StreetLightingCalc

2.2

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Summary

1. What's

1.1. Generalities

StreetLightingCalc is a Cocoa Mac OSX application specialized to perform road lighting calculations, such as monitoring the amount of energy, fixtures layout by type, quantity and power, control and verification of compliance with the law of the plants, etc...

StreetLightingCalc works in metric or imperial units, runs on Apple computers running OSX, fully respecting the specific technology.

The simplicity of use and the interface modeler should not be fooled; StreetLightingCalc has a simple wizard that follows the user to build its project, then we can start calculations and wait for the results. Then continue to verifications, both visually (on the virtual space generated by the Application) and technically (through the amount of developed data).

StreetLightingCalc has some implementable internal databases containing lighting sources catalogues and linked multi-currency prices files;

Powerful LAYER and VIEW management and online HELP for the execution of commands: these are some of the possibilities offered by StreetLightingCalc.

The light sources, calculated as volumetric sources, are managed entirely by the Application, which allows you to import, display, edit and format IESNA LM-63 (ASCII text files normally used by manufacturers of lighting fixtures-North Americans), EULUMDAT (formed by European standards) and even drawings PDF or DXF (the Application converts drawings into photometry!) data files; photometric solids are summarized in 36 azimuthal C-curves and 180 zenithal gamma-angles, while the color of the lamps is given by the color temperature or real color.

StreetLightingCalc can export to RTF a complete list, formatted according to user needs, of the installed products and special items, full of economic computing and electrical power.

There is also an utility for the road projects optimization: given the width of the street, through the choice of a variety of sources, distance and height of the poles, brackets, inclination, ..., the application builds a database for each configuration with all the performed simulations. Through the use of filters you can choose from all the simulations carried out those that meet the parameters of law, the minimum installed capacity per kilometer, the configuration with maximum average luminance, ...

1.2. The Method

After creating or importing the scene, the method used for calculations is the radiance one.

The objects of the scene to calculate are divided into finite elements, which assess the amount of direct illumination due to natural sources (sun and sky) and/or artificial. The method involves the calculation of multiple reflections (for the interior) until the complete redistribution of the illuminance (unless the user do not stop the calculation). In the event that the calculation has been interrupted, the user can resume from where it was suspended to take it to completion.

The information available when calculation is done is both visual (screen image) and numerical for the required verifications. The final real view is built in real colors or in color-scale.

1.3. Video output

The individual surfaces of the object subjected to calculation are editable and can be projected on a plane and presented with the actual colors on both faces. Furthermore, the entire scene appears on the screen and can be modified in real time, because the Application keeps all lighting information previously calculated.

StreetLightingCalc has also a tool section, which shifts the normal plane of the lens (the plane of the screen) forward or backward from the observer cutting, always in real time.

1.4. Numerical output

The outputs of numerical type can be plotted on the surfaces projected on the plane and shown in iso-value curves:

- Illuminament horizontal, vertical X+, Y+, X-, Y-, semi-cylindrical and in main-camera direction;
- Luminance;
- RGB;
- Contrast factor (C.R.F.);
- Glare indexes (TI, G, U.G.R., C.G.I. and G.R.);

The displayed curves can be represented in color overlaying the view, print directly, pasted to the clipboard or saved in one of the allowed export formats (DXF, PDF, JPG).

1.5. What's the use

It is clear that, after this introduction, the use of StreetLightingCalc is wide but targeted on well defined problems. StreetLightingCalc is a flexible, fast and simple tool to address and solve problems related to road lighting.

It is also a powerful and intuitive verification tool to assess the compliance of systems to specific laws. Finally, it allows the economic computation of the entire plan, including lighting fixtures, electrical wiring and special pieces selected from a user-implementable database in more currencies.

1.6. Who needs it

StreetLightingCalc is a Macintosh Application dedicated to professionals working in the industry, architects, engineers, designers, builders, and their professional needs. To large industries that design lighting, institutions that determine the sites of application, the engineers charged in verification of compliance of road plant.

2. Getting started

At the beginning StreetLightingCalc asks for selecting or creating some folders in which the application will save all the libraries and support files for exported reports:
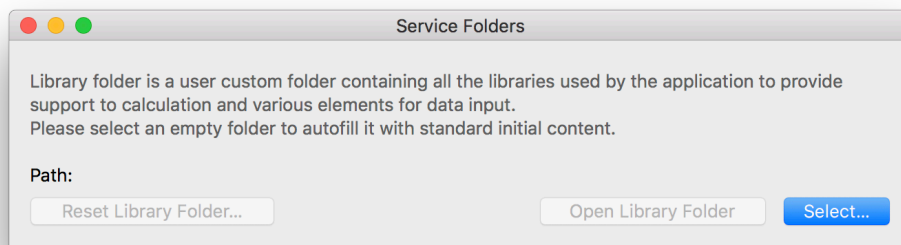
If an empty folder was selected/created as library folder StreetLightingCalc asks if the user wants to fill it with the default content:
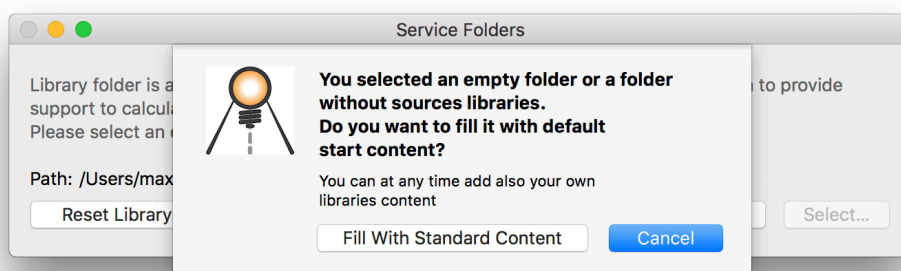
Then the installation procedure for the libraries folder will end:
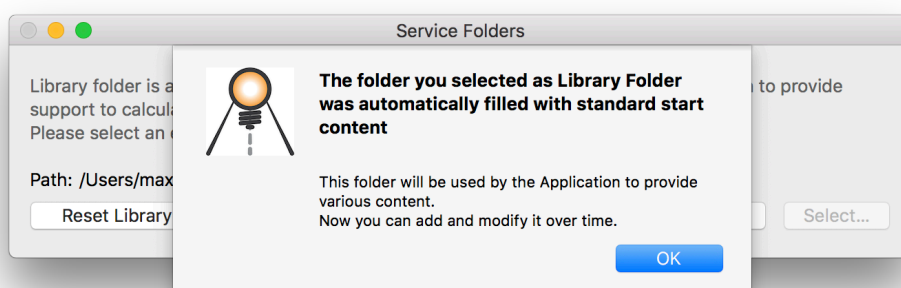
Finally StreetLightingCalc presents the window that permits to to create and optimize road lighting (see

Workspace).

3. Workspace

At the beginning, the Road-Wizard dialogue will be presented:
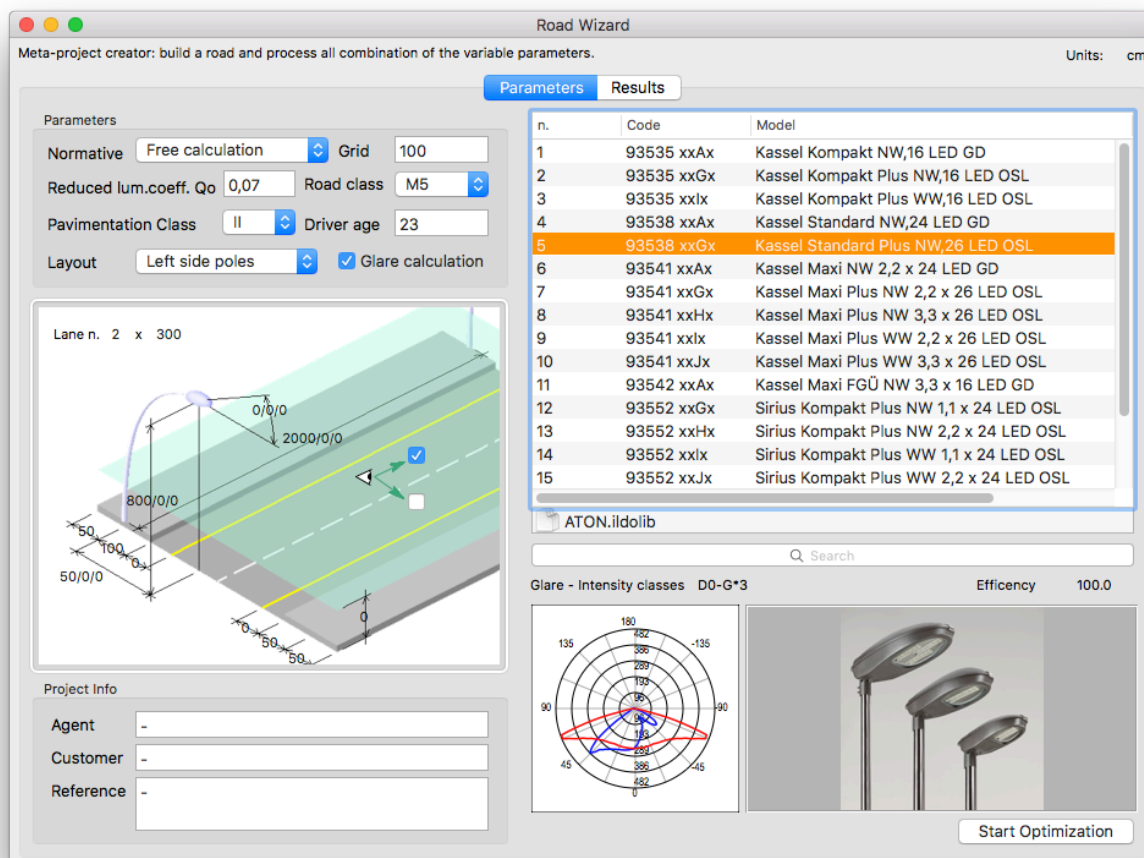
It is possible to automatically draw a road section with (in centimeters/inches) lane number and width, pole distance, sources height, luminaire tilt and bracket length, sidewalks size and the position of the pole respect to these, height and orientation X+ of a virtual surface to calculate vertical (X+, Y+, X-, Y-) and semicilindrical (X+) illuminament, and other parameters as the following dialogue divided in two tabs, in which the first ('Parameters') permits to introduce the parameters and the second to analyze the optimization ('Results').

Sidewalks define the proximity zones and are useful to evaluate the SR parameter.

The "Layout" pop-menu may present a single side road with left-side or right side poles, a staggered pole disposition or a double side with pole in front or centrals:
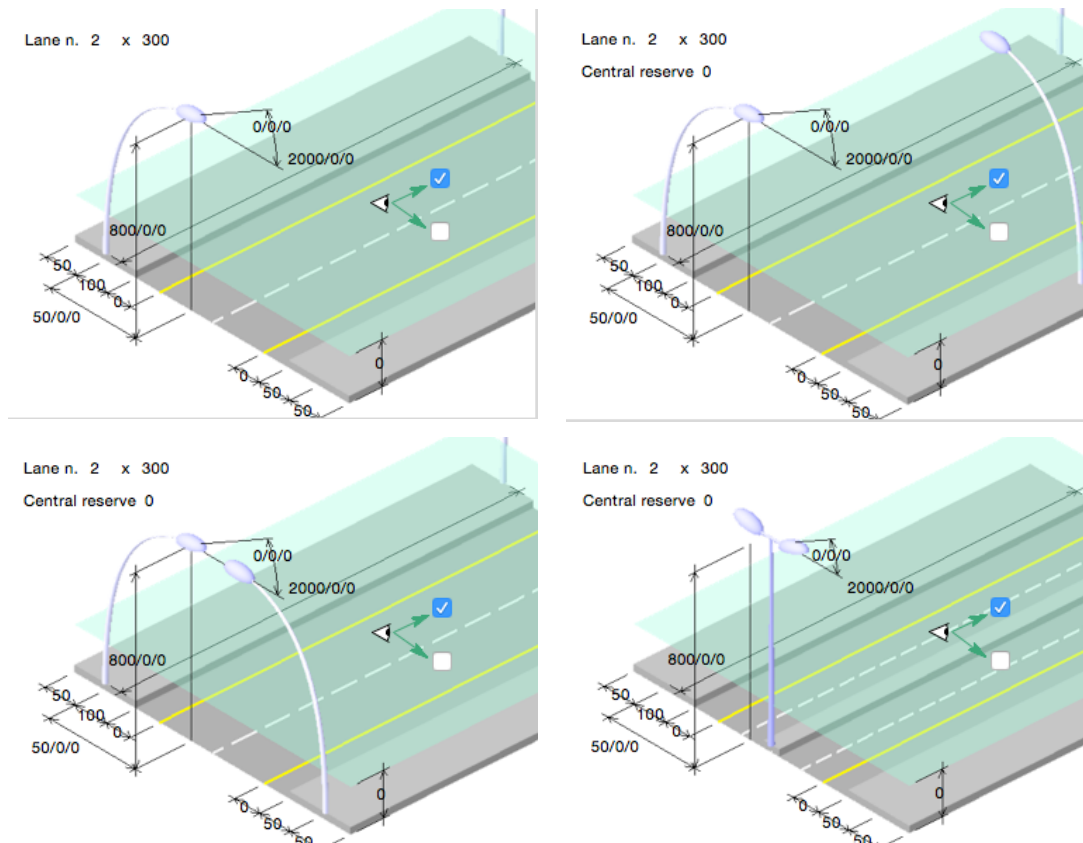
If the central reserve is present or the chosen layout is "Central pole" the Application will build only the left-side road (for symmetry reasons).

The road surface may be of Class I or II, but it is possible to change the proposed reduced luminance coefficient q_0 in the relative edit field.

The calculation grid may be free or may follow the UNI10439, UNI11248/EN13201 or UNI11095 standard. In case of free calculation the user can choose the calculation grid.

The Application permits to introduce the driver age as a parameter in the K multiplier of the veil luminance in the TI glare calculation:

$$0.86 \cdot \left[1 + \left(\frac{\text{Driver age}}{66,4} \right)^4 \right]$$

Checking the "Glare calculation" button the complete law calculation will be performed (observer position, TI calculation, ...).

The source catalogue may be chosen through the button at the end of the source list, containing the name of the active one.

To find some source it is present a "find" edit field under the source list: typing something inside it the Application will search for the sources whose name contains the typed characters.

To start the Road Optimization Tool, lighting source multiple selection and some fields permits to select a range of values from a minimum to a maximum with fixed step:

- source model (with a multiple selection by pressing the ⌘(command) key or the ⇧(shift) key)
- pole distance (type: minimum/maximum/step)
- source height (type: minimum/maximum/step)
- luminaire tilt (type: minimum/maximum/step)
- arm length (type: minimum/maximum/step)

Finally the Application start to calculate all the possible combination of layout (each model at each source heights at each pole distances at each arm and for each tilt) presenting the results in the second tab:

The table presents a series of column:

- the number of simulation
- the number of source model in the catalog
- the source name
- the specific power consumption per km/mile
- the pole distance (if input as minimum/maximum/step)
- the source height (if input as minimum/maximum/step)
- the luminaire tilt (if input as minimum/maximum/step)
- the arm length (if input as minimum/maximum/step)
- the medium horizontal illuminament Em
- the medium luminance Lm
- the horizontal luminance uniformity Uo
- the center-road luminance uniformity Ul

and, for each observer "i":

- the longitudinal lane luminance Lm(i)
- the horizontal luminance lane uniformity Uo(i)
- the longitudinal lane luminance uniformity Ul(i)
- the lane glare TI(i)
- the SR(j) and the TI(j) (UNI 11248/2011) parameter connected to every sidewalks
- the intensity indexes D and G relative to the fixture.

It is possible to order the rows by a specific column value by clicking the column header, or reorder the column order dragging the choose one in the new position.

Finally, it is possible to filter the results editing the threshold-values on the bottom of the window and check the relative button: the simulations that not respect these limits will be hidden.

To simplify this procedure is present a 'Class' pop-up menu with the standard road classification that will fill for you the fields.

The 'Export Result' button will save the whole table in a tab-delimited file, while clicking the 'Build selected configuration' button the Application exit the optimization result dialog and will build the chosen configuration.

Pressing the button 'Build selected configuration' a new project will start with the values displayed in the dialogue and the application shows the scene in 3D mode view.

Following default settings, may be visible:
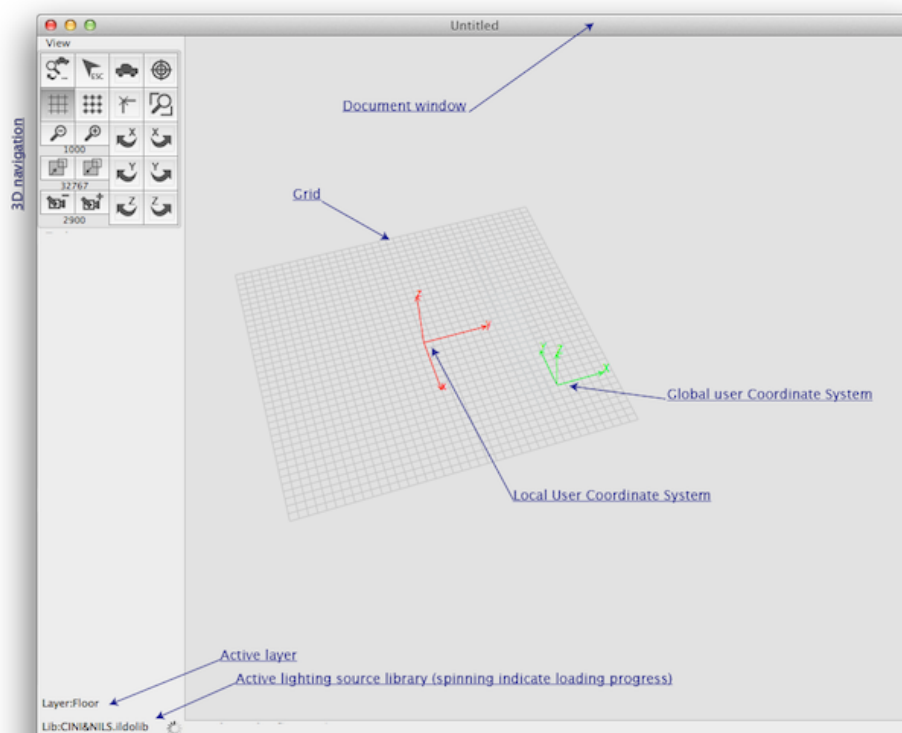
- Global Coordinate System with the axis X-Y-Z in green color (always visible);
- Active Coordinate System with the axis x-y-z in red color;
- The graphic grid of the Active Coordinate System at z=0.

3.1. Document Window

For each Document the main window contains the model and some instruments depending on the type of visualization, but for each mode it is possible:

- reposition the window with the title bar;
- redimension the window from the edges and with zoom (green) and collapse (yellow) button in the title bar;
- close the window whit the close (red) button in the title bar.

Visualization mode may be:

1. 3D view
2. Plan view
3. Result view

3.1.1.   3D View mode

This is the mode in which the software presents a new document and the only one in which is possible to create and edit all drawing elements.

The drawer contains a group of buttons:

Setting dialog	Escape (ESC) command		Models link ON/OFF	Center view
Grid ON/OFF	Snap to grid ON/OFF		Snap to points ON/OFF	Zoom window
Zoom out	Zoom in		Rotate X clockwise	Rotate X counterclockwise
Front cut plane forward	Front cut plane back		Rotate Y clockwise	Rotate Y counterclockwise
Camera out	Camera in		Rotate Z clockwise	Rotate Z counterclockwise

View modifications may be done also with the mouse wheel:

1. top, bottom, left and right view movements permits to scroll the 3D view;
2. pressing the ⌥(option) key at the horizontal mouse-wheel moving the software will react with an horizontal view rotation (pitch), and to a vertical mouse-wheel moving a vertical view rotation (yaw) will be linked.
3. pressing the ⌘(command) key the mouse-wheel moving will be linked to a video-plan view rotation (roll);
4. pressing the ⇧(shift) key vertical mouse-wheel movements will be linked to the zoom (Zoom in and out), while horizontal mouse-wheel movement will be linked to the eye position (Camera in and out).

3.1.1.1. Selection management

The user enters the selection mode. The command stops every other active command and stands by for another selection set to be created.

Selecting only one element the user will be able to modify its internal parameter by a double-click or by the command 'Edit'->'Info'->..., its geometry by the command 'Edit'->Reshape', and its local Coordinate System by the command 'Coordinate'->'Modify'.

To modify the same parameters on more than one element, the user must modify one element of the group, activate the copy of its parameters (command 'Edit'->'Copy') and then paste the desired parameters to the group (command 'Edit'->'Paste Special...').

Multiple selections proceed holding down the key ⇧(shift key) and selecting or deselecting the desired element: if this is overlapped with others, the user will be able to make more clicks, holding down the key ⇧(shift key), and then will be selected, in order, from the first to the last of the overlapped elements and then all together.

Multiple selection may be done by the 'window selection' simply dragging a rectangle with the mouse that has to totally include the elements we want in the selection.
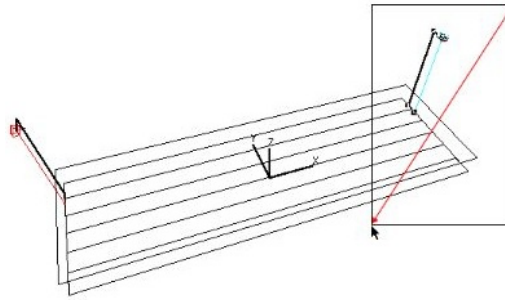
An option for making a multiple selection is the 'crossing window selection' that consists in creating a dragging mouse rectangle, that intersects the wanted objects, with ⌘(command) key pressed:
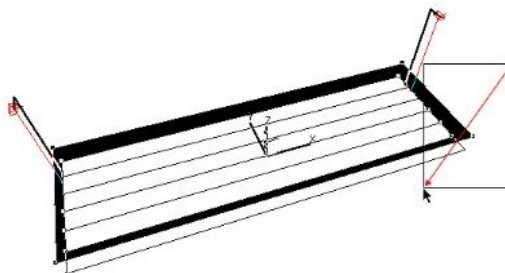
Selecting flat surfaces the Application shows the local X and Z ax (highlighted in green), defining the direction of the 'observers':
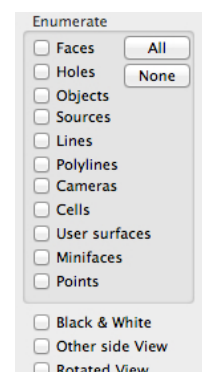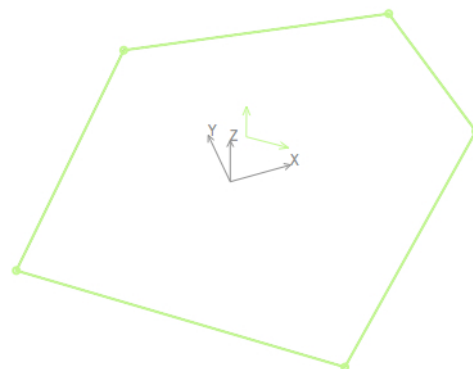
3.1.2. Plan view mode

In the Plan view mode the drawer contains two group of check box (see right image):

The first group permits to enumerate the elements contained in the view, the others permit:

- to draw the plan view in black and white (check box 'Black and White');
- to project selected elements in the opposite side of the first-selected face (check box 'Other side View');
- to rotate 90° the plan view (check box 'Rotated View').

3.1.3. Result view mode

The   characteristics   of   this   mode   are   explained   in   the

Command: RESULTS paragraph.

3.2. User surfaces

StreetLightingCalc permits to define one surface as a 'user surface', to simulate a working plane, and to calculate, in addition to the horizontal, also the vertical and semi-cylindrical illuminances, contrast rendering factors C.R.F. and glare indexes C.G.I. and U.G.R., ...

An user plane is a transparent virtual surface, that retains data relative to rays passing through it; measured points are placed in the barycenter of the finite elements of the same surface (defined by the calculation internal grids), and the local X-axis represents the viewing direction.

4. Guide

4.1. Menu Street Lighting Calc

4.1.1.   Command PREFERENCES...
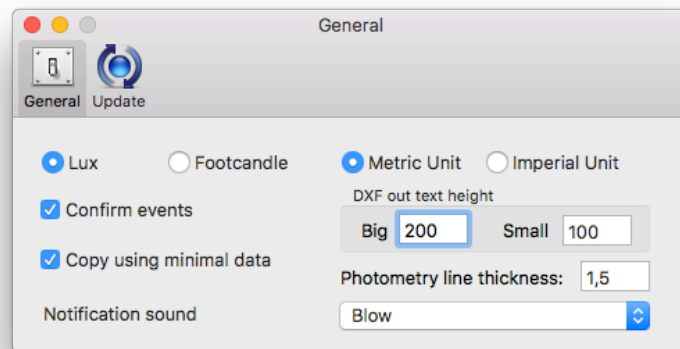
With this dialogue in the 'General' tab it is possible:

- to work with the preferred units: metric (cm, m) or imperial (ft., in)
- with 'Confirm events', to disable confirm warning events like 'Are you sure to delete...';
- with 'Copy using minimal data', to copy only lux values in the result view while opening a mouse region   (not   applicable   for   roads   –   see   4.8.2

Command: RESULTS);
- to define the text height for the dxf exportations;
- to set the line thickness for the photometric curves plot;
-
- to choose the default notification sound.

In the 'Update' tab it is possible to choose to be notified for new releases:
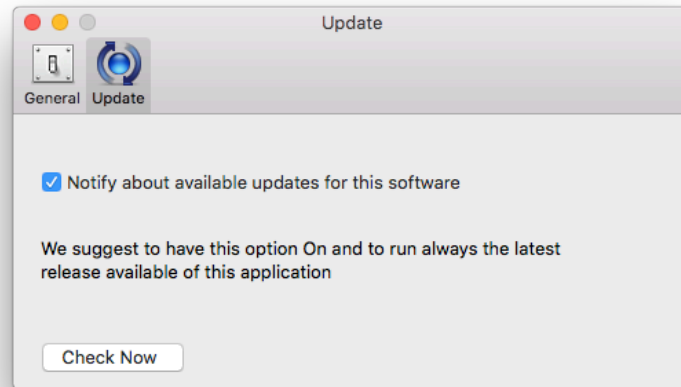
4.1.2.   Command QUIT

From this menu it is possible to exit the Application.

