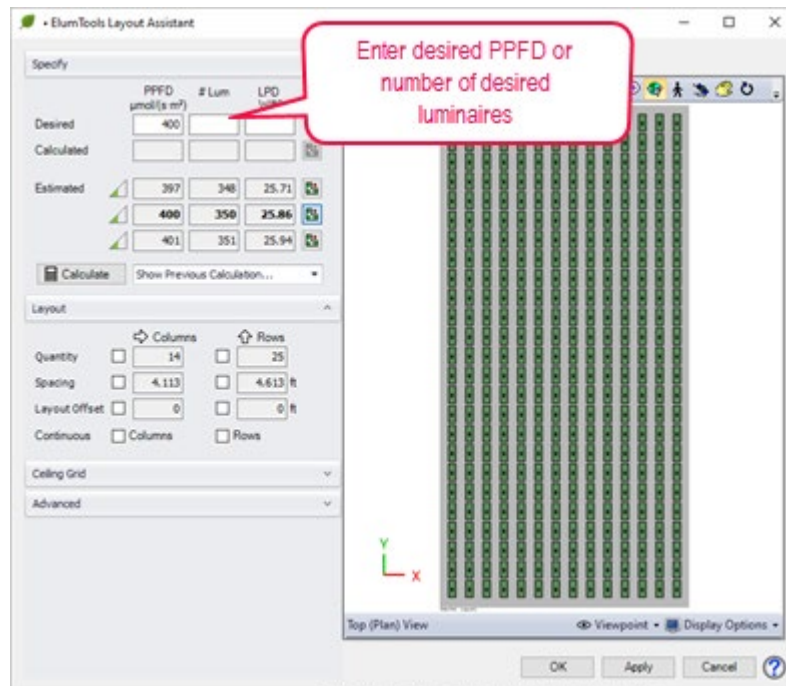
Daylight Mode

ElumTools is capable of calculating single point-in-time daylight illuminance using the IES, CIE and Perez All-Weather Sky models. The Perez model utilizes global weather conditions (TMY2, TMY3) from US-DOE. Daylight can also be combined with electric light to calculate illuminance results due to both sources.
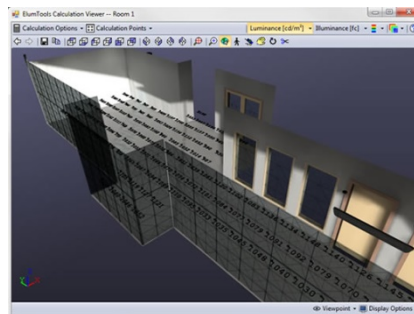
Daylighting is available as a separate mode on the ElumTools ribbon, similar to the Emergency setting. When Daylight mode is selected the Daylight Parameters button becomes visible.
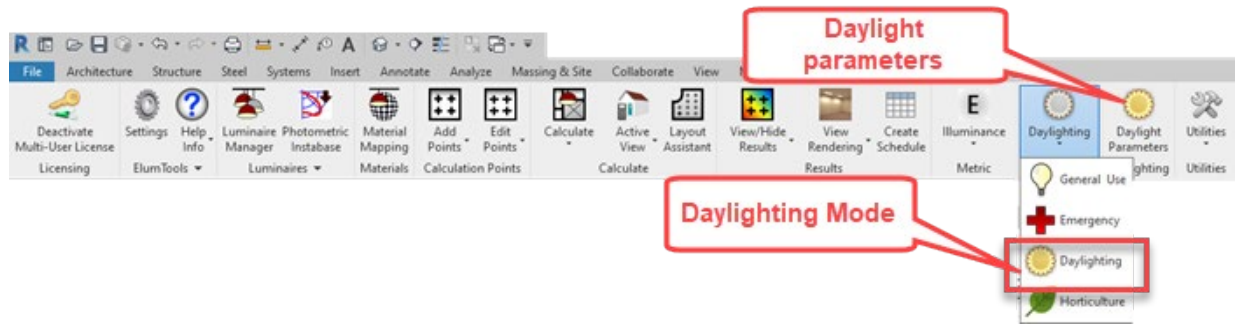

The Daylight Parameters dialog contains all the settings relative to the site location, orientation, date, time and sky conditions. The optional switch to consider electric lighting is also available here.
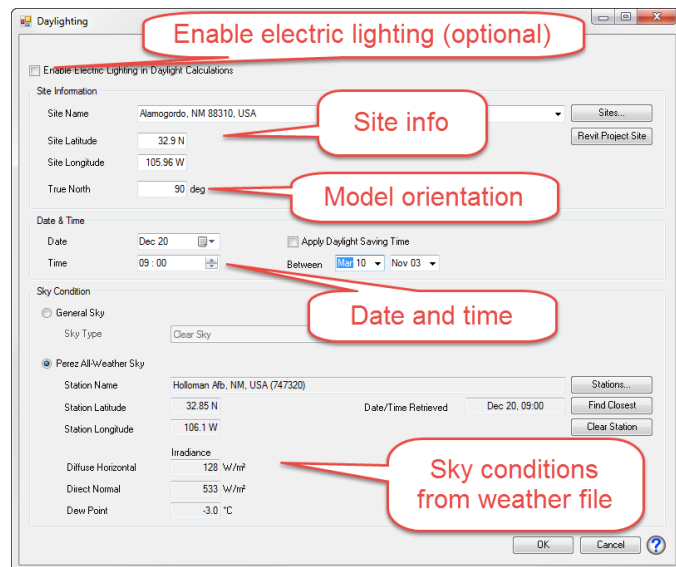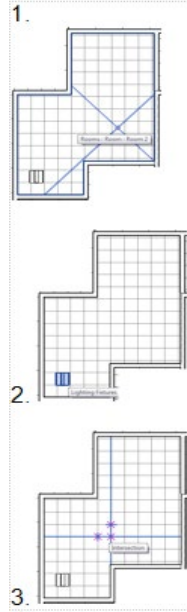