4.2. Menu File

4.2.1.   Command OPEN...

This command permits to open an already-saved StreetLightingCalc file through the standard Mac dialog.

It is also possible to open StreetLightingCalc projects through Drag & Drop procedures.

4.2.2.   Command OPEN RECENT

This menu presents a list of the last opened files, and it is possible quickly open one of it.

4.2.2.1. Command CLEAR MENU

This command clears the list of the recent opened files.

4.2.3.   Command ROAD WIZARD

The   Road-wizard   dialog   will   be   presented   (see   3

Workspace).

4.2.4.   Command: SOURCE LIBRARIES MANAGER

The main window is divided into 4 sections:

- Photometry: permits to navigate and modify the photometric solid
- Catalogue: permits to manage catalogue on disk
- Fixture: permits to modify geometrical, electrical,... characteristic of the fixture
- Lamp: permits to view/select lamps
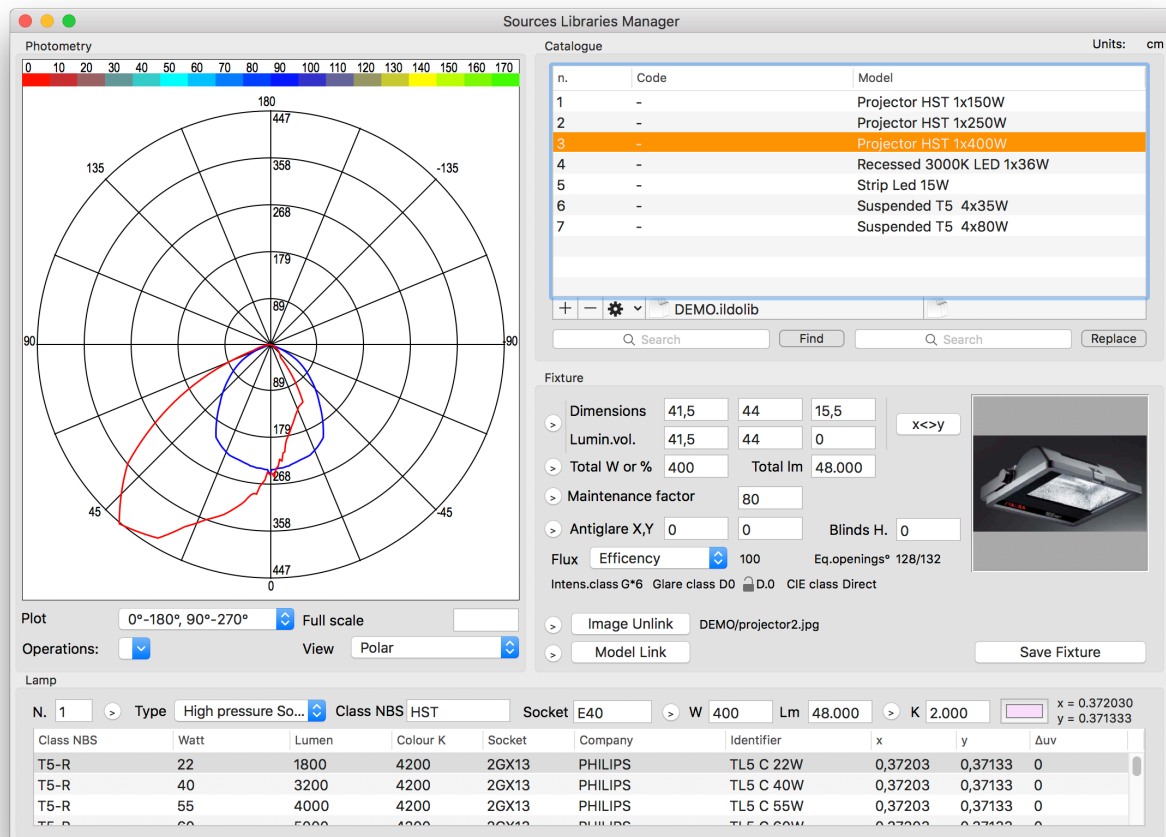
4.2.4.1. Photometry section

The view presents the 18 azimuthal sections of the photometry in candle for 1000 lumen with different colors for each curve or the I-table, according to the 'View' pop-up menu. Many options are possible:

- With the pop-up 'Operations' it is possible to modify the active photometry, and in particular it is possible on a single or multiple selection (after all these procedure, to maintain the modified photometry it is necessary to save it with the item 'Save Fixture' in the 'Fixture' section):
  - to correct efficiency of the selected luminaires: permits to evaluate the ratio between the luminaire emitted flux and the total installed one: the user can scale the photometry to balance this value on a more correct one, following the side dialog; value can be entered also as a series of simple operation (without parenthesis or precedence order) like '100*45,12/36'.
  - to rotate the azimuth of the whole photometry at 10° or 90° steps, clockwise or counter-clockwise, for example to overlap the C=0 axis of the imported photometry with the frontal axis of the StreetLightingCalc source, if the first does not respect the CIE-standard (this is possible importing IESNA formats);

- o to rotate the zenith of the whole photometry at 90° steps, up and down;
  - o to mirror the left side of the photometry to the right side and vice-versa, respect to the C=0-180°;
  - o to reassign the photometry as the average of the left side and the right side, respect to the C=0-180°;
  - o to reassign the photometry as the average respect of the vertical axis and rotating it 90° in the azimuth;
  - o to sum the selected photometries (only multiple selection).
- Through the pop-up menu 'Plot' it is possible to choose the section or combination of sections to show;
- The edit field 'Full scale' assign the diagram Y scale ratio: a 0 value let the software to choose the best value;
- The pop-up menu 'View' permits to display the photometry as polar, Cartesian, I-table or 3D view.
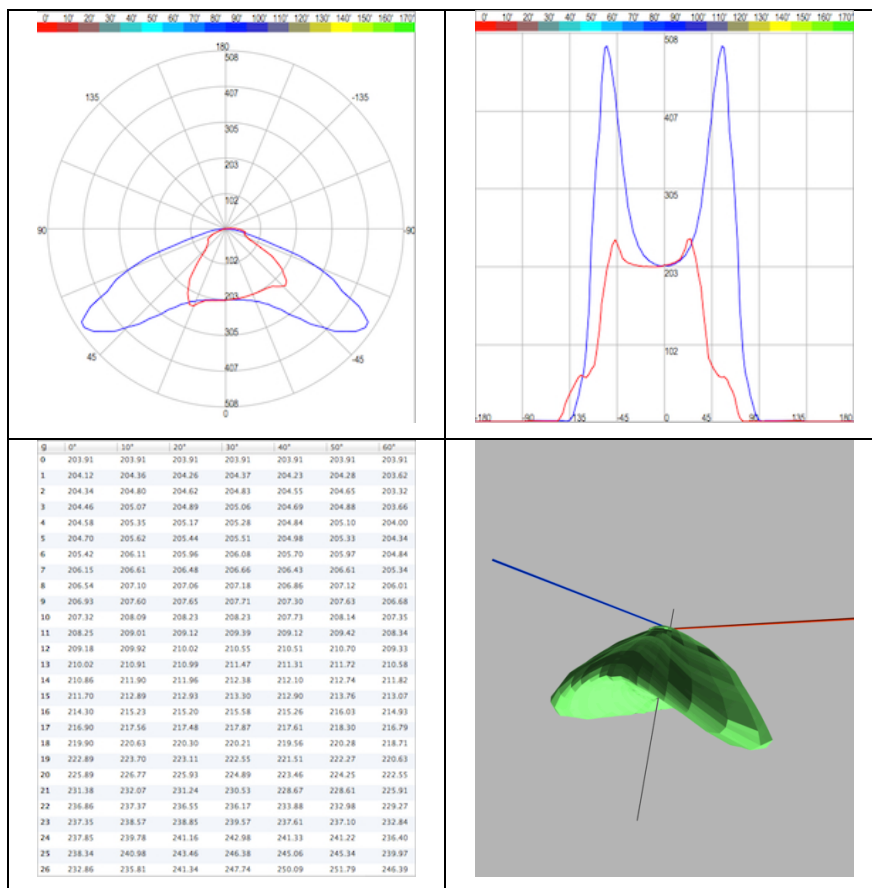
In the I-table view mode the user can modifying a single value by editing the relative field in the list: the Application will answer requiring an interval (called "elastic interval") to smooth the final result following a sine/cosine surface interpolation:

In the 3D view navigation is possible through the standard Mac mode:

- click + drag = rotate;
- right-click + drag = pan;
- alt + click + drag = zoom.

4.2.4.2. *Catalogue section*

This section presents the active source catalogue and a list of its enclosed luminaries alphabetically ordered: choosing a luminaire, the element identifier will be pasted in the relative edit field that make possible to change its name. It is possible to make multiple continuous (⇧-shift key pressed) or discontinue (⌘-command key pressed) selection for particular modification to the selection set.

Furthermore it is possible to order the list of fixtures alphabetically by clicking the column title. In this section it is possible:

- to add a luminaire copied from the selected ones (button '+' and also available as contextual menu); the program asks for sizing flux and power of the new fixture to a new value of total power, according to the following dialogue:
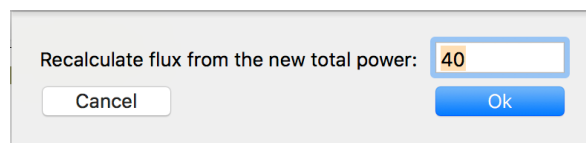
- to delete the selected luminaires (button '-' and also available as contextual menu);
- to create a new empty Catalogue;
- to open an existing one: the active one is highlighted in the field under-center the source list;
- to merge an existing one into the active catalogue;
- to import a single photometry, saved in EULUMDAT, IES or TM14 format (see 4.2.4.2.1 Importing photometries);
- to import a whole photometry folder included all subfolders, saved in EULUMDAT, IES or TM14 format: in this case the software asks for some options: it is possible to rotate each photometry at 10° step clockwise or counterclockwise, to include in the StreetLightingCalc identifier:
  - o label the file name, data bank, version and format;
  - o the Company luminaire catalog number;
  - o the Company luminaire name;
  - o to import all the bulbs with which the luminaire is powered (only EULUMDAT format) following the dialogue:
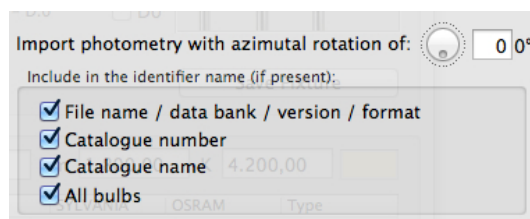
- to save the current catalogue;
- to save a copy of the current catalogue;
- to link a price file to the active catalogue, simply choosing it through the standard Macintosh dialogue: the linked one is highlighted under-left the source list;
- to unlink any price file from the active sources catalogue;
- to join code and model in a single strings that will replace the model string, far all the selected photometries;
- to export all the luminaires in the active catalogue as a simple list of sources in plain text format with tab delimiters, formatted as 'Model' - 'Input flux' (Lamps number x Lamp flux) - 'Output flux' (Luminaire outgoing flux) - 'Efficiency %' (Light Output Ratio);
- to export the selected luminaires as:
  1. IES-NA photometry file, and it is possible to personalize some fields as in the next figure:

2. EULUMDAT photometry file;
3. PDF drawing file;
4. PDF protocol that may include:
     o the longitudinal section (C=0/180) of the luminary's photometry;
     o the longitudinal (C=0/180) and the transversal (C=90/270) section of the luminary's photometry;
     o all the sections of the luminary's photometry;
     o all the numeric fields defining the photometry (I-table);
     o the luminary's picture.

5. Collada (DAE) 3D file (if the 3D view is activated in the 'View' pop-menu);
- to find lighting sources that contain a specific text inside the model name or to replace all the occurrences of a certain text string in the selected sources (once activated the 'Replace' field through the toggle menu inside the 'Find' edit field); moreover, typing '#' followed by a number N the application will cut from the name the first N characters;
- to copy in a single text string the code and the model of the selected source (also available as contextual menu);
- to copy the selected photometries in the Brotens native format for pasting them in another catalogue;
- to paste the previously copied photometries in the active catalogue;
- to copy the active photometry in PDF format;
- to copy the active photometry in PNG format.

4.2.4.2.1. Importing photometries

StreetLightingCalc permits to import photometric data from IES-NA, EULUMDAT, TM14, PDF or DXF files.

The user will be prompted with the following dialogue, to save the photometry rotating it at 10° steps, clockwise or counter-clockwise, with an identifier containing or not:

- the file name, data bank, version and format;
- the Company luminaire catalog number;
- the Company luminaire name

...and to import all the bulbs with which the luminaire is powered (EULUNDAT format):
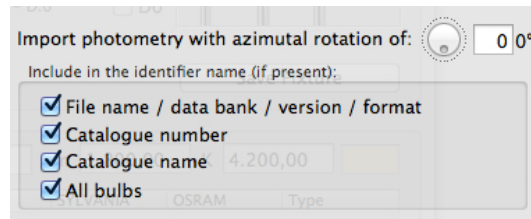
For text files, StreetLightingCalc will try for the first time the IES-LM-63 format (to format a file in such a way see Appendix C: IES-NA data interchange format). If this is not a correct filter, the Application reply with an alert and try EULUMDAT filter (to format a file in such a way see 5.6 Appendix D: EULUMDAT data interchange format) and finally the TM-14 filter will be tried.

If the luminaire to import has the possibility to install different bulbs (EULUMDAT formats), the Application will display a dialog for choosing the configuration to present.

StreetLightingCalc can import also PDF or DXF drawing as photometry, that must contain the following information:

- a couple of lines drawn in **BLACK** crossing in the center of the real photometry if drawing a polar diagram or an horizontal black line and (optional) a **YELLOW** line perpendicular in the middle point of the first if drawing a Cartesian diagram;
- a text object indicating the maximum intensity value (optional);
- a polyline or some connected lines drawn in **RED** (or a mainly-red color – ex.: RGB={0.8, 0.1, 0.2}) defining the C=0, C=180 sections and containing the center of photometry;
- a polyline or some connected lines drawn in **BLUE** (or a mainly blue color – ex.: RGB={0.2, 0.1, 0.8}) defining the C=90, C=270 sections and containing the center of photometry (optional but the first to use if the red one is present);
- a polyline or some connected lines drawn in **MAGENTA** (or a mainly magenta color – ex.: RGB={0.8, 0.7, 0.1}) defining the C=60, C=240 sections and containing the center of photometry (optional but the first to use if the red and blue ones are present);
- a polyline or some connected lines drawn in **CYAN** (or a mainly cyan color – ex.: RGB={0.2, 0.7, 0.8}) defining the C= 10, C=190 sections and containing the center of photometry (optional but the first to use if the red, blue and magenta ones are present).
- a polyline or some connected lines drawn in **GREEN** (or a mainly green color – ex.: RGB={0.2, 0.7, 0.2}) defining the C=30, C=210 sections and containing the center of photometry (optional but possible to use only if the other colors are present);

Opening the DXF file, if not present in the file, the Application asks for the maximum intensity in the selected photometry, to bring the drawing to the real scale. Photometry to import may be drawn as polar or Cartesian diagram, following the next indications:

Drawing a polar representation   Drawing a Cartesian representation
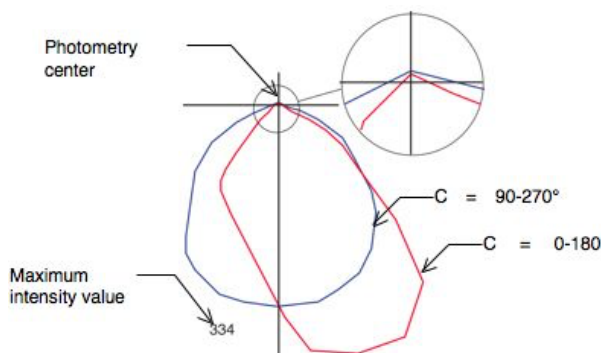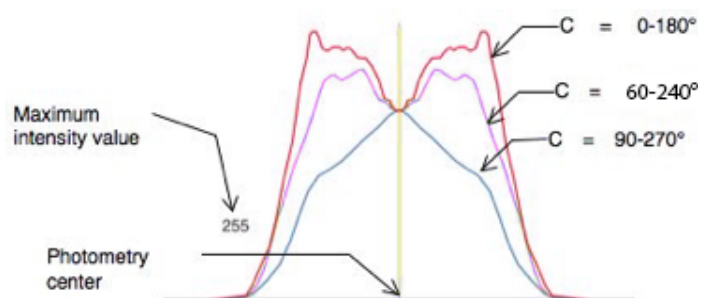
4.2.4.3. Fixture section

In this section it is possible:

- to save the modified luminaire ('Save fixture' button). The label inserted in the edit field may contain some code characters:
  - a couple of round brackets with a fraction '(1/N)': this case means for the software, in the evaluation exportation, that the fixture is a part of a bigger luminaire composed by N identical parts (es. 'fixture AAA (1/3)'); in the price list the cost of the fixture has to be divided by N and finally in the computation it will be reassembled with the price brought to the original cost;
  - some text included in square brackets '[...]' will be omitted in the report. This opportunity is useful to connect luminous parts (saved as photometries) of the same fixture: the part of the label external to the brackets '[...]' has to be the same, while inside the brackets the part may be evidenced, taking care to highlight with a '+' sign all the secondary parts (es. 'fixture AAA[part 1]', 'fixture AAA[+part 2]', ...).
- to assign dimensions and luminous volume. Luminaire geometry is defined through its "Bounding box" (needed for shadow calculation) and its "Luminous box", both described as box oriented in the Local Coordinate System of the lighting source as in figure:
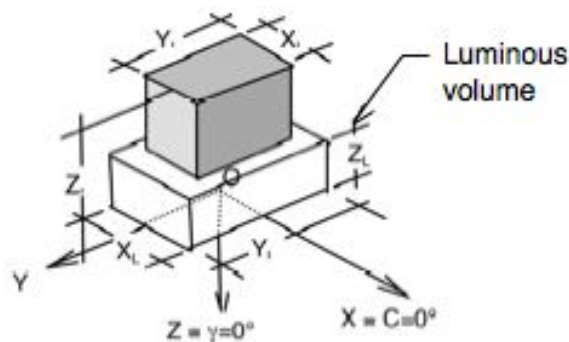
- Because of the local X-axis in StreetLightingCalc is the C=0° axis, for compatibility with the interchange formats it is present the "x <-> y" button, that permits to invert the fixture dimensions along the local axis;
- to assign total power (that take count of electronic parts and of what the luminaire needs to function; it is possible to input this field as an absolute value, es. '120', or as a percentage of the lamps power, es. '20%') and maintenance factor (must be choose on low values 30%÷50% for dusty luminaries and/or rooms, and on better values 70%÷90% for new luminaries and/or clean rooms);
- to assign the total flux of the fixture, that take account of the Light Output Ratio of the Luminaire;
- to assign blind height and antiglare grids;
- to control emitted flux, and in particular:
  - efficiency;
  - 0°-30° emitted flux;
  - 0°-40° emitted flux;
  - 0°-60° emitted flux;
  - 0°-90° emitted flux (DLOR = downward luminaire output ratio);
  - 90°-120° emitted flux;
  - 90°-130° emitted flux;
  - 90°-150° emitted flux;
  - 90°-180° emitted flux (ULOR = upward luminaire output ratio);
  - 0°-180° emitted flux (total).
- to control equivalent light-cone (those angles in which the intensity decay at 50% of the one measured at gamma=0°) ;
- to control the CIE class (the official CIE classification for the fixture) end Intensity Class D and G;
- to force the assignment at Intensity Class D.0 through the check box (if the bulb or its image is visible from an angle of 85° from the vertical, according to the D.0 definition);

- to link/unlink an image to the fixture, that has to be contained in the 'Picture' folder inside the 'Luminaires' folder (choosing 'Cancel' the user can delete every link to the element);
- to link/unlink a 3D dxf-model to the fixture, that has to be contained in the 'Models' folder inside the 'Luminaires' folder (it is important that the model will have origin O and spatial orientation equal to the StreetLightingCalc scheme to have a correct visualization inside SceneKit and with the convention that all the dxf-elements drawn in color #0 represent the luminous parts of the fixture, and in StreetLightingCalc will be drawn in the source color);

The '>' button, if present, permits to automatically assign the actual value to all the selected elements in the source list of the active Catalog.

4.2.4.4. Bulb section

Bulbs installed in the lighting source will be characterized with the following parameters:

- type of emission spectrum;
- number of installed ones;
- power of the single bulb in Watt;
- conventional bulb name;
- lamp holder type;
- luminous flux of the single bulb in Lumen;
- correlated Color Temperature and RGB color.

It is possible to change the proposed Color Temperature simply editing the new value in its field or clicking right side coloured button.

The main dialogue presents, finally, a list reporting some of the most common commercial lamps, for a quick selection through a double click.

The '>' button, if present, permits to automatically assign the actual value to all the selected elements in the source list of the active Catalog.

The bulb database is contained in the "Lamps.txt" file is a simple text file that can be edited with whatever software but saved as text file.

The file has the following structure:

class NBS	W	Lm	K	Holder	Company	Identifier	x	y	Δuv	Type
T5	35	3650	4000	G5	-	T5 tube	. 3855	. 44017	. 02559	FLIN
…										

The first line is the header; follow the real lamp records, one each row.

Each field in a record is separated by a 'tab' code.

The user has to introduce a new lamp at the correct row, following the last field 'Type' in which:

Identifier	description
FCOM	compact fluorescent
FLIN	linear fluorescent
HALO	halogen
HGVA	mercury vapor
JMET	metal halide

Identifier	description
NAHP	sodium high pressure
NABP	sodium low pressure
INCA	incandescent
LED_	led
XENO	xenon

The operation is to insert a new record as a row inside the correct lamp group, then each field of the record has to be filled:

class NBS	standard lamp name;
W	nominal power consumption
Lumen	nominal lumen output
K	Kelvin color temperature of the source
Holder	lampholder
Company	Company
Identifier	Commercial name
x	x-coordinate (CIE 1931)
y	y-coordinate (CIE 1931)
Δuv	distance from the Black Body curve in the CIE 1960 diagram
TYPE	internal identifier for the lamp type (one of the name in the previous table)

Once finished, the user has to save the file as text file with the name "Lamps.txt" in the same directory of the original one.

4.2.5. Command: SERVICE FOLDERS...

This command permits to manage the Application service folders. The first time the Application runs the user is prompted for locating these folders:
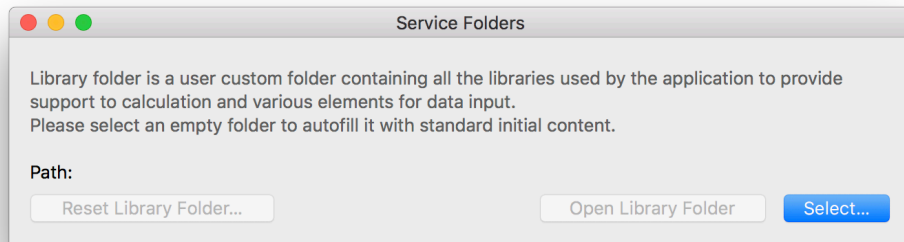
Once chosen, the Application initialize it. It is possible to reset the service folders in every moment simply choosing this menu and pressing the 'Reset Library Folder...' button:
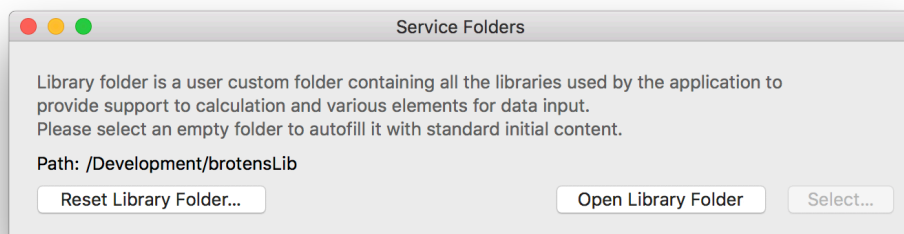
...or navigating inside it through the button 'Open Library Folder'.

4.2.6. Command: CLOSE

This command permits to close the current project.

4.2.7. Command: SAVE

This command permits to save the current project.

4.2.8. Command: DUPLICATE

This command permits to duplicate the current project.

4.2.9. Command: RENAME

This command permits to rename the current project.

4.2.10. Command: MOVE TO...

This command permits to move to another folder the current project.

4.2.11. Command: REVERT TO...

This command permits to recall the last saved versions.

4.2.12. Command: EXPORT

This command allows the saving of work in different formats for compatibility with other programs of CAD, graphics, text, database, etc... The possibility to exchange information with other applications has the purpose to permit the maximum action freedom for the user in compiling drafts and technical reports, showing the results of the calculations. Available export formats follow.

4.2.12.1. Export TEXT, RTF format

The Application will create a complete calculation report with which it is possible to read numeric results and chromatic and spatial coordinates of all the elements in the project.

If the user has made a selection set, the Application will export information and results only for the selected elements; in the other case the whole project will be registered. If TEXT was selected, the Application will export a TEXT file with tabulation, while for RTF/RTFX (Rich Text Format) export the Application will use a template (one fore each currency and/or customer) created ad formatted by the user. In the example-file are present every styles needed for a correct printing of the report, and the user will be able to change them, leaving the number of tabulations and, if possible, the width of the fields.

In the RTF templates, it is possible to insert some automatic information through some codes (case is relevant):

- #1 = The image saved in the slot 'Cover Design';
- #A = Agent name;
- #D = Actual date;
- #h = Actual time;
- #N = File name (complete directory);
- #C = Customer name;
- #R = Reference and place;

Fields to include in the exportation are selectable by the following dialog:

The other saved drawing slots, 'Layout design' and 'Result Design' will be inserted in their opportune places inside the report.

Buttons refer to the following dates:

- (List of) Flat Surfaces:

Number, Level, Type of surface, Area, Color of the upper/lower side (number, name, reflection coefficient), Calculation grid;

- (List of) Openings:

Number, Owner Type, Owner Number, Total glass thickness, Extinction coefficient, Color (number, name, transparency coefficient);

- (List of)Lighting Sources:

Number/Reference to the model, Model, Total power and flux with dimming percentage, Number of Lamps, Lamp type, Lamp label, Lamp socket, Lamp power, Lamp luminous flux, Lamp color, Total installed power, Maintenance factor, X/Y position, Installation height, Pointing (x, y, z/azimuth, zenith); if this field is checked will export in the report the last viewed image in the "Project Source" session. If Detailed is active also: Catalogue, Level, anti-glare shader height, anti-glare shader angles, anti-glare grid height, anti-glare grid x,y dimensions. If Photometries is active also photometric diagrams with the curves visibility selected in the relative pop-menu

- (List of) Objects:

Number, Level, Type of surface, Color of the upper/lower side (number, name, reflection coefficient), Large Grid [cm], Calculation grid or number of X-Y divisions if a mesh;

- (List of) Lines:

Number, Level, Total length, Color number (group), Thickness;

- (List of) Polylines:

Number, Level, Total length, Color number (group), Thickness;

- (List of) Cameras:

Number, Position;

- Daylight Data:

Place, Latitude [°,'], Day, Month, Hour, Direct Radiation [W/m2], Diffuse Radiation [W/m2], Albedo [%];

- Titles from Level 2:

Start title indentation from level 2;

- Quality parameters:

For each user surface: Number, Minimum horizontal illuminance, Maximum, Mean, Minimum/Mean illuminance ratio, Minimum/Maximum illuminance ratio, Mean/Maximum illuminance ratio; if this field is checked the Application will export in the report the last viewed image in the "Results" session;

- Number of quality fields:

The Application will prepare the number of quality fields relative to some surfaces the user want to insert in the report;

- Plan detailed info: (for the roads)

Road width, sources layout type, sources inter-distance, sources height, source beam, source beam tilt angle, luminaire label, bulb type;

- Road Classification EN13201:

Tables contained in the EN13201;

- Computation:

Prizes for each fixture and each special piece, in the currency exportable to the estimation, are saved in the same folder of the source catalog (ex.: "Fixtures") in a text file with the same name of the catalog and the ".prz" extension (ex.:"Fixtures.prz"). This file must contain the same list of lighting sources as in the Application catalog, and will be filled by the following fields, separated by tabulations:

- o element description (it must be the same character string with which the Application recognize the element – to export in text format these identifying strings for a whole catalog, see 4.2.4 Command: SOURCE LIBRARIES MANAGER
- o price in the first currency (ex.: "English" -> £)
- o price in the second currency (ex.: "Italian" -> €)
- o price in the third currency (ex.: "German" -> €)
- o …

Description	currency 1	currency 2	currency 3	….	currency n
Fixture #1	10.6	8.44	100.5	…	128.7
Fixture #2	33.6	456.9	345.1	…	789.0
…	…	…	…	…	…
Fixture #m	236.9	16.8	444.8	…	100.5

Only viewed elements will be exported, and in particular:

- o for each line and polyline: Number, Group (color), Description, Length, Quantity, Prize, Total;
- o for each special piece (to select manually): Number, Image (if saved), Description, Quantity, Prize, Total;

      o   for each installed lighting source model: Progressive number (1, 2, …) and local reference (A, B, …), Image (if saved), Description, Image (if saved), Description, Total power, Quantity, Prize (if saved), Total.

If the option Computation as table is active it is possible to export computation as table with formulas The software, finally, will automatically update the 'Summary.txt' database (saved in the same folder of the Application) filled with the list and the summary data of the RTF, RTFX or TEXT exported projects.

4.2.12.2. Export DXF format

Selecting 'DXF' from the sub-menu the selected element will be saved in DXF format or, if no selection is present, the whole project:

- translating lines in LINE elements;
- faces in POLYLINE elements;
- furniture and free objects will be 'exploded' in 3DFACE elements, each put on a layer whose name is that one of the starting element plus a progressive suffix (Es. starting layer = 'Walls' ; ending layer = 'Walls#o1' ;...); the other object type will be exported as POLYLINE mesh;
- lighting sources will be exported in INSERT (BLOCK) elements schematized as a circle.

In the result session, the exportation will involve numeric fields and iso-value curves, in the other case the user will be prompted to assign the exportation scale (from centimeters/inches to…):

The 'Explode objects' check-box permits the objects exportable as poly-mesh to be 'exploded' in 3DFACE elements.

4.2.12.3. Export in JPEG format

Selecting 'JPEG' from the sub-menu, a JPEG image clipped from the screen will be saved.

4.2.12.4. Export in PDF format

Selecting 'PDF' from the sub-menu, a vectorial PDF file clipped from the screen will be saved.

4.3. Menu Edit

4.3.1.   Command: UNDO

Permits to revert the last command. This permits to come back in the command sequence.

4.3.2.   Command: REDO

Permits to discard the effects of the "Undo" command, going on one step in the command sequence.

4.3.3.   Command: CUT

Works only in the selected edit field, in the standard Macintosh mode.

4.3.4.   Command: COPY

he procedure is different if an edit field is selected or not:

- If an edit-field is selected the command works in the standard Macintosh mode. If the view is selected its content will be inserted into the clipboard in PDF: this allows to transfer information between StreetLightingCalc and the other programs.

If an edit-field is selected the command works in the standard Macintosh mode.

4.3.5.   Command: PASTE

Works only in the selected edit field, in the standard Macintosh mode.

4.4. Menu Coordinate

The menu permits to enter the Active Coordinate System modification section. The triad of the Global Coordinate System is always visible in green color: if the Active System is the Global one, the "Global" item will be marked with "√"; if the Active System is a Local Coordinate System of an element in the scene, the "Local" item will be marked; in the other cases both the menus will be unmarked.

4.4.1.   Command: LOCAL

For a selection set built with a single element of type Plan, Opening, Lighting source or Object, it is possible to attach the Active Coordinate System to the local one of the selected element. Switching from the Global System to a Local System is highlighted by a mark "√" in the menu and by the presence of the red triad in the visualized space.

4.4.2.   Command: GLOBAL

It is always possible to make the Active one the Global Coordinate System; the Application puts a mark "√" in this menu item and eliminates the red triad from the video.

4.4.3.   Command: LOCAL ON THE FLY

Permits to switch from the active to another Local Coordinate System of the element pointed my the mouse, without selecting it. The command is useful, for example, to switch to another Coordinate System while aiming a source.

4.4.4.   Command: MODIFY

The command may be used in two different modes, in the case where there is active a Local Coordinate System of a Flat Surface or not.

4.4.4.1. Is active the Local System of a Flat Surface

This is case in which a single element is selected end the user chooses the command "User" from the menu "Coordinates".

The Application presents a dialog for modifying the Local Coordinate System of the element, in which it is possible to rotate end eventually to move the System only on the plan of the same Surface:
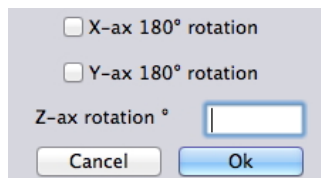
For a Flat surface the System may be:

- rotated on a generic angle around the Z axis of the local Coordinate System (or Systems). ;
- rotated 180° around the local X axis (inverting the positive semi-space viewed from the surface);
- rotated 180° around the local Y axis (inverting the positive semi-space viewed from the surface);

In this last case the Application asks the position of the new origin (point 0 in figure), the direction of the new local X axis (point 1 in figure) and the side of the positive Y semi plan (point 2 in figure):
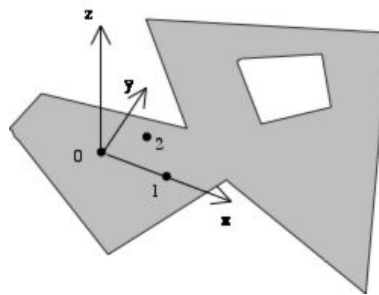
In every moment, during the introduction of the three points needed to assign the position and orientation of the new Coordinate System in the space, it is possible to execute a mouse double click: in this case the orientation procedure will be stopped, and the new Coordinate System is simply translated to the first introduced point.

4.4.4.2. Is active a generic Coordinate System

The Application presents a dialog to modify the Active Coordinate System:
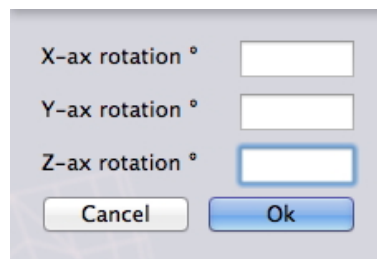
The System may be:

- rotated on a generic angle around a generic axis;

In the last case, the Application asks for the position of the new origin, the direction of the new X axis and the side of the semi plan of the positive Y, similar to the previous paragraph.

4.4.5.   Command: BY 3 POINTS...

Permits to reach quickly the procedure to reassign the Coordinate System by three points: the Application asks the position of the new origin (point 0 in figure), the direction of the new local X axis (point 1 in figure) and the side of the positive Y semi plan (point 2 in figure):
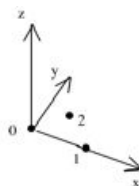
4.4.6.   Command: ROTATE X

Permits to reach quickly the procedure to rotate along the X-axis of the Coordinate System; if it is active the Local Coordinate System of a face, the rotation will be of 180°, in the next case of 90°. Pressing ⌥(option) key while choosing the command the rotation will be done in the opposite side.

4.4.7.   Command: ROTATE Y

Permits to reach quickly the procedure to rotate along the Y-axis of the Coordinate System; if it is active the Local Coordinate System of a face, the rotation will be of 180°, in the next case of 90°. Pressing ⌥(option) key while choosing the command the rotation will be done in the opposite side.

4.4.8.   Command: ROTATE Z

Permits to reach quickly the procedure to rotate along Z-axis the Coordinate System that will always be of 90°. Pressing ⌥(option) key while choosing the command the rotation will be done in the opposite side.

4.4.9.   Command: ASSIGN NEW ORIGIN

The command works differently if some flat surfaces are selected or not: in the first case the software will automatically move the origin of the selected faces each in the barycenter of their points, otherwise the user will be prompted to introduce a point that will be the new global origin.

4.5. Menu Options

4.5.1.   Command: HIGH RESOLUTION

The command permits the regeneration of the whole project alternatively with large and small grids for every element. The "High Resolution" mode is highlighted in the menu item. The Application informs, before to confirm the operation, that may be onerous in terms of calculation timing.

4.5.2.   Command: REMOVE UNUSED POINTS

The Application executes an internal database check, deleting redundant information and entities.

4.6. Menu Layers

From this menu the user can show/hide or make active layers (virtual spaces in which elements are drawn). Layers are a powerful working tool, because they can simplify the scene, temporarily hiding unimportant parts, deleting whole groups of objects and allowing the user to include or exclude from the calculation other objects.

To make a layer the active one simply select it in the menu list, while to show or hide a single layer the user has to select the item while holding down the ⌥(option) key.

4.6.1.   Command: SETTINGS...

Permits to manage layers:
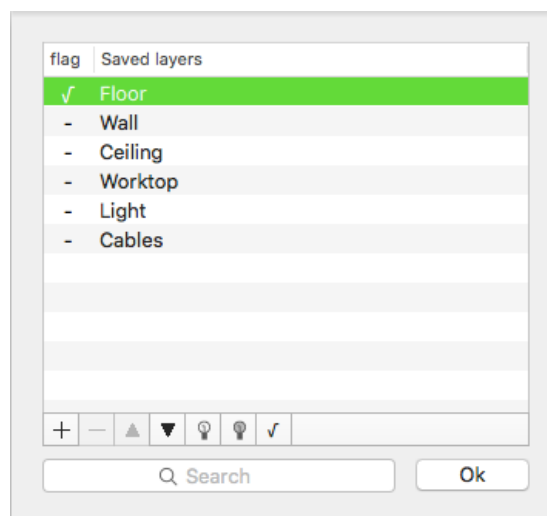
It is possible:

- to add a new layer (button ➕);
- to delete selected layers (button ➖): the user will be prompted to delete all the elements contained in these layers;
- to bring layer upward in the list (button ▲);
- to bring layer downward in the list (button ▼);
- to show the selected layers (button 💡): the layer will be flagged with a '-' sign;
- to hide the selected layers (button 💡): the layer will be unflagged;
- to make the active one the selected layer (button √): the layer will be flagged with a '√' sign;
- to select all layers whose name contains the text edited in the search field.

4.7. Menu View

4.7.1.   Command: VIEW SETTINGS...

The command opens a dialogue that allows the user to modify some parameters of the active document and eventually saving them as default (button 'Default for new documents): it is divided into four tabs:.

4.7.1.1. Visualization section

The section permits to manage some general parameter of the document:
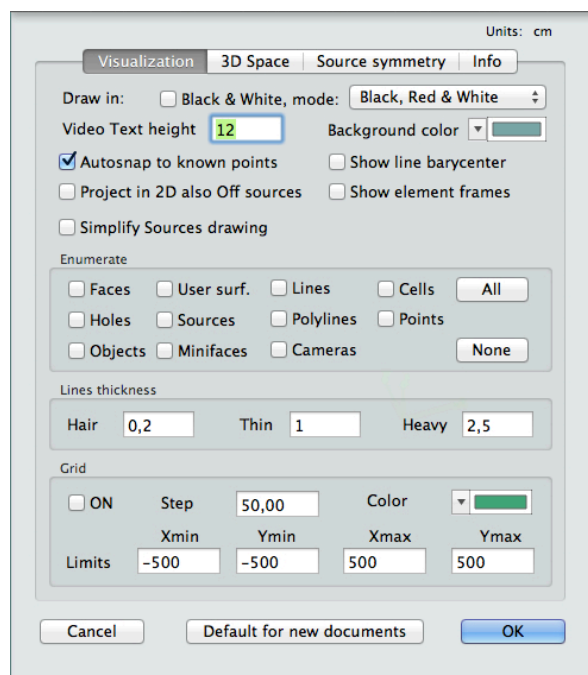
- to view the scene in black and white mode or in black-red-white mode;
- to select the text height in the screen;
- to select the background color;
- to work in auto-snap to known points in creating or modifying element sessions;
- to show the line barycenter, for an easy snap to them; to project in 2D view also the shut-off lighting sources;
- to show the finite-element frames in the 2D views;
- to enumerate elements, points,…
- to choose the thickness of the line with which StreetLightingCalc renders the scene;
- to define the virtual grid color, divisions, limits and visualization.

4.7.1.2. 3D Space section

The section permits the setting of the tridimensional visualization parameters:

- values and steps for every movement of the view (rotations, zoom, camera, scroll);
- switch between assonometric /perspective view.

4.7.1.3. Sources symmetry section

This section permits to manage sources symmetry options:

and in particular:

- Nines field are present, that permits to translate in an independent way the X-symmetrized sources, the Y-symmetrized source and the XY-symmetrized ones;
- the 'Rotational symmetry' is useful to force the y-axis rotation (better configuration for road project) in the symmetric source option: its flag handle the scene according the following scheme (see 4.7.1.3 Sources symmetry section):

X-X and Y-Y standard symmetry:	X-X and Y-Y "rotational" symmetry:
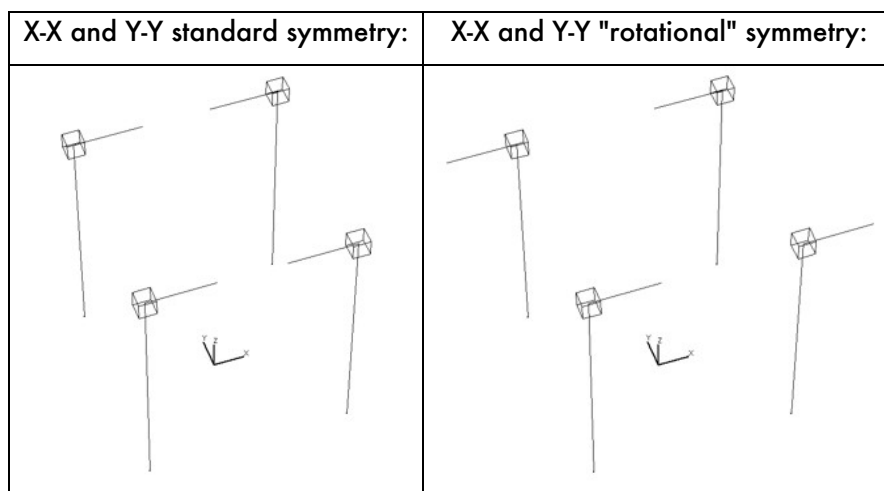
4.7.1.4. Info

The section permits to assign the general info for the document:

4.7.2.   Command: PLAN VIEW

This command allows you to project all selected elements in the Local Coordinate System of the first-selected element (flat surface or object). In a quoted plan view will be visible on the 1st selected element L.C.S., for the each selected elements:

- for each flat surface: its planar projection;
- for each object: its planar projection;
- for each lighting source: its progressive number, a letter for model reference and the pointing vector;
- for each line and polyline: its progressive number and a number for color/group reference;
- for each camera: its position.

The alternate selection of the command marks with "√" and unmark the item.

4.7.3.   Command: OTHER SIDE VIEW

Only in 2D view, permits to invert the side of the 2D projection: this means the back-side of the flat surface and the 'internal' side of the object.

The alternate selection of the command marks with "√" and unmark the item.

4.7.4.   Command: ROTATED VIEW

Only in 2D view, permits to rotate of the 2D projection.

The alternate selection of the command marks with "√" and unmark the item.

4.7.5.   Command: BLACK & WHITE

Permits to switch from a color representation to a black and white (or black, red and white, following the relative Preference in the dialog setting) one and vice-versa. This selection checks with a "√" or uncheck the menu.

4.7.6.   Command: ZOOM IN

The command executes one-step zoom in; the step is fixed in the '3D Space section' dialog, at the item 'steps' as the button 'Zoom in' of the 'View' palette does.

4.7.7.   Command: ZOOM OUT

The command executes one-step zoom out; the step is fixed in the '3D Space section' dialog, at the item 'steps', at the item 'steps' as the button 'Zoom out' of the 'View' palette does.

4.7.8.   Command: ZOOM WINDOW

Through the procedure click-click it is possible to create a rectangle that will point to the area to zoom in, as happens with the button 'Zoom window'.

4.7.9.   Command: CENTER VIEW

Is useful to center the view, as happens with the button 'Center View'.

4.7.10.   Command: ZOOM SCALE

This menu permits to bring the actual plan view to one of the selectable values.

4.7.11.   Sub-Menu: VIEWS

4.7.11.1. Command SETTINGS

Trough these command the Application enters the view manager:
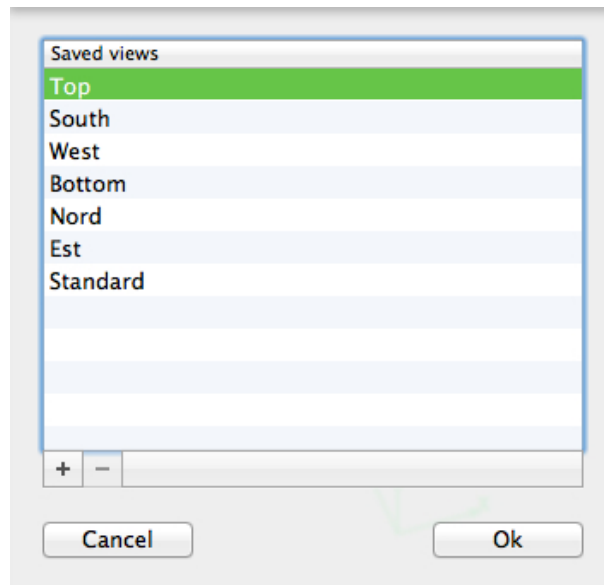
The dialogue permits:

- to create a new view (button +);
- to delete some previously saved view (it is not possible to delete the first seven ones, button −) ;
- to rename existing view, editing it directly in the table.

The dialogue presents the name of every saved view in the last part of the list, and it is possible to make one of them active simply choosing it in the list.

4.7.11.2. Other Command

It is possible to select directly some predefined views (Top, South, West, Bottom, North, East) or others previously saved. Selecting one of the saved view through its menus with the ⌥(option) key pressed permits to reassign the active view to the saved one.

4.7.11.3. Command: SAVE IMAGE FOR…

Permits to save the actual scene for the three types of view:

- Cover Design (3D scene)
- Layout design (2D projection scene)
- Result Design (examine result scene)

…to export in the eventual rtf report (see 4.2.12.1 Export TEXT, RTF format).

4.7.11.4. Command: COPY VIEW

The command permits to save the perspective view parameters (scene rotation, point of view placement, zoom and frontal section) for a following operation of view restoring through the command "Paste view".

4.7.11.5. Command: PASTE VIEW

The command permits to restore the perspective view parameters (scene rotation, point of view placement, zoom and frontal section) previously saved through the command "Copy view".

4.8. Menu Lighting

This section includes the necessary operations for lighting calculation and for the analysis of results. The analysis will be available only for the visible objects on the screen; in other words, there will be excluded from calculation those elements belonging to hidden layers.

4.8.1.   Command: CALCUL

The Application shows a dialog: when the calculation has been started for the first time, it is possible to choose sources to include and some other useful parameters for a right analysis.

There are two different possibilities: if it is the first time that the calculation goes on (left side dialog) or if the procedure has been initialized (right side dialog):
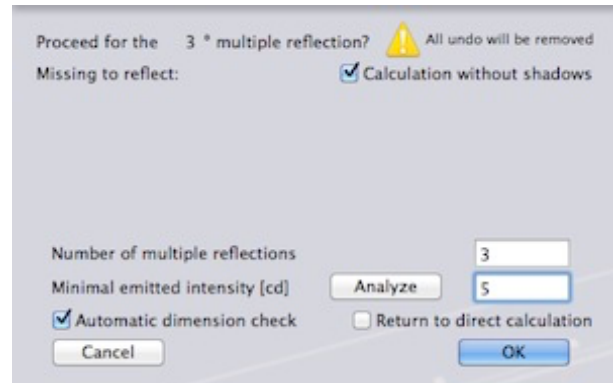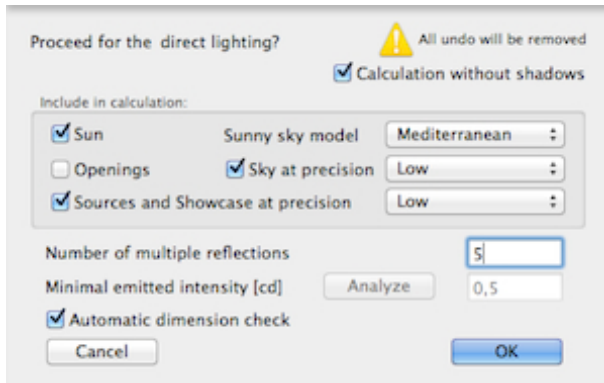
The Application gives information on the state of the calculation procedure (computed only Direct, nth multiple reflection, …).

For still not initialized calculation, the Application asks what to include, and in particular:

- Sun direct will be computed;
- Sky model, that may be CIE-model or Mediterranean-model;
- Sky at low, medium or high precision (in exclusion with the button "Openings"): this option must be selected in the case where the user has to execute diffuse lighting calculation on models not completely closed with surfaces or for where it will be interested in lighting distribution also on the external faces (example: stadium, rooms with windows and very reflective surfaces outside, …). The precision in calculation is affected by the number of divisions of the sky vault with which the Application builds the integrals, that are, in the order 25, 49 or 145 points;
- Openings (in exclusion with the button "Sky"): the button is active only if openings are present in the project: the calculation will include only the integrals on transparent surfaces, computed at the precision given at the appropriate flat surface internal grid;
- Sources at low, medium or high precision: artificial lighting sources will be computed. The precision in calculation involves the volumetric schematization adopted for the sources: low = point light, medium = steps of 40 cm distributed luminance, high = steps of 20 cm distributed luminance.

Calculation will go on, moreover, for the number of total reflections given in the edit field 'Reflection number'. For example, to initiate the calculation with direct only '0' must be keyed to initiate the calculation with the direct and one multiple reflection 1 or more must be keyed. After the direct calculation, inside every group of multiple reflection the user ask to execute, to accelerate them (against some precision loss), it is possible to set a 'Minimum luminance' threshold, below which the relative source-finite element will not be considered. To have an idea of the number of finite elements that will be excluded changing this threshold, it is possible to enter, through the button 'Analyze', a dialogue in which these control parameters are presented.

Following graphics reporting the number of elements involved (x-axis) in calculation in function of a luminance threshold in the first and in the third multiple reflection.
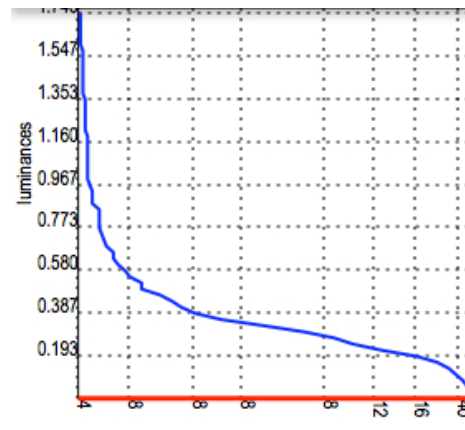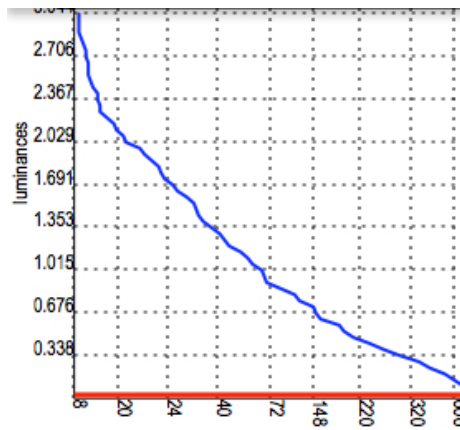
Once the calculation started, the following the dialog: ...
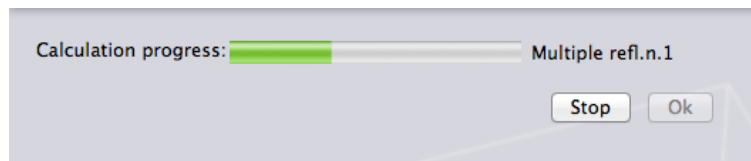
permits to break it by clicking the 'Stop' button or by typing the 'esc' key: after the user reply to confirm breaking the calculation...
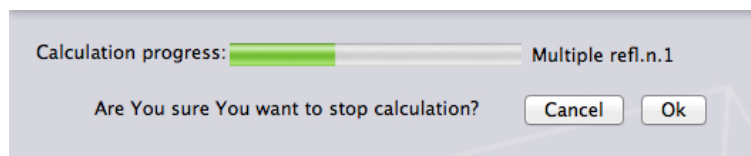
the Application stops it. To start again from the direct, in whatever step of calculation, it is possible to check the 'Return to direct calculation' box. Finally with the 'Calculation without shadows' check box the user is allowed to execute very fast calculation, but without computing shadows: turning on this feature may bring to high approximations, so a reasonable use is suggested.