Layout Assistant

ElumTools can compute luminaire quantity to meet a specific light level in terms of illuminance or PPFD (on the floor, workplane or calculation point surface) for any Room, Space, Area or Region using the Layout Assistant. This very handy command in ElumTools will provide a series of estimates and possible luminaire layouts for you to examine and manipulate. Select the layout of choice, compute the actual point-by-point results, AND export the luminaire positions back into Revit. It is a tremendous time saver.

The following steps show the basic Layout Assistant workflow.
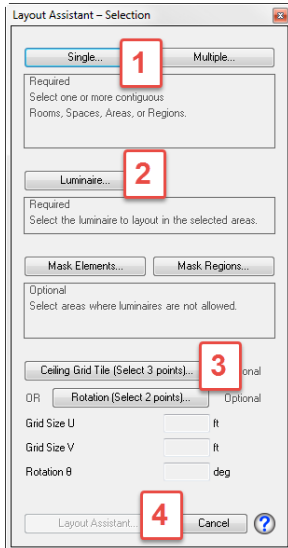
1. Select the boundary (Room or Space in this example).
2. Select a luminaire instance to be used for the layout, preferrably already hosted in the Room/Space.
3. Click three corners of a ceiling tile, if present.
4. Click the Layout Assistant button.

A. Enter the desired illuminance on the floor or workplane, (if calculation points are not already placed in the room, that dialog will appear first to enable points on floor or workplane.)
B. Layout Assistant generates three estimates, with the current selection highlighted and shown.
C. If satisfied, run the complete radiosity calculations.
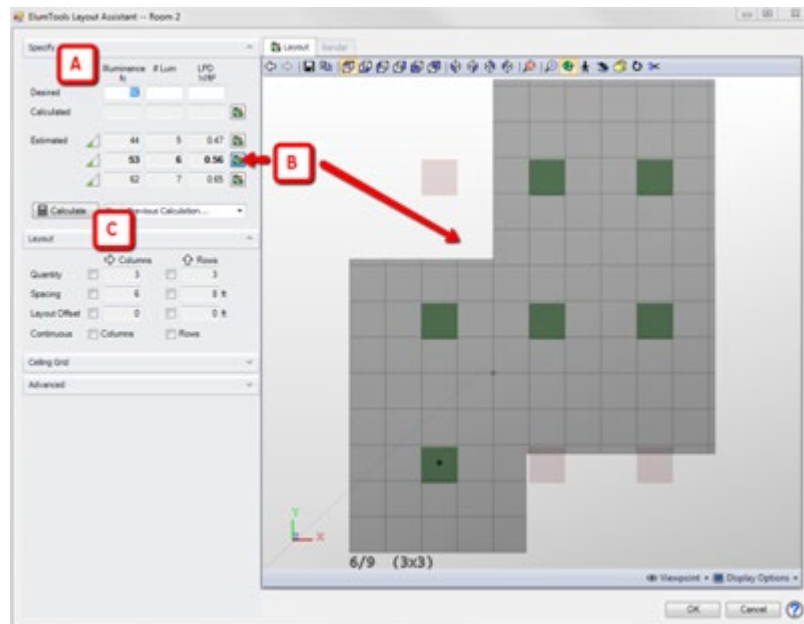
D. When calculations are complete, the Render tab is enabled with full interactive viewing.