4.8.2.   Command: RESULTS

After selecting only one element, this command lets you enter a section for calculation testing. The drawer changes the layout: it is divided into two tabs, as shown down-right.

The Application presents a projection orthogonal to the plan of the surface. Creating on video a rectangular region (click-drag-release mouse operation) it is possible to select those finite elements of the surface also partially belonging to the region. For these elements, the Application presents an analysis of the result in the status line.
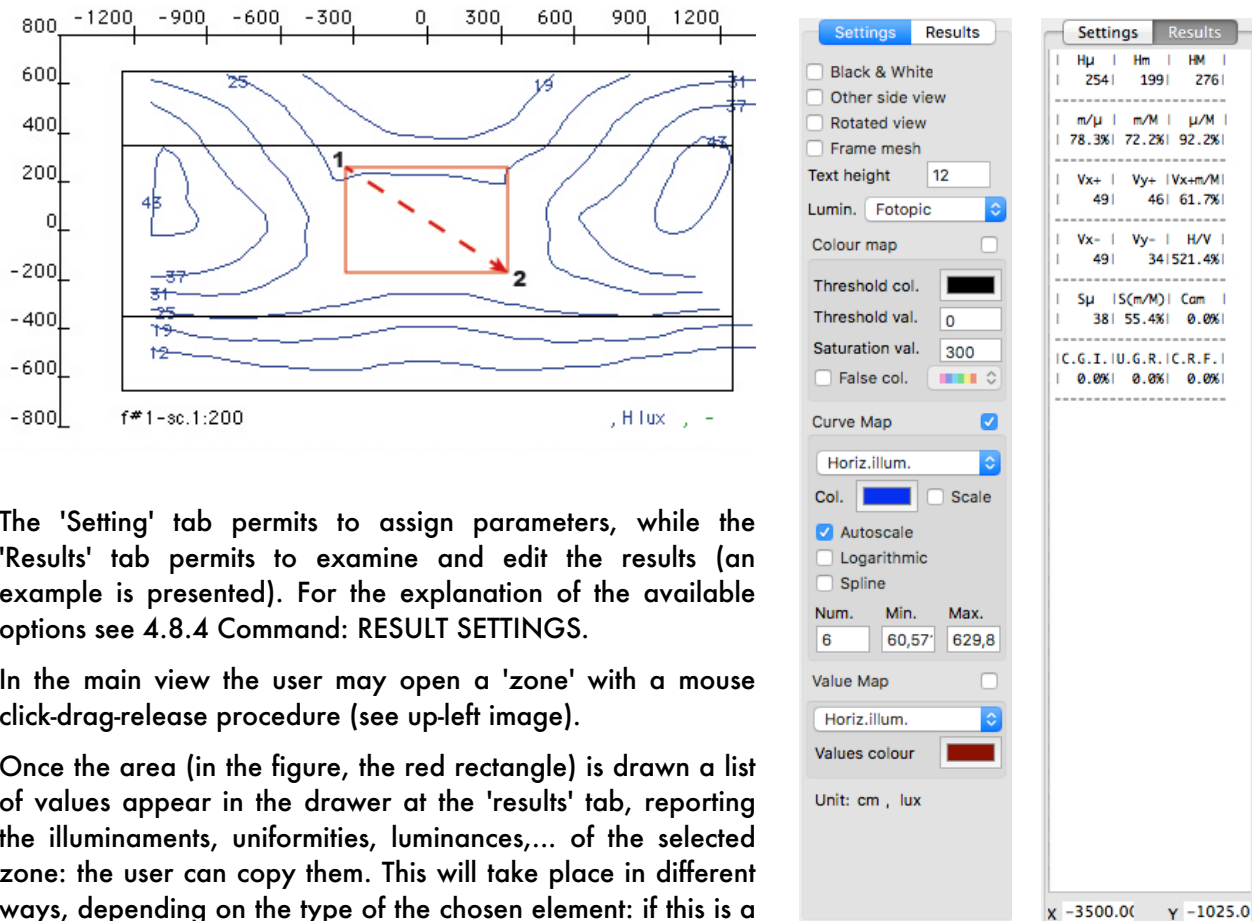
The 'Setting' tab permits to assign parameters, while the 'Results' tab permits to examine and edit the results (an example is presented). For the explanation of the available options see 4.8.4 Command: RESULT SETTINGS.

In the main view the user may open a 'zone' with a mouse click-drag-release procedure (see up-left image).

Once the area (in the figure, the red rectangle) is drawn a list of values appear in the drawer at the 'results' tab, reporting the illuminaments, uniformities, luminances,... of the selected zone: the user can copy them. This will take place in different ways, depending on the type of the chosen element: if this is a flat surface, it is possible to select also other elements to project on the plan of the surface. At this point the clipboard will be automatically filled with the presented text results, in a minimal format if the user selected this option in the Preferences.

Results may be examined in color mapping, in iso-value curves, in numeric values or in mixed mode.

Inside this section, unusable menus, rotation and camera buttons and section scroll bar will be hidden.

To examine the other side of the surface it is necessary to select from the 'Settings' tab or through the dialogue in the 'Lighting'->'Settings' menu the item 'Other side view' check-box.

In the same way, for the visualization in finite elements we have to select from the 'Frame mesh' check-box.

From the 'File'->'Export' menu it will be possible to save the results, for the visible side of the surface, in a file:

- JPEG (bitmapped) for color visualization;
- PDF (vectorial) for curves and numeric fields mapping;
- DXF 2D for curves and numeric fields mapping.

From the 'Edit'->'Copy' menu the result for the visible side of the surface will be transferred to the clipboard.

4.8.3.   Command: OTHER SIDE

Active only in the result analysis mode, it permits to show the back-side of the surface. The mark "√" in the menu advises that the user look at the back-side of the element.

4.8.4.   Command: RESULT SETTINGS

With StreetLightingCalc it is possible to examine results in very many ways, available both on video and in the bitmapped, numeric or vectorial exportation.

It is possible to obtain information, depending from the type of the selected element, on:

- horizontal illum.: horizontal illuminance in lux (for "horizontal" we mean "normal to the surface");
- semi-cylindrical illum.: Semi-cylindrical illuminance (parallel to the surface, direction of the local X-axis direction - only user surfaces);
- hemispherical illum.: Hemispherical illuminance (parallel to the surface - only road surfaces);
- vertical X+, Y+, X-, Y- light.: four Vertical illuminance in lux (for "vertical" we mean "parallel to the surface, in the direction of the local X-axis and Y-axis, positive and negative sides" - only user surfaces);
- camera 1 light: the illuminament in the camera 1 direction (only user surfaces);
- Luminance: luminance in cd/m2 (only not-user surfaces);
- Luminance observer 1…6: luminance in cd/m^2 or cd/ft^2 in the direction of the observer 1, … (only road surfaces);
- C.R.F.: Contrast Rendering Factor (only user surfaces);
- C.G.I.: Contrast Glare Index (only user surfaces);
- U.G.R.: Unified Glare Ratio (only user surfaces);
- G.R.: Glare Ratio (only user surfaces);
- Daylight Factor: if calculation goes on only for sky radiation (only 'normal' surfaces);
- R, G, B: RGB color components.

The results viewed on the screen may be copied in the clipboard or exported in all available formats that are bitmapped, vectorial or numeric.

The dialog is divided into three sections: the upper side is relative to the color visualization, the central one to iso-value curves and the lower to the numeric fields mapping.

4.8.4.1. Color Mapping

By selecting "Color mapping (horizontal)" button the user can examine the horizontal (on the surface) lighting. At 8-colors (button "False"), eventually mapping luminances ("Luminance" check-box), it is possible to choose the spectrum to plot results among three ones.
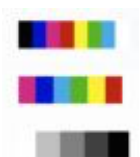
At real-color visualization (button "True") for the single finite elements is possible to apply to the view a "Filter" to simulate a luminous sensation less or more similar to the human eye sensitivity. Luminance may be mapped in a linear (filter "none"), quadratic (filter "2") or fourth-root (filter "4") way, according to the following scheme:
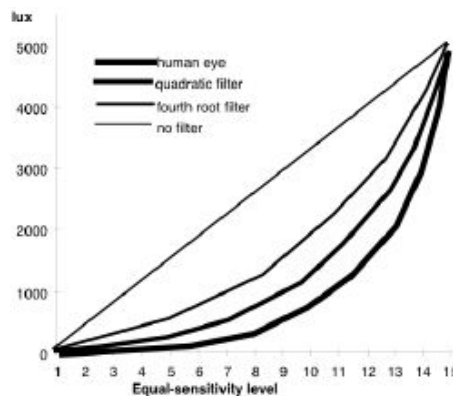
The following figure shows luminous sensation filters in a day lighted room: 1=none, 2=quadratic, 3=human eye:
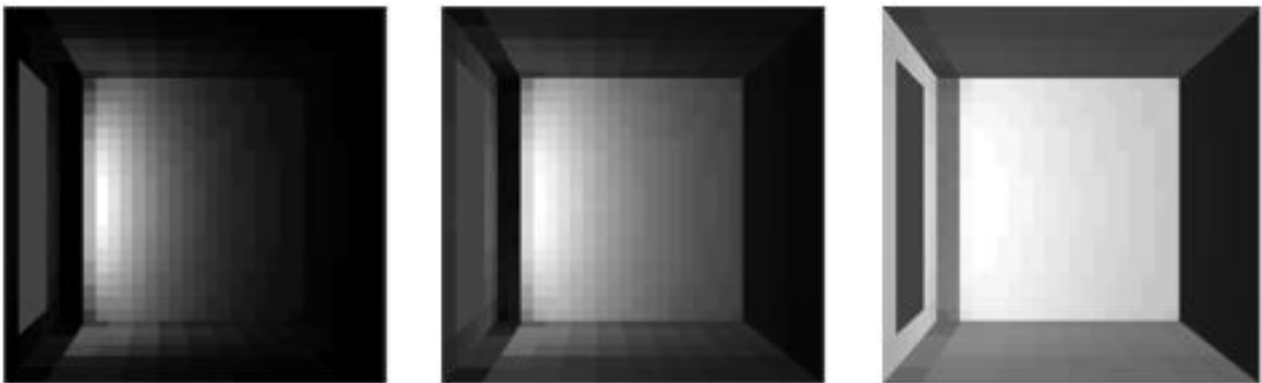
With the value contained in the "Threshold" edit field it is possible to create an "high-pass" filter, to emphasize (by a color selectable from the pop-up menu "Color" near this edit field) those finite elements that are in a lower lighting condition then the fixed threshold.

In this mode the chromatic effect in the video scene is "proportional" to the real effect according to an input value in the "Saturation" edit field. Lower saturation values make the scene lighter, higher values permit a better mapping on higher lighting values. With the "Max" button the Application suggests as saturation, the maximum lighting value found in the project. The Saturation field, finally, may be considered as the aperture of a camera.

4.8.4.2. Curve mapping

Curve mapping may be executed in the modes proposed by the Application, according to the type of the selected element (user surface or not) and to the type of calculation (only sky diffuse radiation or other).

The "Curve color" pop-up menu permits to choose the color for the curves to plot, while selecting "Colour scale" every curve will be plotted following the spectrum colour scale of the paragraph 4.8.4.1. The user can choose the first curve (field "Min."), the last one (field "Max.") and the number of curves to plot (field "Curve num."), while it is possible to plot curves at "logarithmic intervals" checking the appropriate button. The "Auto range" button optimizes the plot from the minimum to the maximum value available in the selected element.

The "Spline" fields permit to choose the type of interpolation for the curves to plot.

Once cheched the "Curve Map" box for a flat surface, the user will have the actual 2D map plotted also in 3D: uncheck the box in the "Result Setting" dialogue to release this option.

4.8.4.3. Values mapping

Values mapping may be executed in the modes proposed by the Application, according to the type of the selected element (user surface or not) and to the type of calculation (only sky diffuse radiation or other).

The "Color" pop-up menu permits to choose the color for the values to plot. At the end of the dialogue there is the pop-up menu "Luminance" that permits to switch from the standard photopic calculation of the luminance to the unified (MOVE modified) one. This take count of the mesopic vision due to:

- the luminance field L (linearly interpolated from scotopic L≤0,25 to photopic L≥3,00 cd·m^{-2}) ;
- the lamp type, color and power (Scotopic/Photopic lamp parameter) .

The Unified Luminance L is calculated as follow:

$$L = \left[\frac{XP}{683} + \frac{(1-X)S}{1700}\right] \cdot \frac{683}{X+0.402(1-X)}$$

...where

- X is the MOVE parameter defined through the next graphic:
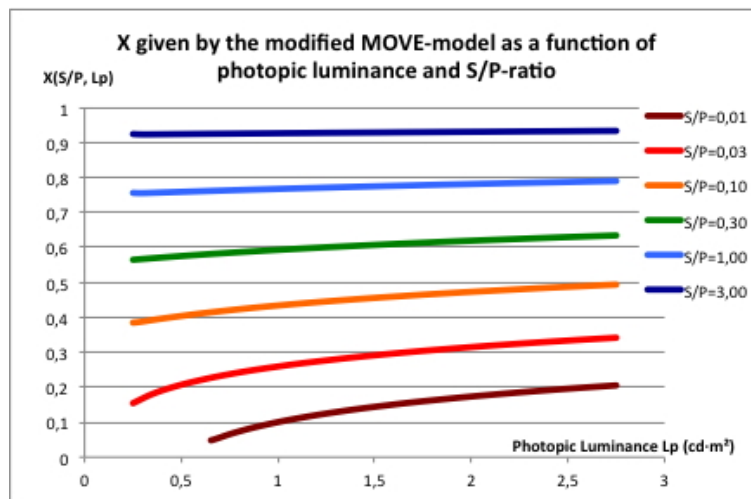
- S and P are the Scotopic and Photopic parameters whose ratio is function of the lamp type, color and power: this parameter is calculated as the average of all the lamp present in the project.

Finally, there is a field "Text Height " permits to choose the height of the text in the visualization.

5. Tutorials

5.1. Road

This tutorial permits to build a road and to choose an efficient lighting solution.

5.1.1. Building the road with the road tool.

1. The first step consist in opening from the menu "File" the item "Road Wizard..." that will open the road tool, choosing the "ATON.ildolib" catalogue and the fixture n.2 and then set the parameters like in the following figure:
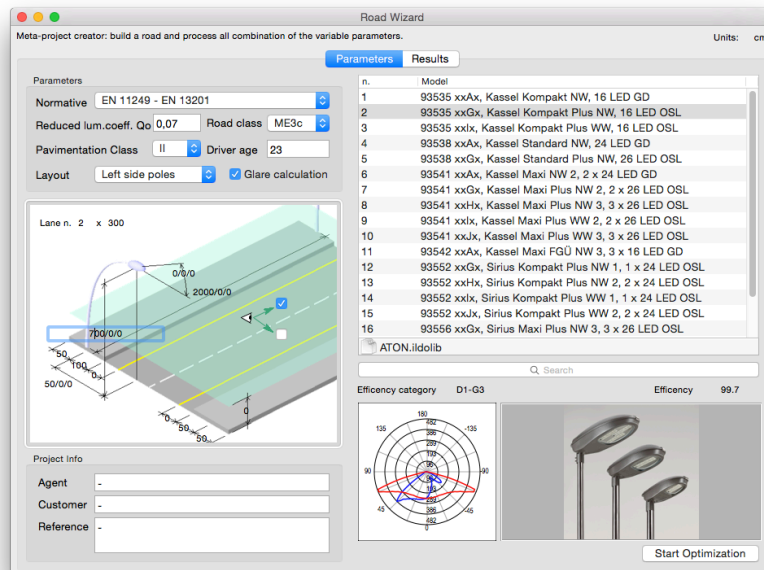
2. Pressing the "Start optimization" button the software will create the model for the selected configuration:
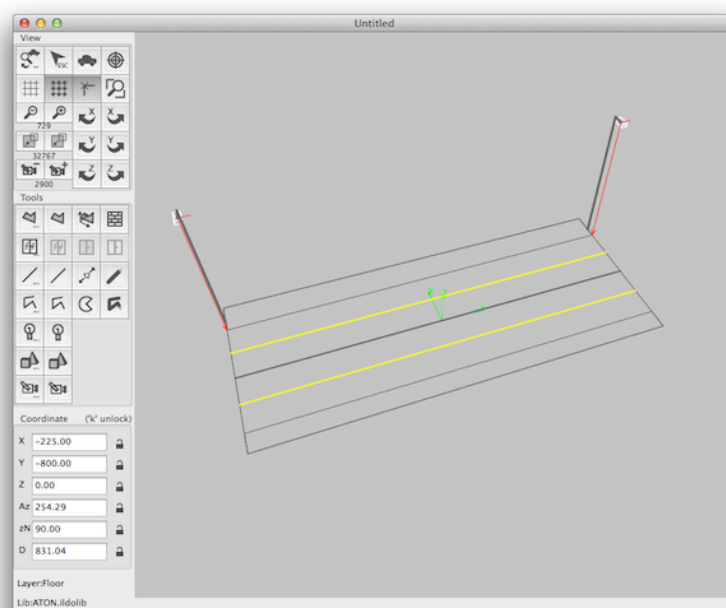
We can start calculation: choose "Lighting" - "Calcul" and accept the following options:
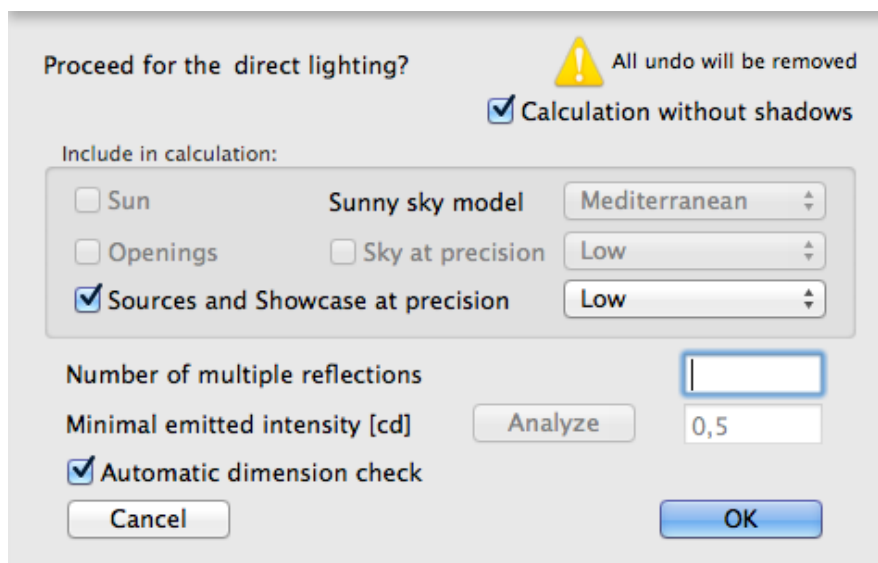
 Select the road surface and the lines on it with a crossing window selection...
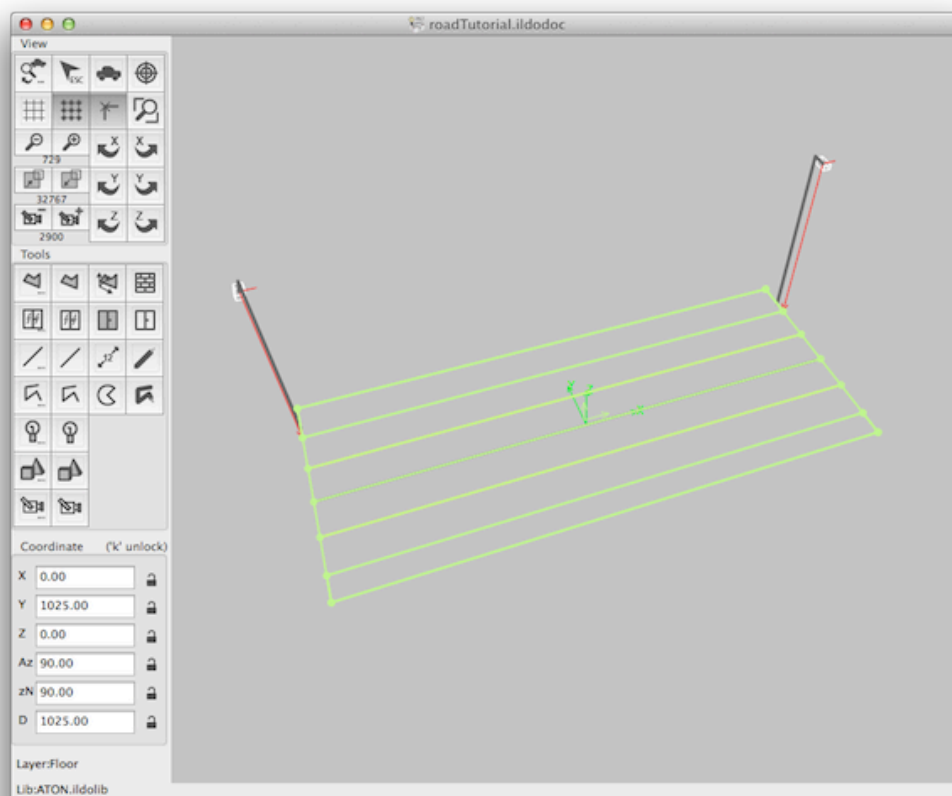
...choose "Lighting" - "Result..." and put the view in scale 1:50 accepting the following parameters:
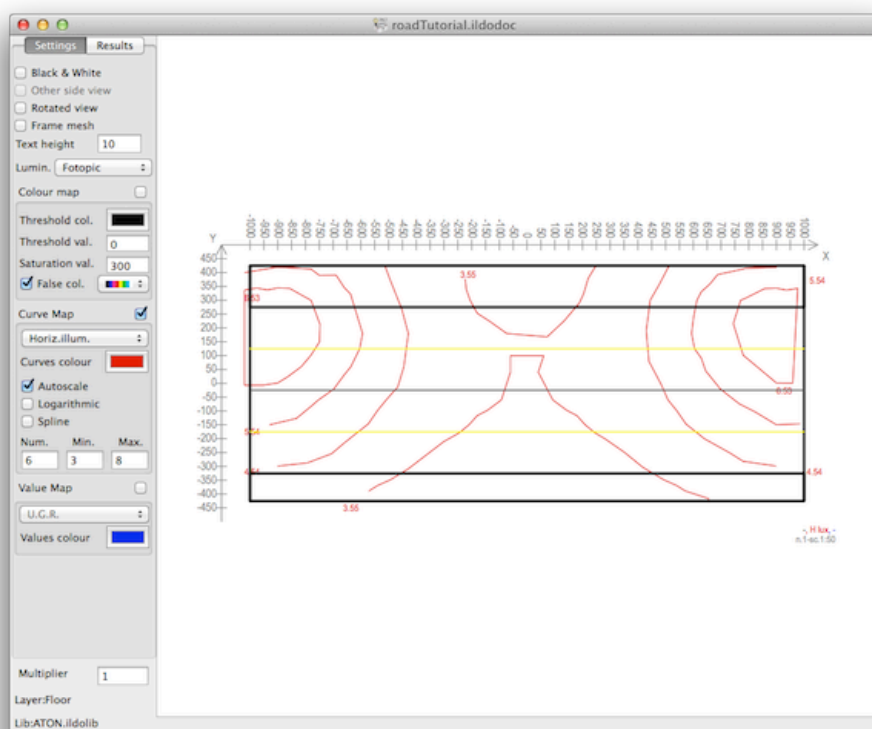
Opening with the mouse a rectangle that contains the whole face (light green one), You'll se the global results:
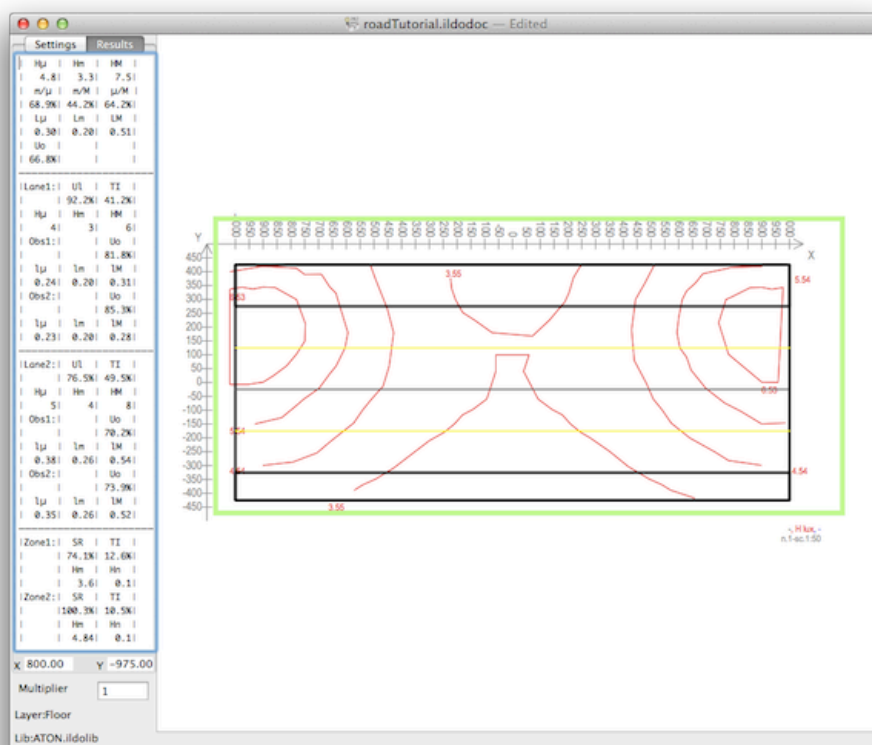
You can investigate what's happened in several zones dragging some rectangle inside the surface: the drawer will present the results for that zone:
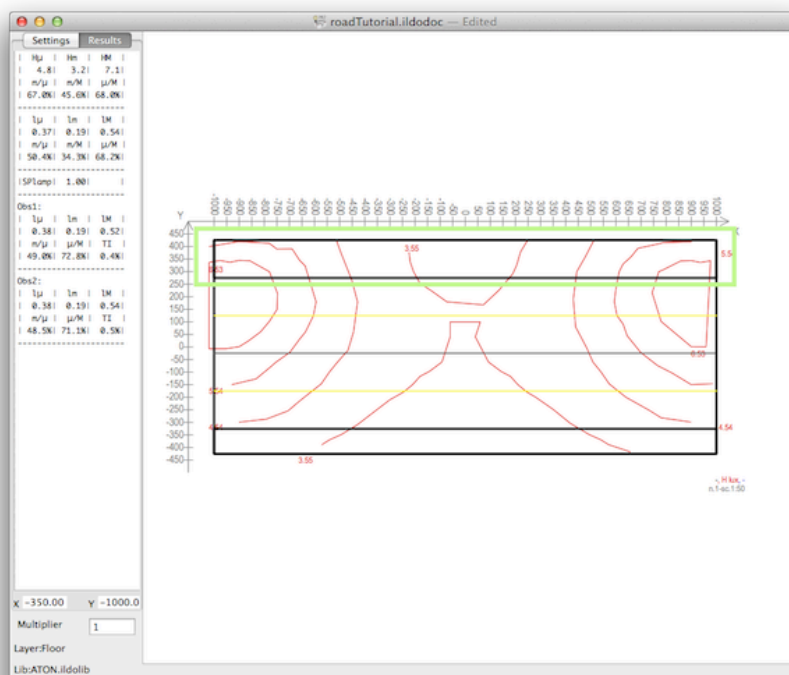
Now we'll export the report. Scroll a little the view to make the light-green selection rectangle disappear and choose the menu "View"-"Save image for report as "Result Design" to include this view in the report.

Return to the main view choosing again "Lighting" - "Results" from the menu, add to the selection set the two red luminaires...
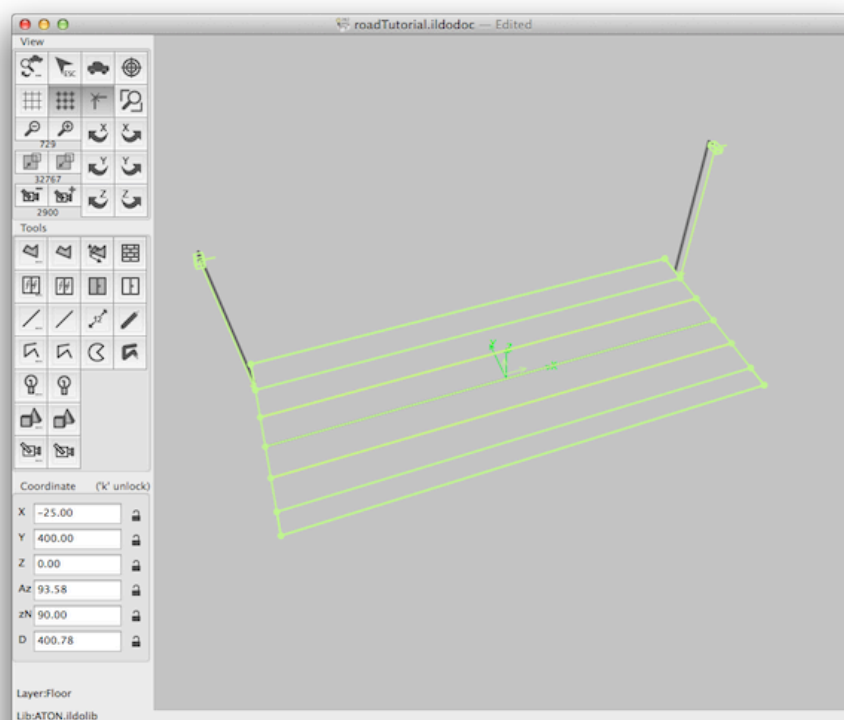
...and choose "View" - "Plan view" from the menu. You will see the following figure that represent the project layout and then choose the menu "View"-"Save image for report as "Layout Design" to include this view in the report:
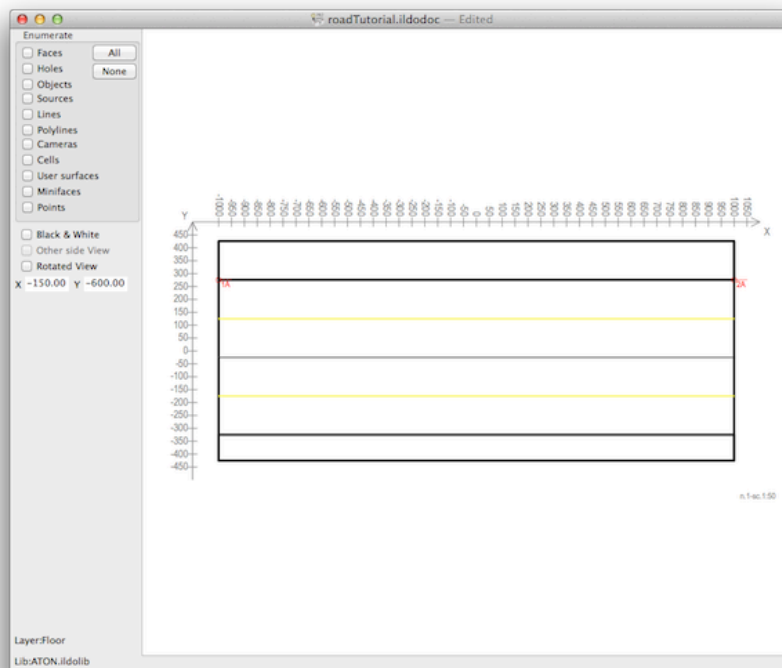
Come back to the main view choosing again "View" - "Plan view" from the menu and force the display in black/red/white by choosing "View" - "Black/White" from the menu, and from the drawer turn off the "grid visualization" (the icon must be unhighlighted) and turn ON the "3D models linking" (the icon must be highlighted). You will see:
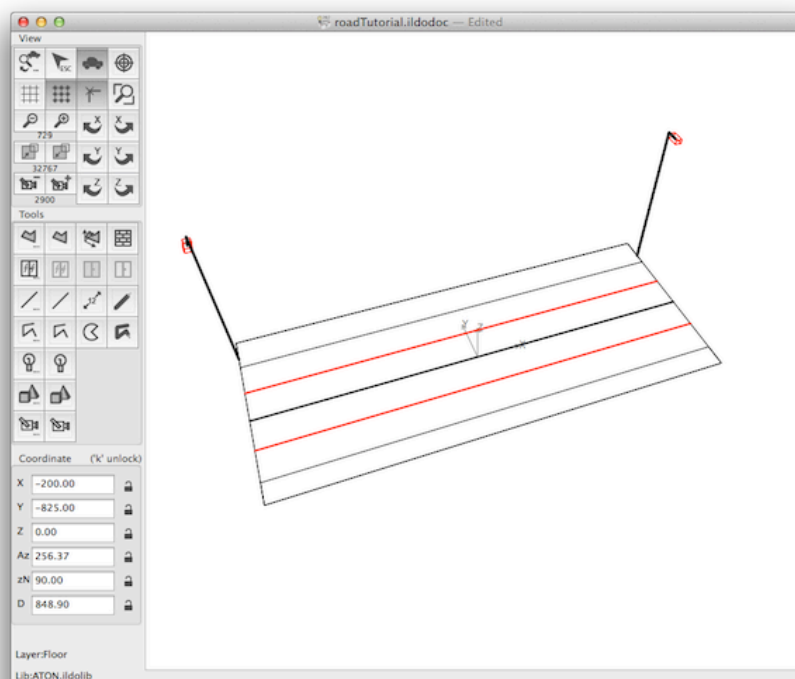
Choose the menu "View"-"Save image for report as 'Cover Design'"; to include this view in the report. Now choose "File" - "Export..." with RTF format...
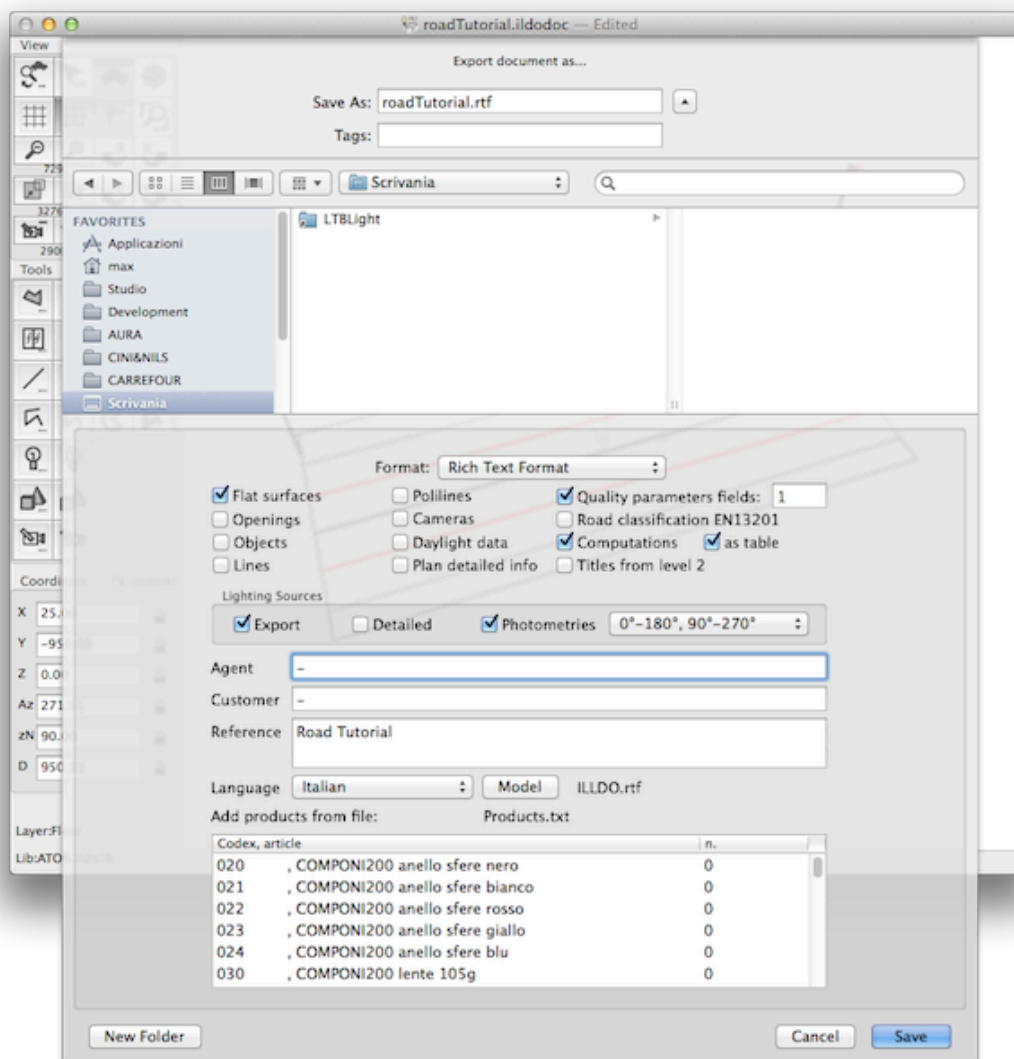
...and accept the previous parameters in the dialogue.

 Press 'Save' and go on. Find the file just now created and open it with a word processor. Follow the opened pages:

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Rif.Progetto:roadTutorial.rtf del 20/11/13   Committente:-

Road Tutorial

1   Lighting software: **LetThereBeLight**

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Rif.Progetto:roadTutorial.rtf del 20/11/13   Committente:-

INFORMAZIONI SUL MODELLO

DIMENSIONI DEL MODELLO (X, Y, Z): 20.00 x 8.50 x 0.00 m

1.1. SUPERFICI PIANE

n.	Livello	Superficie	Area [m2]	Colore superiore-inferiore	Griglia [cm]
1	Floor	strada CLI	170.0	-	120

1.2. APPARECCHI ILLUMINANTI

n./rif.	Codice - Modello	Lam.	Sorgente	Modello	Attacco	W	lm	K	W tot.	Man.	Posizione (x,y)	H install.	Puntam.(x,y,z)	az.,zen.
1A	93535 xxGx, Kassel Kompakt Plus NW,...	1	Led	LED	-	22.0	1755.0	5000	22.0	80	-1000, 300	700	-1000,300,0	0,180
2A	93535 xxGx, Kassel Kompakt Plus NW,...	1	Led	LED	-	22.0	1755.0	5000	22.0	80	1000, 300	700	1000,300,0	0,180
3A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	3000, 300	700	3000,300,0	0,180
4A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	5000, 300	700	5000,300,0	0,180
5A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	7000, 300	700	7000,300,0	0,180
6A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	9000, 300	700	9000,300,0	0,180
7A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	11000, 300	700	11000,300,0	0,180
8A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	13000, 300	700	13000,300,0	0,180
9A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	15000, 300	700	15000,300,0	0,180
10A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	17000, 300	700	17000,300,0	0,180
11A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	19000, 300	700	19000,300,0	0,180
12A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	21000, 300	700	21000,300,0	0,180
13A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	23000, 300	700	23000,300,0	0,180
14A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	25000, 300	700	25000,300,0	0,180
15A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	27000, 300	700	27000,300,0	0,180
16A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	29000, 300	700	29000,300,0	0,180
17A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	31000, 300	700	31000,300,0	0,180
18A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	33000, 300	700	33000,300,0	0,180
19A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	35000, 300	700	35000,300,0	0,180
20A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	37000, 300	700	37000,300,0	0,180
21A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	39000, 300	700	39000,300,0	0,180
22A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	41000, 300	700	41000,300,0	0,180
23A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	43000, 300	700	43000,300,0	0,180
24A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	45000, 300	700	45000,300,0	0,180
25A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	47000, 300	700	47000,300,0	0,180
26A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	49000, 300	700	49000,300,0	0,180
27A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	51000, 300	700	51000,300,0	0,180
28A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	-3000, 300	700	-3000,300,0	0,180
29A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	-5000, 300	700	-5000,300,0	0,180

2   Lighting software: **LetThereBeLight**

StreetLightingCalc

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Rif.Progetto:roadTutorial.rtf del 20/11/13   Committente:-

INFORMAZIONI SUL MODELLO

DIMENSIONI DEL MODELLO (X, Y, Z): 20.00 x 8.50 x 0.00 m

1.1. SUPERFICI PIANE

n.	Livello	Superficie	Area [m2]	Colore superiore-inferiore	Griglia [cm]
1	Floor	strada CLI	170.0	-	120

1.2. APPARECCHI ILLUMINANTI

n./rif.	Codice - Modello	Lam.	Sorgente	Modello	Attacco	W	lm	K	W tot.	Man.	Posizione (x,y)	H install.	Puntam.(x,y,z)	az.,zen.
1A	93535 xxGx, Kassel Kompakt Plus NW,...	1	Led	LED	-	22.0	1755.0	5000	22.0	80	-1000, 300	700	-1000,300,0	0,180
2A	93535 xxGx, Kassel Kompakt Plus NW,...	1	Led	LED	-	22.0	1755.0	5000	22.0	80	1000, 300	700	1000,300,0	0,180
3A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	3000, 300	700	3000,300,0	0,180
4A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	5000, 300	700	5000,300,0	0,180
5A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	7000, 300	700	7000,300,0	0,180
6A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	9000, 300	700	9000,300,0	0,180
7A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	11000, 300	700	11000,300,0	0,180
8A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	13000, 300	700	13000,300,0	0,180
9A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	15000, 300	700	15000,300,0	0,180
10A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	17000, 300	700	17000,300,0	0,180
11A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	19000, 300	700	19000,300,0	0,180
12A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	21000, 300	700	21000,300,0	0,180
13A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	23000, 300	700	23000,300,0	0,180
14A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	25000, 300	700	25000,300,0	0,180
15A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	27000, 300	700	27000,300,0	0,180
16A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	29000, 300	700	29000,300,0	0,180
17A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	31000, 300	700	31000,300,0	0,180
18A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	33000, 300	700	33000,300,0	0,180
19A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	35000, 300	700	35000,300,0	0,180
20A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	37000, 300	700	37000,300,0	0,180
21A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	39000, 300	700	39000,300,0	0,180
22A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	41000, 300	700	41000,300,0	0,180
23A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	43000, 300	700	43000,300,0	0,180
24A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	45000, 300	700	45000,300,0	0,180
25A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	47000, 300	700	47000,300,0	0,180
26A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	49000, 300	700	49000,300,0	0,180
27A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	51000, 300	700	51000,300,0	0,180
28A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	-3000, 300	700	-3000,300,0	0,180
29A	93535 xxGx, Kassel Kompakt Plus NW,... (off)	1	Led	LED	-	22.0	1755.0	5000	22.0	80	-5000, 300	700	-5000,300,0	0,180

2

Lighting software: *LetThereBeLight*

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viale Fratelli Vivaldi 1 - 95123 - Catania - tel. 095 8202874 / fax 178 222 1806   Studio BROCATO   www.ltblight.com - tech@ltblight.com

Rif.Progetto:roadTutorial.rtf del 20/11/13   Committente:-

1.2.1. INSTALLAZIONE DEGLI APPARECCHI (n./rif.)
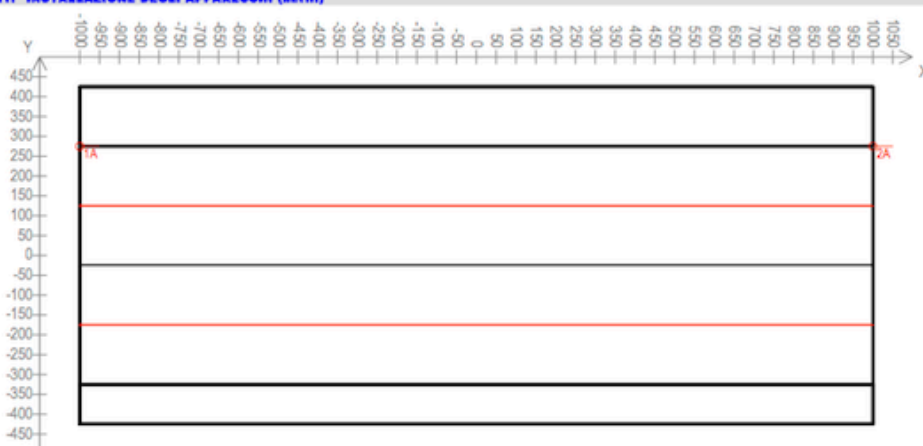
n.1-sc.1:50

3

Lighting software: *LetThereBeLight*

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Rif.Progetto:roadTutorial.rtf del 20/11/13   Committente:-

RISULTATI SUI PIANI DI LAVORO

Piano	Valore Medio lux	Valore Minimo lux	Valore Massimo lux	Min/Medio	Min/Max	Medio/Max
Road class ME3d						
illuminaments	Em=4.8 lux	3.3 lux	7.5 lux	68.9%	44.2%	64.2%
luminances	Lm=0.30 cd/m2!	0.20 cd/m2	0.51 cd/m2	Uo=0.7%	-	Ul=88.5%
laneID 1						
illuminaments	Em=4.5 lux	3.3 lux	6.1 lux	Ul=92.2%	TI=41.2%	
luminances						
observerID 1	Lm=0.24 cd/m2	0.20 cd/m2	0.31 cd/m2	Uo=81.8%!		
observerID 2	Lm=0.23 cd/m2	0.20 cd/m2	0.28 cd/m2	Uo=85.3%!		
laneID 2						
illuminaments	Em=5.2 lux	3.5 lux	7.5 lux	Ul=76.5%	TI=49.5%	
luminances						
observerID 1	Lm=0.38 cd/m2	0.26 cd/m2	0.54 cd/m2	Uo=70.2%!		
observerID 2	Lm=0.35 cd/m2	0.26 cd/m2	0.52 cd/m2	Uo=73.9%!		
zone ID 1						
illuminaments	Em=3.6 lux	3.3 lux	SR=74.1%	TI=0.0%		
zone ID 2						
illuminaments	Em=4.8 lux	3.5 lux	SR=100.3%	TI=0.0%		

4   Lighting software: **LetThereBeLight**

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Rif.Progetto:roadTutorial.rtf del 20/11/13   Committente:-

1.3. ISOVALORI SUI PIANI DI LAVORO

-, H lux, -
n.1-sc.1:50

5   Lighting software: **LetThereBeLight**

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Rif.Progetto:roadTutorial.rtf del 20/11/13   Committente:-
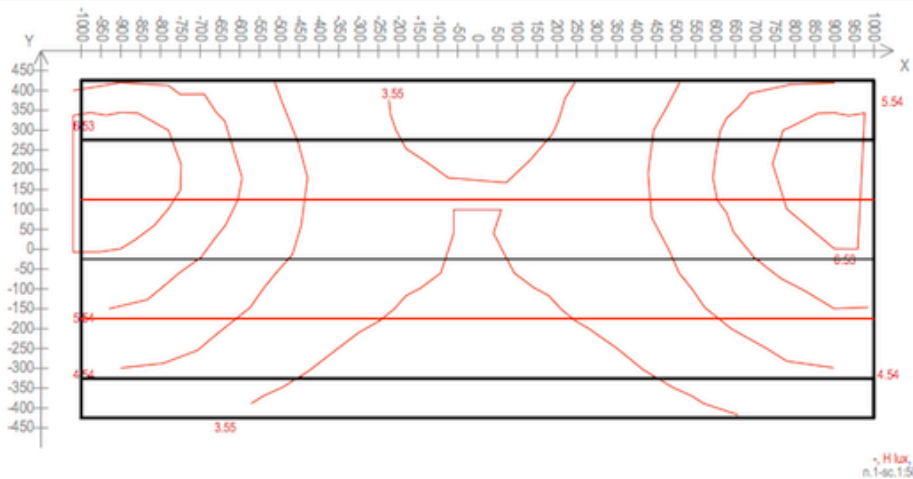
LISTA DEI PRODOTTI

APPARECCHI ILLUMINANTI

rif.	Immagine	Codice - Modello	Potenza tot.[W]	Quantita'	Prezzo	Importo
A		93535 xxGx, Kassel Kompakt Plus NW, 16 LED OSL	44	2	N.D.	0,00

TOTALE APPARECCHI ILLUMINANTI   44
POTENZA SPECIFICA INSTALLATA   0,259W/m²

6   Lighting software: LetThereBeLight

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Rif.Progetto:roadTutorial.rtf del 20/11/13   Committente:-

APPENDICE A: FOTOMETRIE DELLE SORGENTI
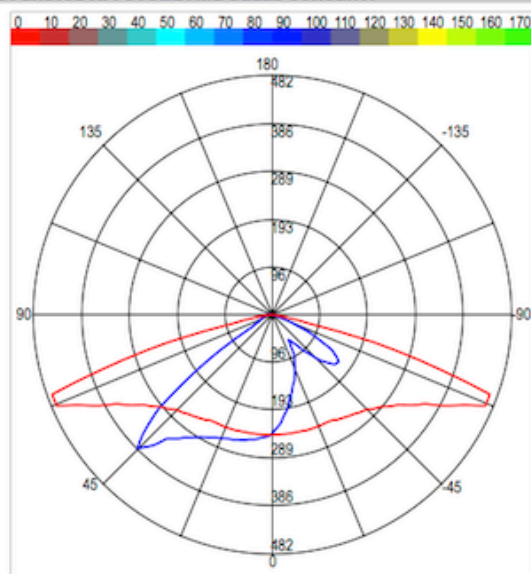
Modello: ..... 93535 xxGx, Kassel Kompakt Plus NW, 16 LED OSL
Catalogo: ....ATON.lldolib
Classificazione CIE:..Diretta
Semi-Diretta 22.00W
Dimensioni: ....27.5 x 57.0 x 17.5 cm
Volume luminoso: ....6.0 x 18.0 x 0.0 cm
Efficienza: ....99.71 %
Flussi zonali [lm]:
- 0/30:...334.40 (19.11 %)
- 0/40:...576.17 (32.92 %)
- 0/60:..1285.19 (73.44 %)
- 0/90:..1749.01 (99.94 %)
- 90/120:...0.97 (0.06 %)
- 90/130:...0.97 (0.06 %)
- 90/150:...0.97 (0.06 %)
- 90/180:...0.97 (0.06 %)
- 0/180:..1749.99 (100.00 %)
Lampada/e istallata/e:
- n.:...1
- tipo:..Led
- nome:..LED
- portalampada:..-
- potenza:..22.00 W
- flusso:...1755 lm
- temp. di colore:...5000 K
Schermi laterali:
- profondita':...27.5 cm
- angolo C=0:..0.0 cm
- angolo C=90:..0.0 cm
- angolo C=180:..0.0 cm
- angolo C=270:..0.0 cm
Griglia:
- dimensioni xy:.....................................0.0 x 0.0 cm
- profondita':...0.0 cm