E. The calculated layout is now the current selection.

F. New estimates are prepared with more knowledge on how the light and geometry behave. The confidence level is higher.

G. Adjust the spacing and rows, columns if desired.
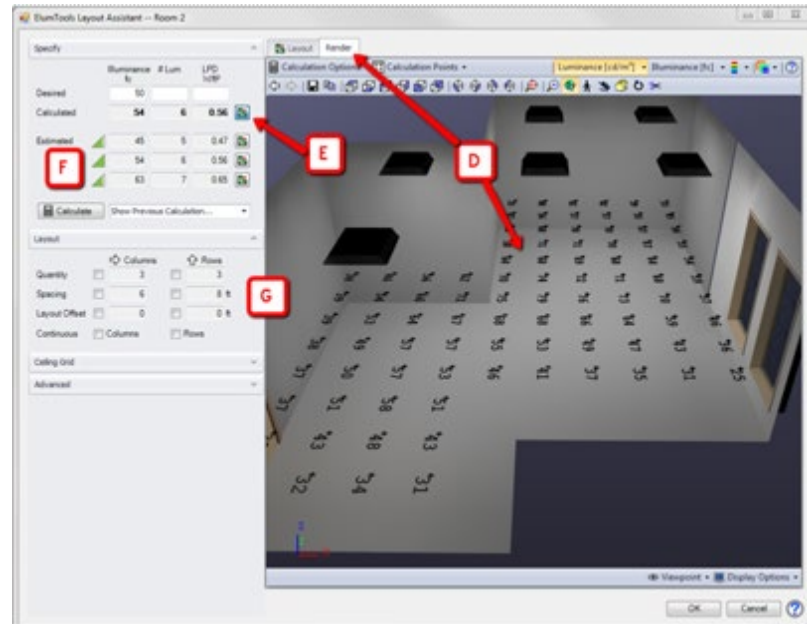
H. Click the OK button to export the luminaire locations and calculations back to the current Revit view.
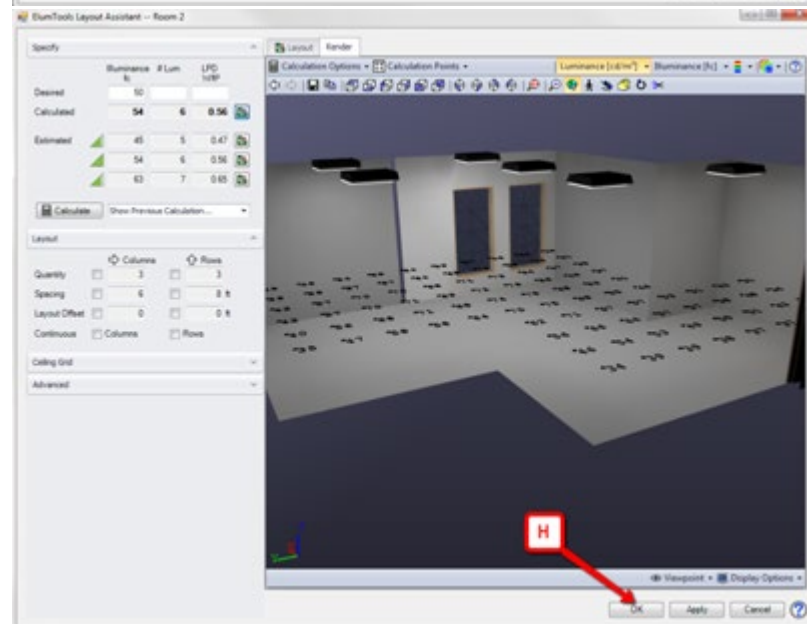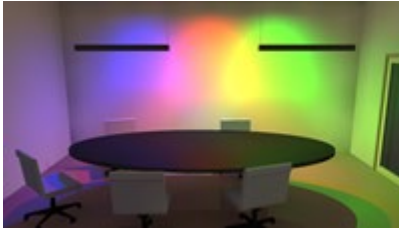

I. Here we have new luminaire positions and calculations, all done from the Layout Assistant.
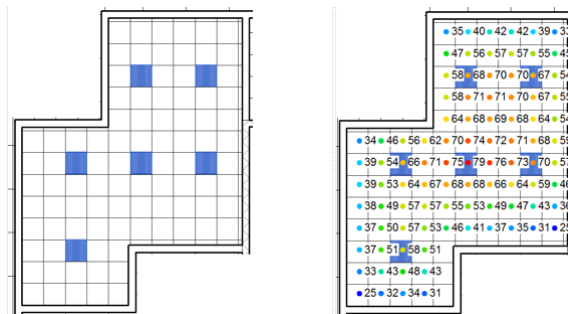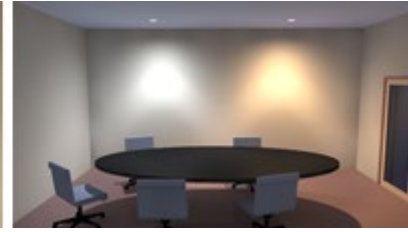
Additional capabilities

ElumTools can also render the correlated color temperature (CCT) of light sources, accurately simulate colored sources due to filters or otherwise, and ray trace your favorite viewpoints for higher quality visualizations.

Colored sources *Ray tracing* *Color temperature*

ElumTools IS lighting in Revit

The concept of computing the lighting results directly within the Revit environment using a boundary specific methodology fosters a fast and efficient workflow removing the long calculation times associated with the whole-environment approach of external software. Designers can utilize the software as a design tool on an iterative basis as needed. Point-by-point results provide validation of required lighting criteria, and interactive draft visualizations yield an understanding of the lighting system only possible with radiosity rendering.

Unlike many of today's all-encompassing lighting simulation programs, The *ElumTools* software is exceptionally intuitive, streamlined and approachable. By design, the software can be productive for any Revit user with basic lighting knowledge, and very little if any training is required.

ElumTools can be licensed via a single user or multi-user subscription. Licensed users have access to several previous releases of ElumTools for use with older Revit projects.

Download a Trial version and take advantage of our learning videos at **www.lightinganalysts.com.**

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