7   Lighting software: LetThereBeLight

Let's add some other results map for the road surface. Select again the surface and the lines...
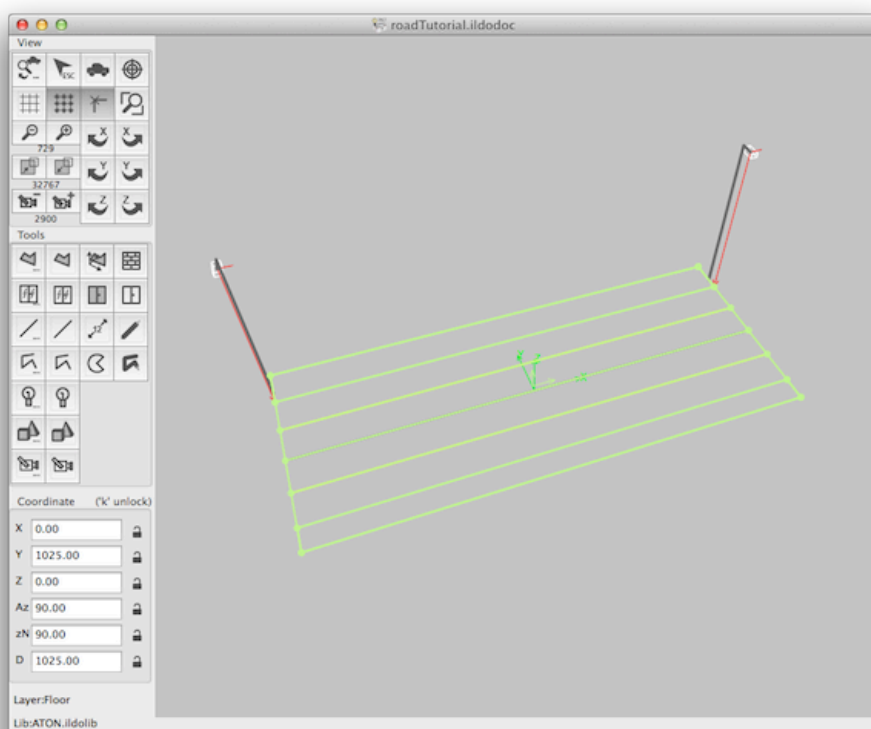
...and choose "Lighting" - "Results" from the menu. Then set the parameters in the drawer as follows (Curve map: Camera 1 Luminance; Autoscale; n.curves: 8):
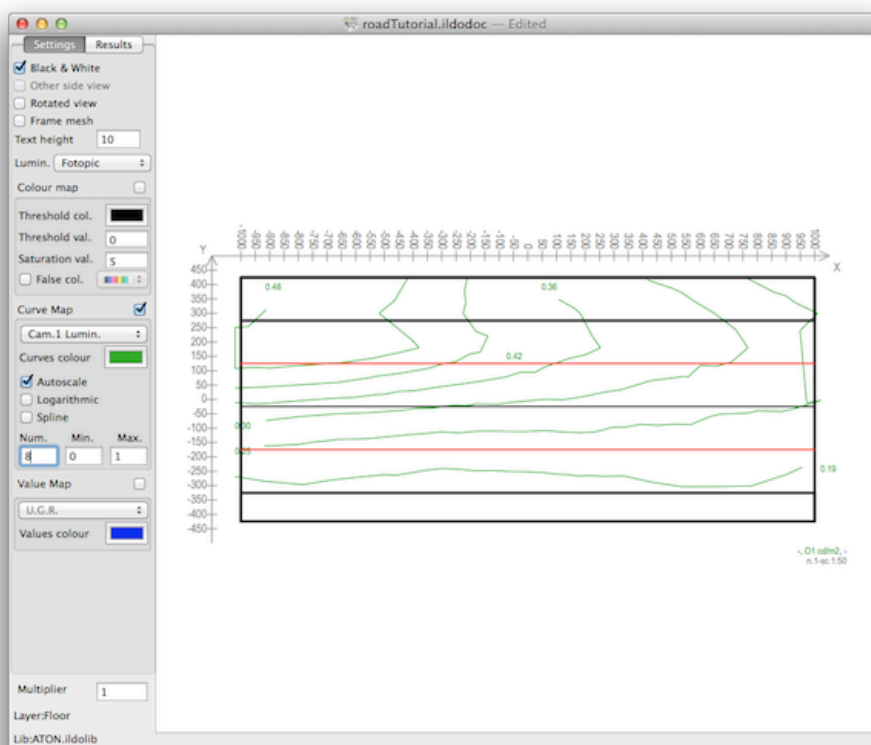
Click somewhere on the view and copy it, than go to the report file at pag.5, place the cursor after the image, press 'return' and paste the copied image. The report file will have a page more:
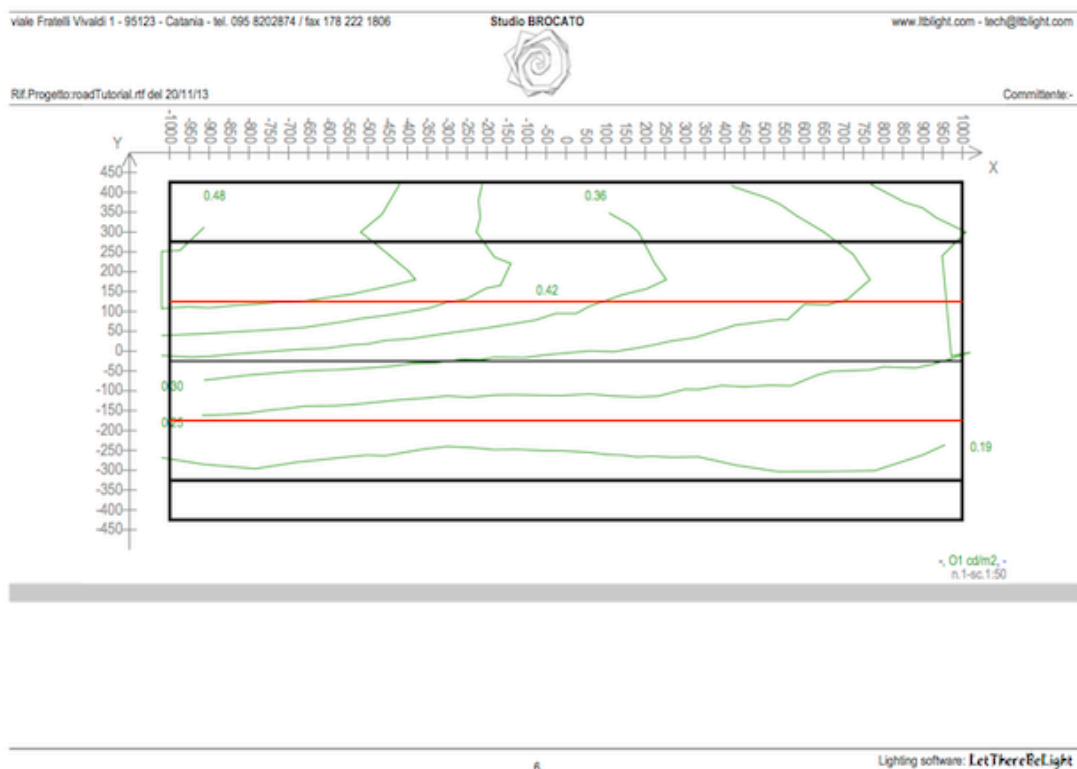
Set the parameters in the drawer as follows (Curve map: Camera 2 Luminance; Autoscale; n.curves: 8):
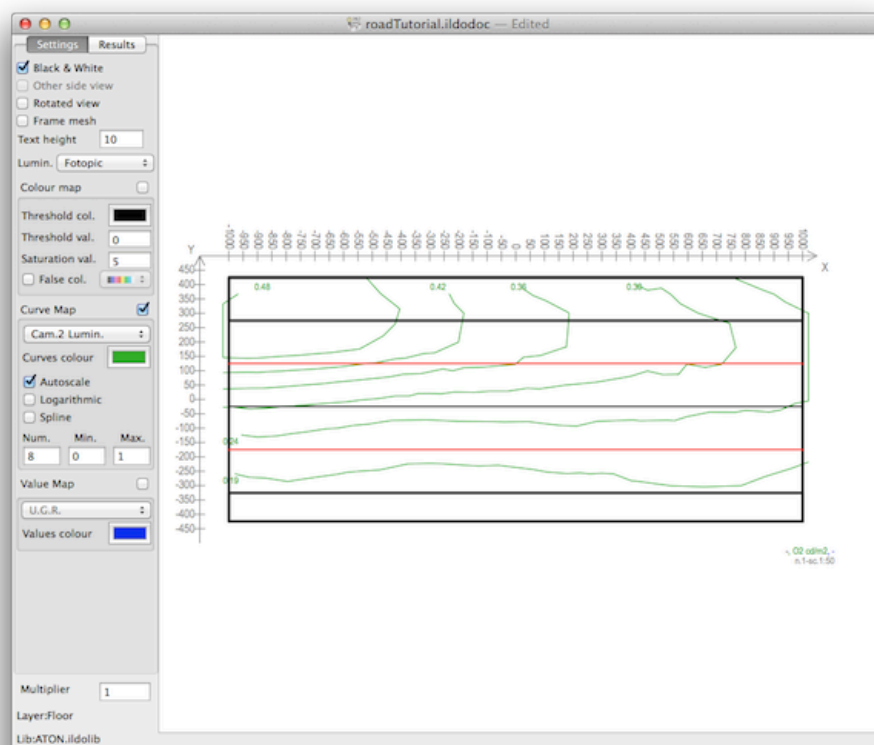
Click somewhere on the view and copy it, than go to the report file at pag.6 (the new added one), place the cursor after the image, press 'return' and paste the copied image. The report file will have a page more:
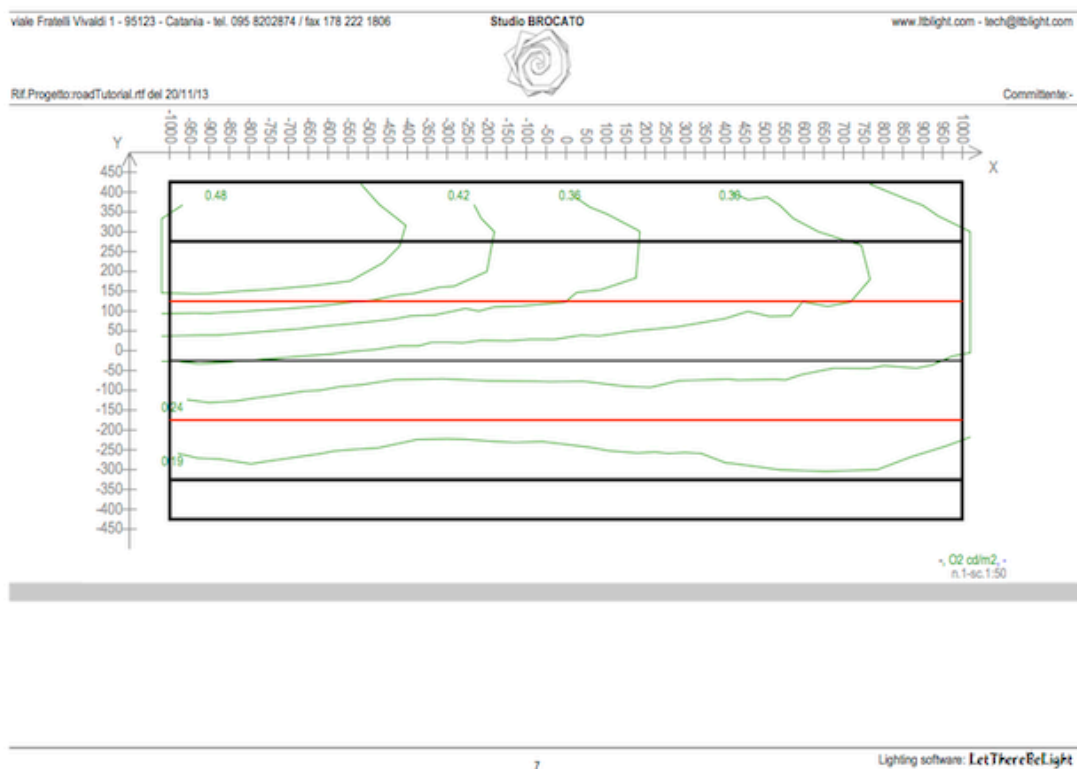
Save the file in the native word processing format and this is all.

5.2. Manage photometries

This tutorial permits to import a photometric file, to do some manipulations on it and to export a full report.

5.2.1. Import, correct and save a photometric file.

1. The first step consist in importing the 'demo.ldt' file from the catalogue pop-menu:
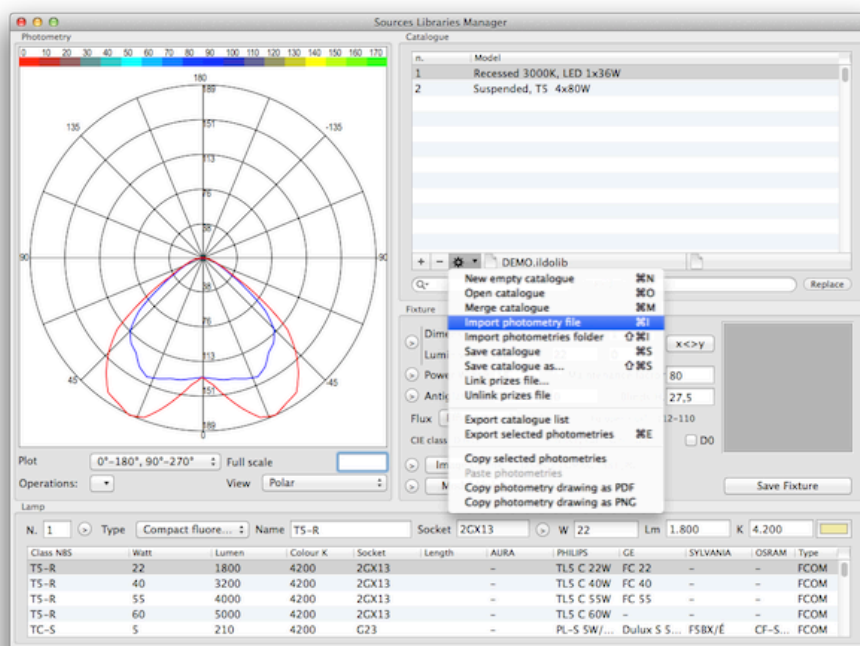
2. Let's correct the name in 'demo. 36x750mA LED' simply with a double-click on the table row to enter the edit mode.
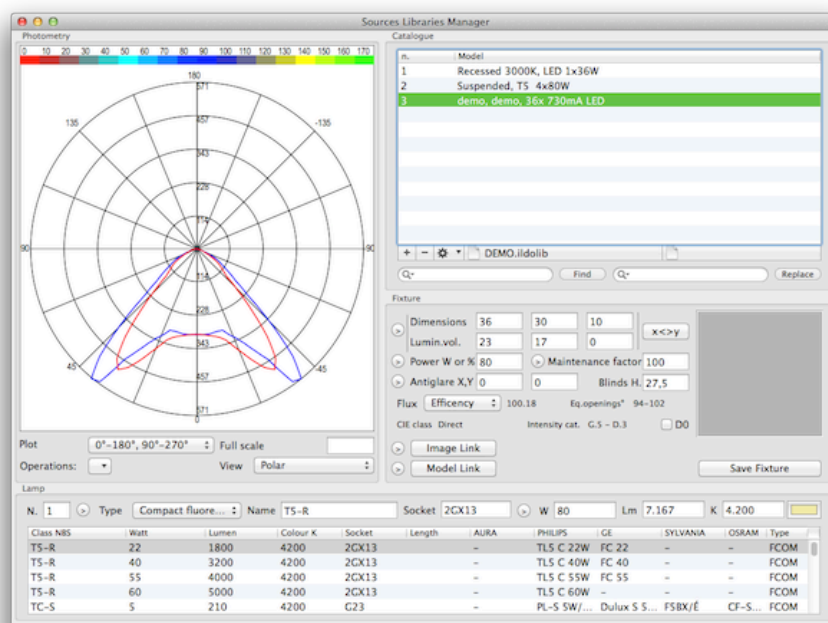
3. Now let's rotate the photometry 90° azimuth to make the plan of the maximum emission (in the previous image, the plan of the blue curve, C=90°/270°) the main plan (C=0°-180°): from the 'Operation' pop-menu 'Rotate +90° azimuth'.
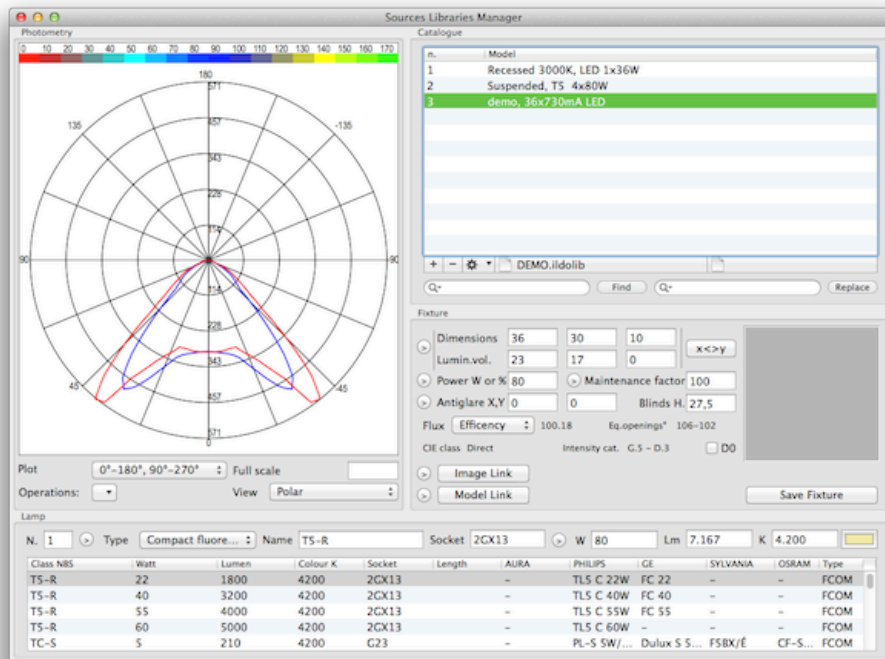
4. For coherence we need to rotate also the geometry 90° azimuth, through the 'x<>y' button in the fixture box:
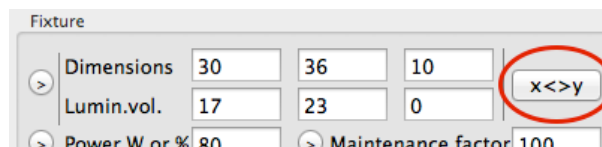
5. Now we have to notice that the total power is equal to the lamp power:
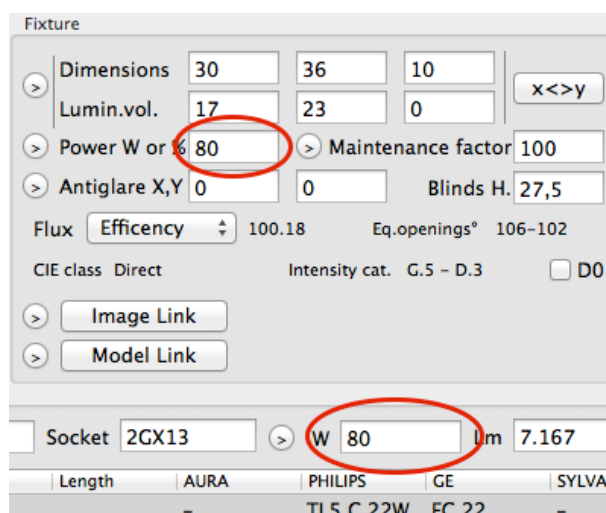
6. This may be or may be not an error, but for now we assume that this is the inconsistence of the EULUMDAT file, so let's correct the total power adding a 10% of power due to the ballast consumption: type '10%' in the 'Power W or %' edit field in the Fixture box and press return, to let the application calculate the real total consumption:

7. Select an image to link to this photometry by clicking the 'Image Link' button in the fixture box, and select the 'recessed60x60led.jpg' one in the folder suggested by the application. The button will change in 'Image Unlink' (this button now will be used to discard actual link) and the image box will be filled with the selected picture:

8. At this point we can save the fixture in the open catalogue simply clicking the 'Save Fixture' button: remember that until now the active catalogue was not updated on disk, so we have to select the 'Save catalogue' pop-menu to make permanent the modifications.

5.2.2. Examine photometry

1. The user is able to choose the photometry representation through the 'View' pop-menu among the polar, Cartesian or table view:
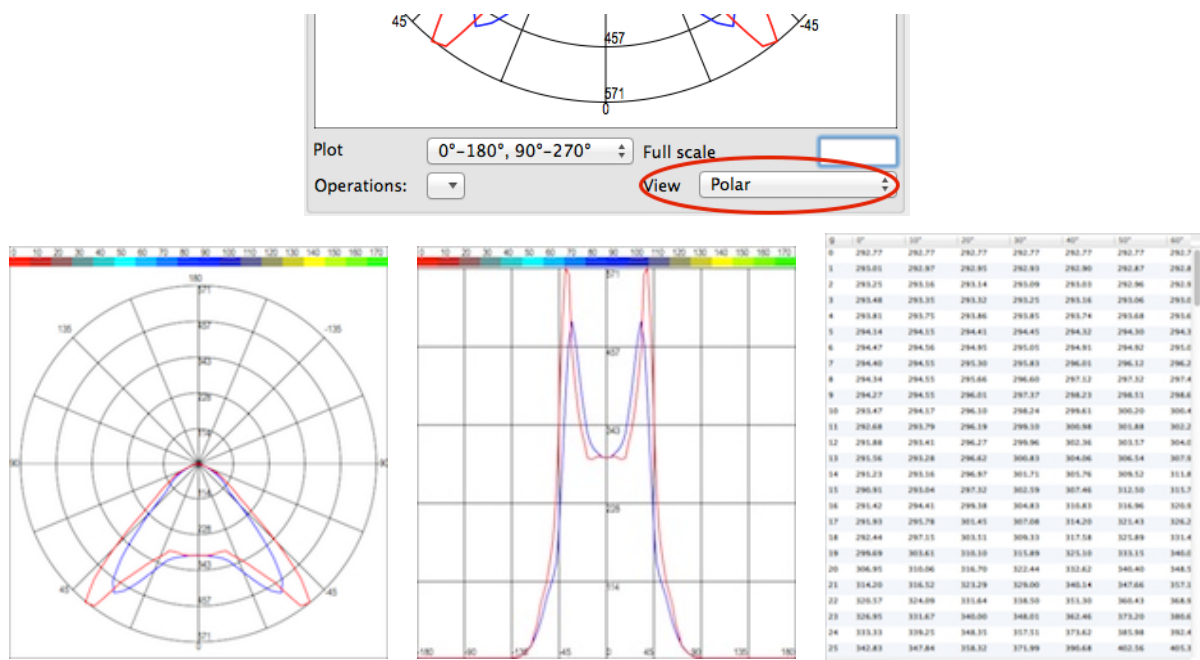
2.   Is it also possible to plot a single curve, both the C=0°/C=180° and C=90°/C=270° curves or all the C-curves through the 'Plot' pop-menu: let's select 'All curves' from the 'Plot' pop-menu and 'Polar' from the 'View' pop-menu, and the Photometry box will present the following diagram...
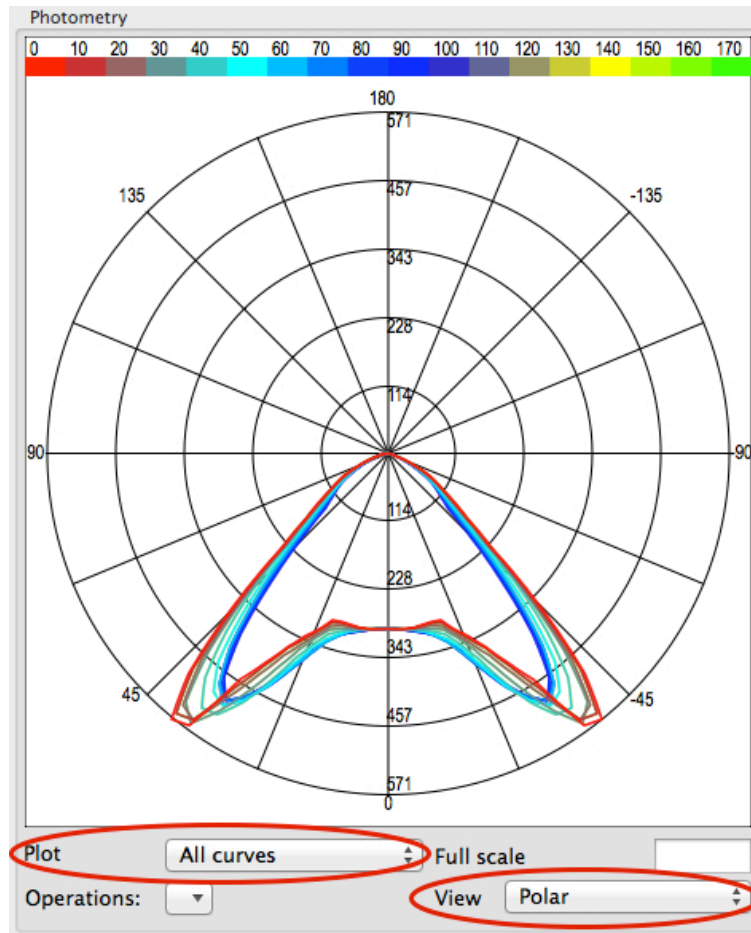
3.   ...that may be copied in the pasteboard with the 'Copy photometry as PDF/PNG' commands in the 'Catalogue' pop-menu:
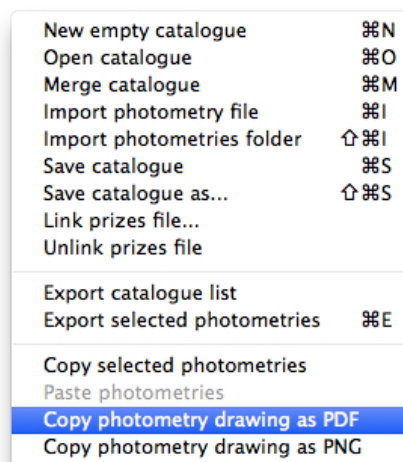
5.2.3. Export photometry protocol.

1. It is possible to export in PDF the total report for the selected photometry, through the 'Export selected photometries' command in the Catalogue pop-menu:
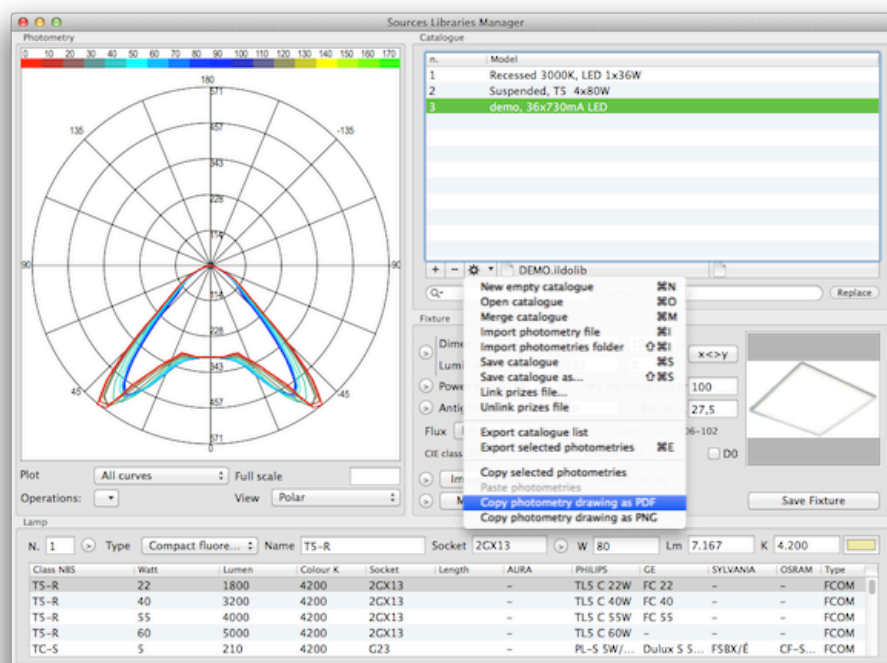
2. Then select 'PDF report' as Format and the parameters following the next image:
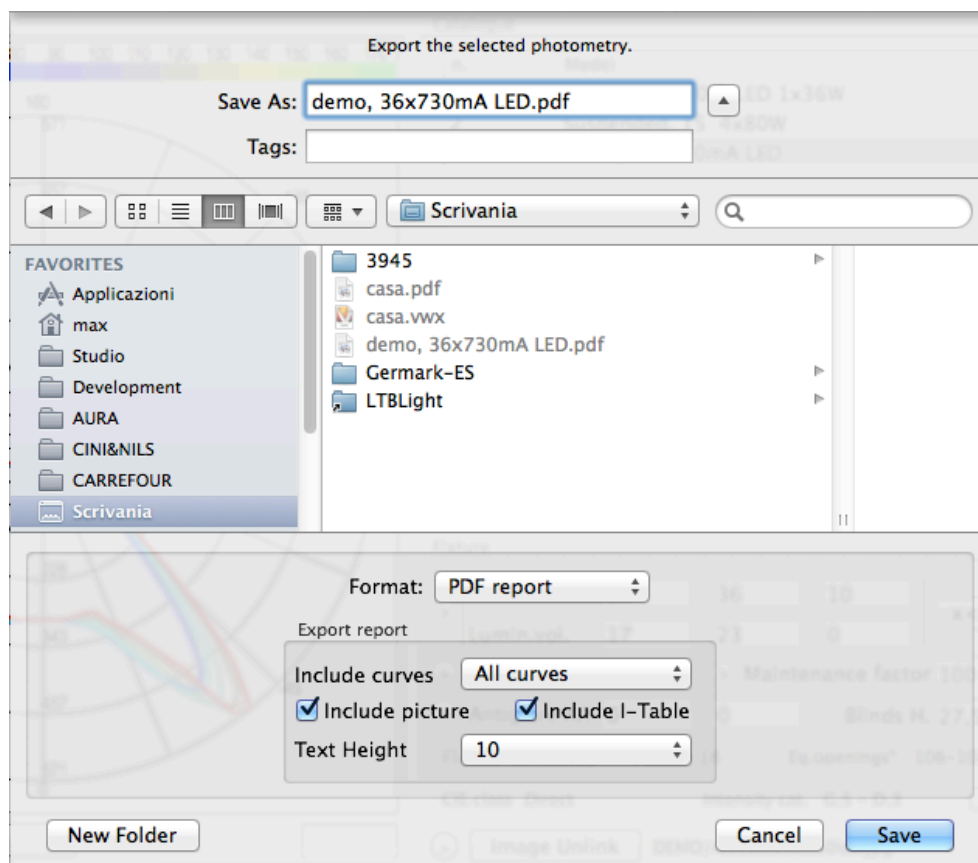
3. The saved report will contain one page with the photometry summary, 12 pages presenting the I-table and one page with the planar representation of the photometric solid:

- photometry summary:

LIGHTING SOURCE PROTOCOL

Model:	demo, 36x730mA LED
Catalog:	DEMO.ildolib
CIE classification:	Direct
Total power:	88.00W
Dimensions:	30.0 x 36.0 x 10.0 cm
Luminous volume:	17.0 x 23.0 x 0.0 cm
Efficency:	100 %
Zonal fluxes [lm]:	
- 0/30:	2102.17 (29.28 %)
- 0/40:	4377.81 (60.97 %)
- 0/60:	6692.01 (93.20 %)
- 0/90:	7179.99 (100.00 %)
- 90/120:	0.00 (0.00 %)
- 90/130:	0.00 (0.00 %)
- 90/150:	0.00 (0.00 %)
- 90/180:	0.00 (0.00 %)
- 0/180:	7179.99 (100.00 %)
Installed lamp/s:	
- n.:	1
- type:	Fluorescent comp.
- name:	T5-R
- socket:	2GX13
- power:	80.00 W
- flux:	7167 lm
- color temp.:	4200 K
Side shades:	
- depth:	27.5 cm
- angle C=0:	0.0 cm
- angle C=90:	0.0 cm
- angle C=180:	0.0 cm
- angle C=270:	0.0 cm
Grid:	
- xy dimensions:	0.0 x 0.0 cm
- depth:	0.0 cm

- 1 -

- I-table:

LIGHTING SOURCE PROTOCOL

						C						
gamma	0	10	20	30	40	50	60	70	80	90	100	110
0d	292.8	292.8	292.8	292.8	292.8	292.8	292.8	292.8	292.8	292.8	292.8	292.8
1d	293.0	293.0	293.0	292.9	292.9	292.9	292.9	292.8	293.0	292.9	293.0	292.8
2d	293.2	293.2	293.1	293.1	293.0	293.0	292.9	292.9	293.3	293.1	293.3	292.9
3d	293.5	293.3	293.3	293.3	293.2	293.1	293.0	293.0	293.5	293.3	293.5	293.0
4d	293.8	293.8	293.9	293.9	293.7	293.7	293.7	293.8	294.5	294.3	294.5	293.8
5d	294.1	294.2	294.4	294.5	294.3	294.3	294.3	294.6	295.4	295.4	295.4	294.6
6d	294.5	294.6	295.0	295.1	294.9	294.9	295.0	295.4	296.3	296.4	296.3	295.4
7d	294.4	294.6	295.3	295.8	296.0	296.1	296.2	296.7	297.8	297.9	297.8	296.7
8d	294.3	294.6	295.7	296.6	297.1	297.3	297.4	298.1	299.4	299.3	299.4	298.1
9d	294.3	294.5	296.0	297.4	298.2	298.5	298.6	299.4	300.9	300.7	300.9	299.4
10d	293.5	294.2	296.1	298.2	299.6	300.2	300.4	301.4	302.7	302.3	302.7	301.4
11d	292.7	293.8	296.2	299.1	301.0	301.9	302.2	303.3	304.5	304.0	304.5	303.3
12d	291.9	293.4	296.3	300.0	302.4	303.6	304.0	305.2	306.3	305.6	306.3	305.2
13d	291.6	293.3	296.6	300.8	304.1	306.5	307.9	308.5	309.0	308.3	309.0	308.5
14d	291.2	293.2	297.0	301.7	305.8	309.5	311.8	311.8	311.8	311.0	311.8	311.8
15d	290.9	293.0	297.3	302.6	307.5	312.5	315.7	315.2	314.6	313.7	314.6	315.2
16d	291.4	294.4	299.4	304.8	310.8	317.0	321.0	320.4	319.2	318.3	319.2	320.4
17d	291.9	295.8	301.4	307.1	314.2	321.4	326.2	325.5	323.8	322.9	323.8	325.5
18d	292.4	297.2	303.5	309.3	317.6	325.9	331.5	330.7	328.5	327.6	328.5	330.7
19d	299.7	303.6	310.1	315.9	325.1	333.1	340.0	340.2	338.2	337.1	338.2	340.2
20d	306.9	310.1	316.7	322.4	332.6	340.4	348.6	349.7	348.0	346.5	348.0	349.7
21d	314.2	316.5	323.3	329.0	340.1	347.7	357.1	359.2	357.8	356.0	357.8	359.2
22d	320.6	324.1	331.6	338.5	351.3	360.4	368.9	371.1	370.0	367.0	370.0	371.1
23d	326.9	331.7	340.0	348.0	362.5	373.2	380.7	382.9	382.3	378.0	382.3	382.9
24d	333.3	339.2	348.3	357.5	373.6	386.0	392.5	394.8	394.5	389.0	394.5	394.8
25d	342.8	347.8	358.3	372.0	390.7	402.6	405.3	407.9	408.6	402.4	408.6	407.9
26d	352.3	356.4	368.3	386.5	407.7	419.1	418.2	421.0	422.7	415.8	422.7	421.0
27d	361.8	365.0	378.3	401.0	424.8	435.7	431.1	434.1	436.8	429.2	436.8	434.1
28d	375.3	379.6	394.1	419.2	443.1	448.5	445.9	445.1	448.3	442.3	448.3	445.1
29d	388.8	394.3	410.0	437.4	461.5	461.4	460.7	456.2	459.7	455.4	459.7	456.2
30d	402.3	408.9	425.8	455.6	479.8	474.2	475.5	467.2	471.2	468.5	471.2	467.2
31d	418.2	428.1	445.4	474.4	493.1	483.4	484.0	475.5	478.3	476.3	478.3	475.5
32d	434.1	447.4	464.9	493.3	506.4	492.7	492.5	483.7	485.4	484.2	485.4	483.7
33d	450.0	466.6	484.4	512.1	519.6	501.9	501.1	491.9	492.5	492.1	492.5	491.9
34d	487.1	494.2	506.2	526.9	521.5	498.5	492.6	486.4	484.3	481.9	484.3	486.4
35d	524.1	521.8	527.9	541.7	523.3	495.1	484.1	480.9	476.2	471.8	476.2	480.9
36d	561.1	549.4	549.7	556.5	525.1	491.7	475.6	475.4	468.1	461.7	468.1	475.4
37d	564.4	552.4	546.5	548.7	510.6	476.5	455.7	454.5	445.7	436.7	445.7	454.5
38d	567.6	555.4	543.3	540.8	496.1	461.4	435.7	433.6	423.3	411.7	423.3	433.6
39d	570.8	558.4	540.1	533.0	481.6	446.2	415.8	412.8	400.9	386.7	400.9	412.8
40d	545.2	533.3	513.5	503.2	454.6	417.0	386.4	382.1	367.6	353.4	367.6	382.1
41d	519.6	508.2	487.0	473.3	427.6	387.7	357.1	351.4	334.4	320.1	334.4	351.4
42d	494.0	483.2	460.5	443.5	400.6	358.5	327.8	320.7	301.2	286.8	301.2	320.7
43d	451.3	439.6	419.0	403.7	368.2	328.8	300.1	291.2	273.0	258.0	273.0	291.2
44d	408.6	396.1	377.5	363.8	335.9	299.1	272.3	261.6	244.9	229.3	244.9	261.6
45d	365.9	352.6	336.0	324.0	303.6	269.4	244.5	232.1	216.7	200.5	216.7	232.1
46d	323.2	311.5	298.3	287.3	271.7	244.3	220.9	209.3	195.0	179.7	195.0	209.3
47d	280.5	270.4	260.7	250.6	239.7	219.1	197.2	186.6	173.2	158.9	173.2	186.6
48d	237.9	229.3	223.0	214.0	207.7	194.0	173.5	163.9	151.5	138.1	151.5	163.9
49d	216.1	210.9	204.7	196.8	190.9	178.6	161.1	152.1	142.7	131.2	142.7	152.1
50d	194.7	192.5	186.5	179.6	174.1	163.3	148.6	140.2	133.8	124.3	133.8	140.2
51d	173.1	174.1	168.3	162.4	157.3	147.9	136.1	128.4	125.0	117.5	125.0	128.4

- 2 -

...follows 11 pages

- ... planar representation of the photometric solid:

LIGHTING SOURCE PROTOCOL
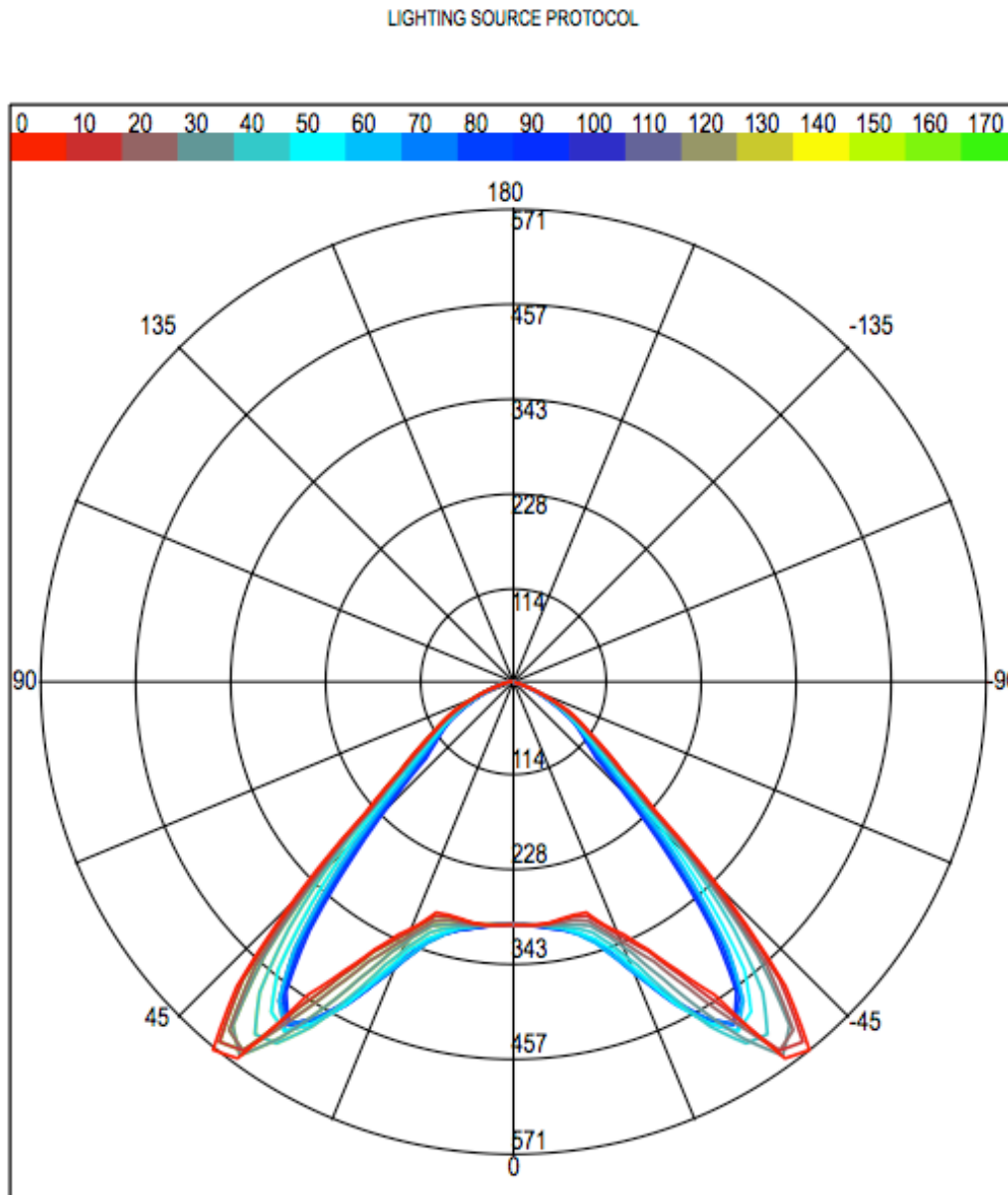
- 14 -

That's all!

5.3. Appendix A: Analysis results
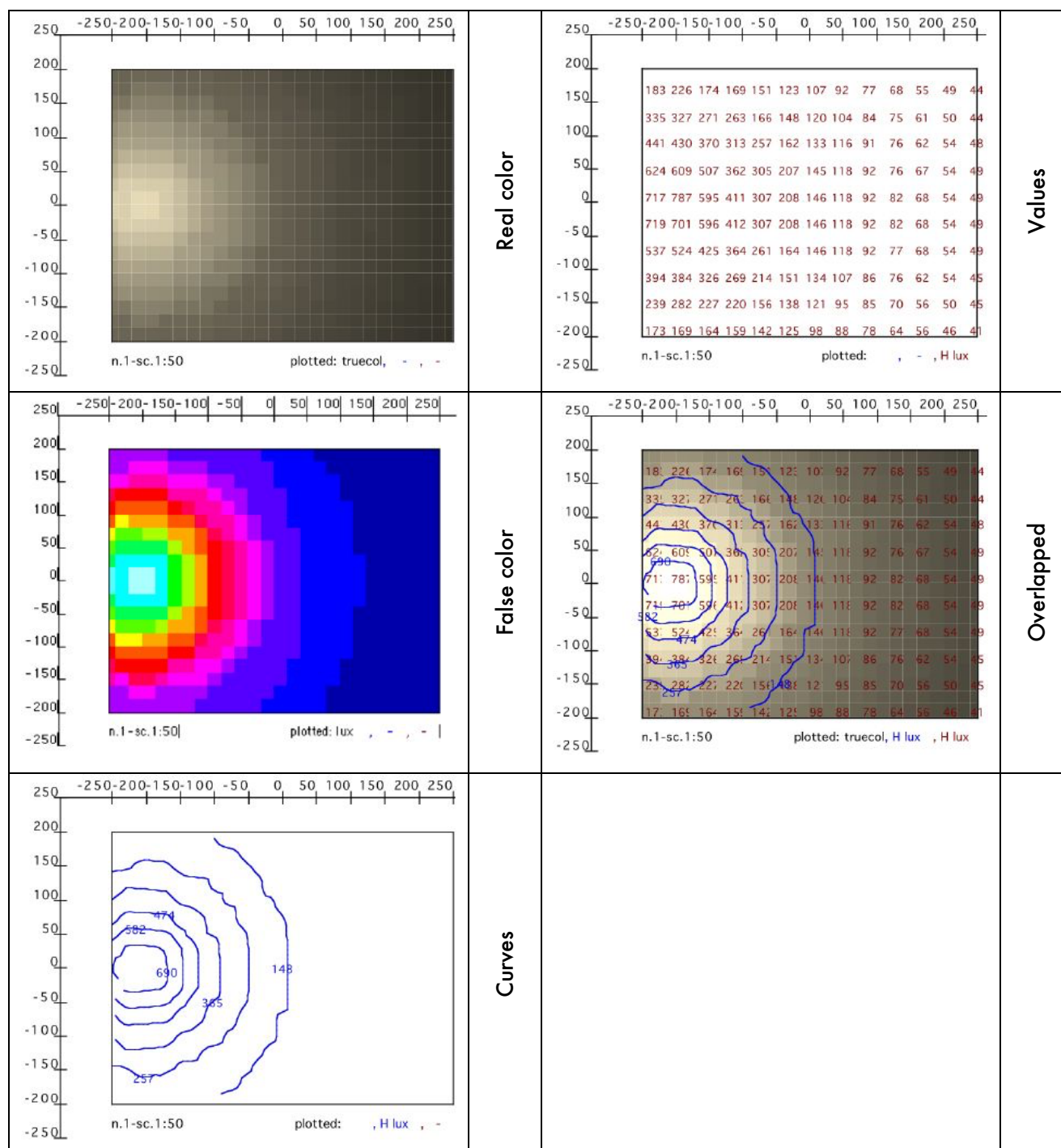
5.4. Appendix B: Luminaire protocol

LIGHTING SOURCE PROTOCOL

Model:	325+316, miniTensoDOMO QUADRETT.arg. + miniTensoCIELI DIFF.
Catalog:	CINI&NILS.ildolib
CIE classification:	Semi-Direct
Total power:	120.00W
Dimensions:	20.2 x 22.5 x 10.0 cm
Luminous volume:	20.2 x 22.5 x 0.0 cm
Efficency:	43 %

Zonal fluxes [lm]:
- 0/30:	116.10 (11.11 %)
- 0/40:	213.45 (20.42 %)
- 0/60:	481.48 (46.06 %)
- 0/90:	838.16 (80.19 %)
- 90/120:	145.42 (13.91 %)
- 90/130:	186.95 (17.89 %)
- 90/150:	205.22 (19.63 %)
- 90/180:	207.08 (19.81 %)
- 0/180:	1045.24 (100.00 %)

Installed lamp/s:
- n.:	1
- type:	Halogen
- name:	linear
- socket:	R7s
- power:	120.00 W
- flux:	2450 lm
- color temp.:	3000 K

Side shades:
- depth:	0.0 cm
- angle C=0:	0.0 cm
- angle C=90:	0.0 cm
- angle C=180:	0.0 cm
- angle C=270:	0.0 cm

Grid:
- xy dimensions:	0.0 x 0.0 cm
- depth:	0.0 cm

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LIGHTING SOURCE PROTOCOL

| | | | | | | C | | | | | | |
gamma	0	10	20	30	40	50	60	70	80	90	100	110
0d	54.2	54.2	54.2	54.2	54.2	54.2	54.2	54.2	54.2	54.2	54.2	54.2
1d	54.1	54.1	54.1	54.1	54.1	54.1	54.1	54.1	54.1	54.1	54.1	54.1
2d	54.1	54.1	54.1	54.1	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0
3d	54.1	54.1	54.1	54.0	54.0	54.0	54.0	53.9	53.9	54.0	53.9	53.9
4d	54.1	54.1	54.0	54.0	53.9	53.9	53.9	53.9	53.9	53.9	53.9	53.9
5d	54.1	54.1	54.0	53.9	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8
6d	54.2	54.2	54.1	54.0	53.8	53.8	53.7	53.7	53.7	53.7	53.7	53.7
7d	54.4	54.3	54.2	54.0	53.8	53.8	53.7	53.6	53.6	53.6	53.6	53.6
8d	54.6	54.4	54.3	54.0	53.8	53.8	53.6	53.5	53.5	53.5	53.5	53.5
9d	54.7	54.5	54.4	54.1	53.7	53.7	53.5	53.4	53.3	53.3	53.3	53.4
10d	54.9	54.7	54.5	54.1	53.7	53.7	53.5	53.2	53.2	53.2	53.2	53.2
11d	55.1	54.9	54.7	54.2	53.8	53.8	53.5	53.1	53.1	53.1	53.1	53.1
12d	55.4	55.1	54.8	54.4	53.9	53.9	53.5	53.0	53.0	53.0	53.0	53.0
13d	55.6	55.3	55.0	54.5	54.0	54.0	53.4	52.9	52.9	52.8	52.9	52.9
14d	55.9	55.5	55.2	54.6	54.0	54.0	53.4	52.8	52.8	52.7	52.8	52.8
15d	56.1	55.7	55.4	54.8	54.1	54.1	53.4	52.7	52.6	52.6	52.6	52.7
16d	56.9	56.4	55.8	55.0	54.2	54.2	53.4	52.6	52.5	52.4	52.5	52.6
17d	57.7	57.0	56.3	55.3	54.3	54.3	53.4	52.6	52.4	52.3	52.4	52.6
18d	58.4	57.6	56.8	55.6	54.4	54.4	53.4	52.5	52.3	52.2	52.3	52.5
19d	59.2	58.2	57.2	55.8	54.5	54.5	53.4	52.4	52.2	52.1	52.2	52.4
20d	60.0	58.8	57.7	56.1	54.5	54.5	53.4	52.3	52.1	51.9	52.1	52.3
21d	61.9	60.5	59.1	57.0	54.8	54.8	53.6	52.3	52.1	51.9	52.1	52.3
22d	63.7	62.1	60.5	57.8	55.2	55.2	53.7	52.2	52.0	51.8	52.0	52.2
23d	65.6	63.8	61.9	58.7	55.5	55.5	53.8	52.2	52.0	51.7	52.0	52.2
24d	67.5	65.4	63.4	59.6	55.8	55.8	54.0	52.2	51.9	51.6	51.9	52.2
25d	69.3	67.1	64.8	60.4	56.1	56.1	54.1	52.1	51.8	51.5	51.8	52.1
26d	70.6	68.3	66.0	61.4	56.9	56.9	54.5	52.2	51.8	51.5	51.8	52.2
27d	71.8	69.5	67.2	62.4	57.7	57.7	55.0	52.2	51.9	51.5	51.9	52.2
28d	73.0	70.7	68.4	63.4	58.5	58.5	55.4	52.3	51.9	51.4	51.9	52.3
29d	74.2	71.9	69.6	64.4	59.3	59.3	55.8	52.3	51.9	51.4	51.9	52.3
30d	75.4	73.1	70.8	65.4	60.1	60.1	56.2	52.4	51.9	51.4	51.9	52.4
31d	76.0	73.6	71.2	66.0	60.7	60.7	56.6	52.4	51.7	51.1	51.7	52.4
32d	76.6	74.1	71.7	66.5	61.4	61.4	56.9	52.4	51.6	50.8	51.6	52.4
33d	77.2	74.7	72.1	67.1	62.0	62.0	57.2	52.5	51.5	50.5	51.5	52.5
34d	77.8	75.2	72.6	67.6	62.6	62.6	57.6	52.5	51.4	50.3	51.4	52.5
35d	78.4	75.7	73.0	68.2	63.3	63.3	57.9	52.5	51.2	50.0	51.2	52.5
36d	78.9	76.1	73.4	68.4	63.4	63.4	58.0	52.3	50.9	49.4	50.9	52.3
37d	79.4	76.6	73.8	68.6	63.5	63.5	57.8	52.2	50.5	48.8	50.5	52.2
38d	79.8	77.0	74.1	68.9	63.6	63.6	57.8	52.0	50.1	48.2	50.1	52.0
39d	80.3	77.4	74.5	69.1	63.7	63.7	57.8	51.9	49.7	47.5	49.7	51.9
40d	80.8	77.8	74.8	69.3	63.8	63.8	57.7	51.7	49.3	46.9	49.3	51.7
41d	81.6	78.5	75.4	69.6	63.9	63.9	57.4	51.3	48.6	46.0	48.6	51.3
42d	82.4	79.2	76.0	70.0	64.0	64.0	57.4	50.9	48.0	45.0	48.0	50.9
43d	83.3	79.9	76.5	70.3	64.1	64.1	57.3	50.5	47.3	44.1	47.3	50.5
44d	84.1	80.6	77.1	70.6	64.2	64.2	57.1	50.1	46.6	43.2	46.6	50.1
45d	84.9	81.3	77.6	70.9	64.2	64.2	57.0	49.7	46.0	42.2	46.0	49.7
46d	86.6	82.6	78.5	71.4	64.3	64.3	56.7	49.1	45.2	41.2	45.2	49.1
47d	88.3	83.9	79.4	71.9	64.4	64.4	56.5	48.5	44.3	40.2	44.3	48.5
48d	90.1	85.2	80.4	72.4	64.5	64.5	56.2	47.9	43.5	39.2	43.5	47.9
49d	91.8	86.5	81.3	72.9	64.6	64.6	56.0	47.3	42.7	38.2	42.7	47.3
50d	93.5	87.9	82.2	73.4	64.7	64.7	55.7	46.7	41.9	37.2	41.9	46.7
51d	96.2	89.8	83.4	74.2	65.0	65.0	55.5	46.0	41.2	36.3	41.2	46.0

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...follows all other fields

LIGHTING SOURCE PROTOCOL
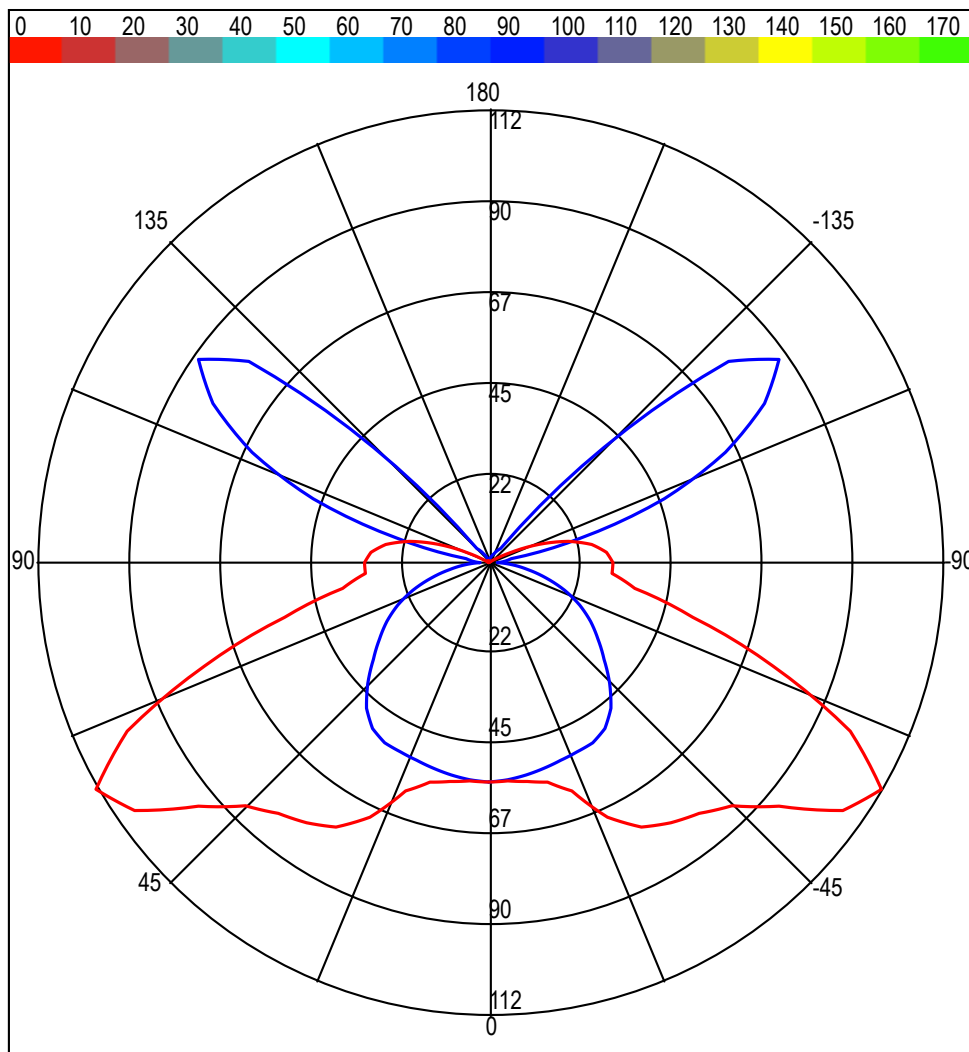
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5.5. Appendix C: IES-NA data interchange format

of: (Ian Ashdown, P. Eng. Research & Development Manager - Ledalite Architectural Products
            Incorporated 9087A - 198th Street - Langley, B.C. - Canada V1M 3B1 - Tel. (604) 888-6811
            - Fax. (604) 888-0566 - e mail: iashdown@ledalite.com - URL: http://www.ledalite.com ...

Synopsis: The IESNA LM-63 photometric data file is an ASCII text file commonly used by North
            American lighting fixture manufacturers to distribute photometric information about their
            products. ...

The Standard File Format IES ... is an ACII text file. There are three revisions, based on LM-63-1986, LM-63-1991, and LM-63-1995.

5.5.1. IES LM-63-1986

The file format specification for the LM-63-1986 variant is:

Id   Description

01   {label line 1}

02   {label line 2}

03   ...

04   {label line n}

05   TILT={file-spec} or {INCLUDE} or {NONE}

06   {lamp-to-luminaire geometry}

07   {# of pairs of angles and multiplying factors}

08   {angles}

09   {multiplying factors}

10   {# of lamps} {lumens per lamp} {candela multiplier} {# of vertical angles} {# of horizontal angles}
{photometric type} {units type} {width} {length} {height}

11   {ballast factor} {ballast-lamp photometric factor} {input watts}

12   {vertical angles}

13   {horizontal angles}

14   {candela values for all vertical angles at first horizontal angle}

15   {candela values for all vertical angles at second horizontal angle}

16   ...

17   {candela values for all vertical angles at nth horizontal angle}

A detailed description of each line is presented in the following sections.

5.5.2. IES LM-63-1991

The file format specification for the LM-63-1991 variant is:

Id   Description

00   IESNA91

01   {Keyword [TEST]}

02   {Keyword [MANUFAC]}

03   ...

04   {Keyword n}

05   TILT={file-spec} or {INCLUDE} or {NONE}

06   {lamp-to-luminaire geometry}

07   {# of pairs of angles and multiplying factors}

08   {angles}

09   {multiplying factors}

10   vertical angles} {# of horizontal angles} {photometric type} {units type} {width} {length} {height}

11   {ballast factor} {ballast-lamp photometric factor} {input watts}

12   {vertical angles}

13   {horizontal angles}

14   {candela values for all vertical angles at first horizontal angle}

15   {candela values for all vertical angles at second horizontal angle}

16   ...

17   {candela values for all vertical angles at nth horizontal angle}

The changes between LM-63-1986 and LM-63-1991 are:

- Identifier line 00 ("IESNA91") was added to distinguish the file from LM-63-1986 photometric data files.
- The free-form label lines (identifiers 01 through 04) were replaced with lines that begin with user-defined keywords.

A detailed description of each line is presented in the following sections.

5.5.3.   IES LM-63-1995

The file format specification for the LM-63-1995 variant is:

Id   Description

00   IESNA:LM-63-1995

01   {Keyword 1}

02   {Keyword 2}

03   ...

04   {Keyword n}

05   TILT={file-spec} or {INCLUDE} or {NONE}

06   {lamp-to-luminaire geometry}

07   {# of pairs of angles and multiplying factors}

08   {angles}

09   {multiplying factors}

10   {# of lamps} {lumens per lamp} {candela multiplier} {# of vertical angles} {# of horizontal angles} {photometric type} {units type} {width} {length} {height}

11   {ballast factor} {future use} {input watts}

12   {vertical angles}

13   {horizontal angles}

14   {candela values for all vertical angles at first horizontal angle}

15   {candela values for all vertical angles at second horizontal angle}

16   .. .

17   {candela values for all vertical angles at nth horizontal angle}

The changes between LM-63-1991 and LM-63-1995 are:

- Identifier line 00 was changed to "IESNA:LM-63-1995") to distinguish the file from LM-63-1986 and LM-63-1991 photometric data files and other (future) IESNA standard file formats.
- The number of predefined keywords was expanded and new features (such as support for near-field photometric data) introduced via the keyword mechanism.
- The {ballast-lamp photometric factor} was changed to {future use}.

A detailed description of each line is presented in the following sections.

5.5.4.   IES Standard File Format - Detailed Description

All lines shall be terminated with a {CR}{LF} pair. (This is the text file convention for MS-DOS programming environments).

An "identifier line" as presented in Section 2, "IES Standard File Format - Specification," may be consist of one or more ASCII text lines in the photometric data file. Multiple lines are typically present when the space needed to represent the values in the identifier line exceeds the allowable line length.

The maximum length of any label / keyword line (including the {CR}{LF} terminating pair) is 82 characters. The maximum length of any other line (including the {CR}{LF} terminating pair) is 132 characters.

5.5.4.1. File Format Identifier (Identifier Line 00)

IES LM-63-1991 and LM-63-1995 photometric data files begin with a unique file format identifier line, namely "IESNA91" or "IESNA:LM-63-1995". IES LM-63-1986 does not have a file format identifier line.

5.5.4.2. Label Lines / Keywords (Identifier Lines 01 Through 04)

Label lines contain descriptive text about the luminaire, the lamp(s) used, and other descriptive comments. Keywords, which were introduced in LM-63-1991, require that each label line begins with a defined IES keyword in square brackets. For example:

[TEST]   ABC1234 ABC Laboratories

The keywords [TEST] and [MANUFAC] are required in LM-63-1991, but not in LM-63-1995. (Label lines are optional in LM-63-1986 and LM-63-1995.) The following keywords are a suggested minimum for LM-63-1995:

[TEST]   Test report number and laboratory

[MANUFAC]   Luminaire manufacturer

[LUMCAT]   Luminaire catalog number

[LUMINAIRE] Luminaire description

[LAMPCAT]   Lamp catalog number

[LAMP] Lamp description

LM-63-1995 presents a list of predefined keywords that identify test-related data, luminaire product information, luminaire characteristics, and miscellaneous information. User-defined keywords are also permitted.

Details regarding the syntax of user-defined keywords are presented in IES LM-63-1995. The accompanying IES Standard File parser reads and stores, but does not interpret, keyword lines.

5.5.4.3. TILT= (Identifier Line 05)

The lamp output may vary as a function of the luminaire tilt angle. If so, then the photometric data file may provide photometric data multipliers for various tilt angles. The "TILT=" line uniquely delimits the end of label / keyword lines in the photometric data file.

There are three variants of this line:

- "TILT=NONE": The lamp output (presumably) does not vary as a function of the luminaire If TILT=NONE is present, the identifier lines 06 {lamp-to-luminaire geometry}, 07 {# of pairs of angles and multiplying factors} 08 {angles}, 09 {multiplying factors} are not present in the photometric data file.
- "TILT=INCLUDE": The lamp output varies as a function of the luminaire tilt angle. If TILT=INCLUDE is present, the identifier lines 06 {lamp-to-luminaire geometry}, 07 {# of pairs of angles and multiplying factors} 08 {angles}, 09 {multiplying factors} are present in the photometric data file.
- "TILT={filename}": The lamp output varies as a function of the luminaire tilt angle. If TILT={filename} is present (where "filename" is the name of a valid TILT photometric data file), the identifier lines 06 {lamp-to-luminaire geometry}, 07 {# of pairs of angles and multiplying factors} 08 {angles}, 09 {multiplying factors} are present in the identified and separate TILT photometric data file.

5.5.4.4. Lamp-to-Luminaire Geometry (Identifier Line 06)

This integer value indicates the orientation of the lamp within the luminaire as follows:

1. Lamp base is either vertical base up or vertical base down when the luminaire is aimed straight down.
2. Lamp is horizontal and remains horizontal when the luminaire is aimed straight down or rotated about the zero-degree horizontal plane.
3. Lamp is horizontal when the luminaire is pointed straight down, but does not remains horizontal when the luminaire is rotated about the zero-degree horizontal plane.

The lamp-to-luminaire geometry line is absent if TILT=NONE.

5.5.4.5. Number of Pairs of TILT Angles and Multiplying Factors (Identifier Line 07)

This integer value indicates the total number of lamp tilt angles and their corresponding candela multiplying factors. It is absent if TILT=NONE.

5.5.4.6. TILT Angles (Identifier Line 08)

This line enumerates the (floating point) lamp tilt angles. It is absent if TILT=NONE.

5.5.4.7. TILT Multiplying Factors (Identifier Line 09)

This line enumerates the (floating point) candela multiplying factors for the corresponding lamp tilt angles. It is absent if TILT=NONE.

5.5.4.8. Number of Lamps (Identifier Line 10)

This integer value indicates the total number of lamps in the luminaire.

5.5.4.9. *Lumens Per Lamp (Identifier Line 10)*

This floating point value indicates the rated lumens per lamp on which the photometric test was based. (This value is obtained from the lamp manufacturer's published technical data for the lamp, and does not represent the actual lumens emitted by the test lamp).

If the luminaire has two or more lamps with different rated lumens per lamp, this value represents the average lumens per lamp for the luminaire. In the (very rare) cases of absolute photometry, this value is -1.

5.5.4.10. *Candela Multiplier (Identifier Line 10)*

This floating point value indicates a multiplying factor that is to be applied to all candela values in the photometric data file (identifier lines 14 through 17).

5.5.4.11. *Number of Vertical Angles (Identifier Line 10)*

This integer value indicates the total number of vertical angles in the photometric data (identifier lines 14 through 17).

5.5.4.12. *Number of Horizontal Angles (Identifier Line 10)*

This integer value indicates the total number of horizontal angles in the photometric data (identifier lines 14 through 17).

5.5.4.13. *Photometric Type (Identifier Line 10)*

This integer value indicates the type of photometric web used for the photometric measurements as follows:

1. Type C photometry
2. Type B photometry
3. Type A photometry

Luminaries are photometered by locating the luminaire at the center of an imaginary sphere and measuring the light intensity (candela) values at grid points (the "photometric web') on the sphere's surface. The orientation of the luminary's axes relative to that of the sphere determines the photometric type.

Type C photometry is normally used for architectural and roadway luminaries. The polar axis of the photometric web coincides with the vertical axis of the luminaire, and the 0-180 degree photometric plane coincides with the luminary's major axis (length).

Type B photometry is normally used for adjustable outdoor area and sports lighting luminaries. The polar axis of the luminaire coincides with the minor axis (width) of the luminaire, and the 0-180 degree photometric plane coincides with the luminary's vertical axis.

Type A photometry is normally used for automotive headlights and signal lights. The polar axis of the luminaire coincides with the major axis (length) of the luminaire, and the 0-180 degree photometric plane coincides with the luminary's vertical axis.

It is important to note that these photometric types are *not* clearly defined in IES LM-63. All three versions refer the reader to the IES Lighting Handbook for descriptions of Type A and Type B photometry, and to CIE 27-1973 ("Photometry of Luminaries for Street Lighting") and CIE 43-1979 ("Photometry of Floodlights") for a description of Type C photometry. It then says that "Type C is the form in common use in the United States (although it was formerly referred to as Type A)."

This is in contrast to CIE Publication 102-1993, "Recommended File format for Electronic Transfer of Luminaire Photometric Data," which clearly and unambiguously defines three types of photometry: A (alpha), B (beta), and C (gamma). The diagrams in CIE 102-1993 leave no doubt as to how their photometric webs are oriented with respect to the luminaire. Unfortunately, the IES LM-63 Type A

photometry is equivalent to the CIE 102-1993 Type C photometry, and the IES LM-63 Type C photometry is equivalent to the CIE 102-1993 Type A photometry.

5.5.4.14. Units Type (Identifier Line 10)

This integer value indicates the units used for the dimensions of the luminous opening in the luminaire as follows:

1. Feet
2. Meters

5.5.4.15. Luminous Opening Dimensions (Identifier Line 10)

While the term "luminous opening" is somewhat ambiguous for many architectural luminaries and other light sources, it is useful in calculating average luminaire luminances and modeling the luminaries as homogeneous area light sources.

5.5.4.15.1.   Luminaire Width

This floating point value indicates the distance across the luminous opening of the luminaire as measured along the 90-270 degree photometric plane.

5.5.4.15.2.   Luminaire Length

This floating point value indicates the distance across the luminous opening of the luminaire as measured along the 0-180 degree photometric plane.

5.5.4.15.3.   Luminaire Height

This floating point value indicates the average height of the luminous opening of the luminaire as measured along the vertical axis.

5.5.4.15.4.   Nonrectangular Luminous Openings

The luminous opening is normally considered to be rectangular. However, other predefined shapes can be modeled by specifying one or more of the above dimensions as zero or negative floating point numbers as follows:

Width	Length	Height	Description
0	0	0	Point
w	l	h	rectangular (default)
-d	0	0	Circular (where d = diameter of circle)
-d	0	-d	Sphere (where d = diameter of circle)
-d	0	h	Vertical cylinder (d = diameter of cylinder)
0	l	-d	Horizontal cylinder oriented along lum.length
w	0	-d	Horizontal cylinder oriented along lum.width
-w	l	h	Ellipse oriented along luminaire length
w	-l	h	Ellipse oriented along luminaire width
-w	l	-h	Ellipsoid oriented along luminaire length
w	-l	-h	Ellipsoid oriented along luminaire width

See 5.5.3 IES LM-63-1995 IES for detailed descriptions and diagrams.

5.5.4.16. Ballast Factor (Identifier Line 11)

This floating point value indicates the ratio of the lamp lumens when operated on a commercially-available ballast, to the rated lamp lumens as measured by the lamp manufacturer using a standard (reference) ballast.

All candela values in the photometric data file (identifier lines 14 through 17) must be multiplied by the ballast factor before the candela values are used in an application program.

5.5.4.17. Ballast-Lamp Photometric Factor / Future Use (Identifier Line 11)

In LM-63-1986 and LM-63-1991, this floating point value indicates the ratio of the lamp lumen output using the given ballast and lamp type used to generate a photometric report, to the lumen output of the same luminaire with the ballast and lamp type used for photometric testing.

In LM-63-1995, it was recognized that most lighting manufacturers incorporate the ballast-lamp photometric factor in the preceding ballast factor and set the ballast-lamp photometric factor to unity.

Consequently, the ballast-lamp photometric factor was designated as being for future use and the value set to unity to be compatible with previous releases of LM-63.

All candela values in the photometric data file (identifier lines 14 through 17) must be multiplied by the ballast-lamp photometric factor before the candela values are used in an application program.

5.5.4.18. Input Watts (Identifier Line 11)

This floating point value indicates the total power (measured in watts) consumed by the luminaire, as measured during the photometric test (the input watts value is *not* adjusted by the ballast factor or ballast-lamp photometric factor, even though the power consumption of a luminaire may change if the measured candela values are modified).

5.5.4.19. Vertical Angles (Identifier Line 12)

This line enumerates the (floating point) vertical angles. For Type C photometry, the first vertical angle will be either 0 or 90 degrees, and the last vertical angle will be either 90 or 180 degrees.

For Type A or B photometry, the first vertical angle will be either -90 or 0 degrees, and the last vertical angle will be 90 degrees.

5.5.4.20. Horizontal Angles (Identifier Line 13)

This line enumerates the (floating point) horizontal angles.

For Type C photometry, the first value is (almost) always 0 degrees, and the last value is one of the following:

0°   There is only one horizontal angle, implying that the luminaire is laterally symmetric in all photometric planes;

90°   The luminaire is assumed to be symmetric in each quadrant;

180°   The luminaire is assumed to be bilaterally symmetric about the 0-180 degree photometric plane;

360°   The luminaire is assumed to exhibit no lateral symmetry ([1]).

A luminaire that is bilaterally symmetric about the 90-270 degree photometric plane will have a first value of 90 degrees and a last value of 270 degrees.

For Type A or B photometry where the luminaire is laterally symmetric about a vertical reference plane, the first horizontal angle will be 0 degrees, and the last horizontal angle will be 90 degrees.

---

[1] *This is an error in the draft IES LM-63-1995 standard, because the 360-degree plane is coincident with the 0-degree plane. It should read "greater than 180 degrees and less than 360 degrees"*

For Type A or B photometry where the luminaire is not laterally symmetric about a vertical reference plane, the first horizontal angle will be -90 degrees, and the last horizontal angle will be 90 degrees.

5.5.4.21. Candela Values (Identifier Lines 14 Through 17)

These lines enumerate the (floating point) candela values. There is one line for each corresponding horizontal angle, and one candela value for each corresponding vertical angle.

5.5.5.   IES Standard File Example

The following is an example of an IES LM-63-1995 photometric data file:

The following is an example of an IES LM–63–1995 photometric data file:

```
IESNA:LM-63-1995
[TEST]            ABC1234 ABC Laboratories
[MANUFAC]         Aardvark Lighting Inc.
[LUMCAT]          SKYVIEW 123-XYZ-abs-400
[LUMINAIRE]       Wide beam flood to be used without tilt
[LAMPCAT]         MH-400-CLEAR
[LAMP]            Metal Halide 400 watt
[BALLASTCAT]      Global 16G6031-17R
[BALLAST]         400W 277V MH
[MAINTCAT]        4
[OTHER]           This luminaire is useful as an indirect flood
[MORE]            and to reduce light pollution in down light
[MORE]            applications.
[SEARCH]          POLLUTION SPORTS INDIRECT
[BLOCK]
[LUMCAT]          TENNISVIEW 123-XYZ-abc-400
[LUMINAIRE]       Wide beam flood for indirect applications.
[ENDBLOCK]
TILT=INCLUDE
1
13
0 15 30 45 60 75 90 105 120 135 150 165 180
1.0 .95 .94 .90 .88 .87 .98 .87 .88 .90 .94 .95 1.0
1 50000 1 5 3 1 1 .5 .6 0
1.0 1.0 495
0 22.5 45 67.5 90
0 45 90
10000 50000 25000 10000 5000
10000 35000 16000 8000 3000
10000 20000 10000 5000 1000
```

5.6. Appendix D: EULUMDAT data interchange format

of: Zumtobel Licht's COPHOS Development Team, http://www.cophos.co.at

Synopsis: Proposal for a data format for exchange of luminaire data (interior, exterior, and/or road lighting luminaries) under the operating systems ms-dos 2.xx/3.xx under condition of unequivocal coordination between luminaire and data set...

NOTE: Each of the following fields is an ASCII string that is terminated with an MS-DOS 'CR+LF' pair.

N.	Description	N.character
1	Company ident./data bank/version/format identif.	max. 78
2	Ityp = Type indicator: 1 ... point source with symmetry about the vert.axis 2 ... linear luminaire 3 ... point source with any other symmetry (only linear luminaries, Ityp = 2, are being subdivided in longitudinal and transverse directions)	1
3	Isym = Symmetry indicator: 0 ... no symmetry 1 ... symmetry about the vertical axis 2 ... symmetry to plane C0-C180 3 ... symmetry to plane C90-C270 4 ... symmetry to plane C0-C180 and C90-C270	1
4	Mc = Number of C-planes between 0° e 360° (usually 24 for interior, 36 for road luminaries)	2
5	Dc = Distance between C-planes (Dc = 0 for non-equidistantly available C-planes)	5
6	Ng = Number of luminous intensities in each C-plane (usually 19 or 37)	2
7	Dg = Distance between luminous intensities per C-plane (Dg = 0 for non-equidistantly available luminous intensities in C-planes)	5
8	Measurement report number	max. 78
9	Luminaire name	max. 78
10	Luminaire number	max. 78
11	File name	8
12	Date/user	max. 78
13	Length/diameter of luminaire (mm)	4
14	Width of luminaire b (mm) (b = 0 for circular luminaire)	4
15	Height of luminaire (mm)	4
16	Length/diameter of luminous area (mm)	4
17	b1 = Width of luminous area (mm) (b1 = 0 for circular luminous area of luminaire)	4
18	Height of luminous area C0-plane (mm)	4
19	Height of luminous area C90-plane (mm)	4
20	Height of luminous area C180-plane (mm)	4
21	Height of luminous area C270-plane (mm)	4
22	DFF = Downward flux fraction (%)	4
23	LORL = Light output ratio luminaire (%)	4
24	Conversion factor for luminous intensities (depending on measurement)	6
25	Tilt of luminaire during measurement (road lighting luminaries)	6
26	n = Number of standard sets of lamps (optional, extendable on company-specific basis)	4
26a	Number of lamps	n * 4
26b	Type of lamps	n * 24

26c	Total luminous flux of lamps (lm)	n * 12
26d	Color appearance / color temperature of lamps	n * 16
26e	Color rendering group / color rendering index	n * 6
26f	Wattage including ballast (W)	n * 8
27	DR = Direct ratios for room indices 0.6÷5 (for determination of luminaire numbers according to utilization factor method)	10 * 7
28	Angles C (beginning with 0°)	Mc * 6
29	Angles G (beginning with 0°)	Ng * 6
30	Luminous intensity distribution (cd/klm) (Mc2-Mc1+1)*Ng*6 with: Isym = 0: Mc1 = 1 Mc2 = Mc Isym = 1: Mc1 = 1 Mc2 = 1 Isym = 2: Mc1 = 1 Mc2 = Mc/2+1 Isym = 3: Mc1 = 3*Mc/4+1 Mc2 = Mc1+Mc/2 Isym = 4: Mc1 = 1 Mc2 = Mc/4+1	

5.6.1. EULUMDAT Standard File Example

The following is an example of an EULUMDAT photometric data file (the file is splitted into 4 columns for clarity):

```
LED                0.86265        0.0        3432.3
2                  0.88517        3.0        1260.4
1                  0.91294        6.0        478.3
24                 0.92490        9.0        254.6
15                 0.93917        12.0       174.4
31                 0.94937        15.0       137.3
3.0                0.95872        18.0       117.1
LED00004           0.96163        21.0       103.7
Ipotesi 2S MH-T    0.96680        24.0       87.5
--                 0              27.0       74.5
LED00004           15             30.0       67.3
21.12.90/Lue       30             33.0       61.6
300                45             36.0       55.6
180                60             39.0       38.2
160                75             42.0       12.4
244                90             45.0       4.2
146                105            48.0       2.2
0                  120            51.0       2.0
0                  135            54.0       1.9
0                  150            57.0       1.9
0                  165            60.0       0.3
100                180            63.0       0.0
51.9               195            66.0       0.0
1.0                210            69.0       0.0
0.0                225            72.0       0.0
1                  240            75.0       0.2
1                  255            78.0       0.0
CDM-T 70W/83       270            81.0       0.0
6200.0             285            84.0       0.0
–                  300            87.0
–                  315            90.0
0.0                330            7296.4
0.83282            345            6035.9
```