How to use Dialux?
What is it?

• DIALux is continuously being developed by a team of 20. You can plan in DIALux with the luminaires of the world's leading manufacturers and therefore have the greatest possible freedom in the design process. And the list of international partner companies is getting longer and longer.
Your benefits at a glance:

- Simple, effective and professional light planning
- Latest luminaire data of the world's leading manufacturers
- Latest state of the art software always available free of charge
- Energy evaluation at the drop of a hat
- Coloured light scenes with LED or other colour changing luminaires
- Planing whole buildings including outdoors spaces*
Flow chart for light planning

1. Analysis of the planning objective
   • Define the activities and different visual work that may be performed in the premises at different times of the day.
   • Define the lighting demands with regard to safety, visual needs and the visual experience.
   • Examine the need for emergency lighting. Define the aims for energy consumption, environment and maintenance of the lighting installation.

2. Analysis of planning conditions
   • Define applicable provisions, standards, recommendations as well as special demands from the client and users.
   • Define the conditions for lighting the room, the type of workplace and its working area, etc.
   • Investigate the conditions for the premises’ design, furnishings, type of monitors, flexibility, daylight and the character of the premises.
   • Establish the economic prerequisites for the installation and the maintenance conditions for the lighting installation.

3. Overall planning
   • Investigate the conditions for interaction between electric light and natural daylight. Check the possibility of daylight screening.
   • Investigate which light sources, luminaires and lighting systems best satisfy the demands aims and conditions.
   • Investigate the control possibilities for the lighting to increase comfort and improve energy usage.
   • Investigate the overall co-ordination with other installations, colour setting and furnishings.
4. Detailed planning
- Evaluate the different lighting systems; technically, visually and economically.
- Establish the lighting system’s optimal maintenance factors taking the maintenance conditions into consideration.
- Make a financial evaluation by calculating the life cycle costs based on the investment, operation and maintenance.
- Compare the selected lighting systems with regard to other installations, colour setting, furnishings and the chosen equipment.

5. Documentation
- Should be prepared as shown below with supplements according to the client’s wishes.
- Include Installation drawings, control and assembly instructions as well as associated lists of light sources and luminaires.
- Lighting calculations and visualisations that verify under which conditions the system operates to the specified demands. Present calculation prerequisites and the lighting system’s maintenance plan.
- Present calculation prerequisites and the lighting system’s maintenance plan.
New project

New interior project
New exterior project
New street project
Toolbar
Set up the dimensions

- Room editor - Change dimension
Set up the room properties
Set up the room properties

- Name
- Material
- Texture
Data base

- Downloaded catalogues
- Online catalogues
Luminaire, mounting, arrangement
Calculating and results
Summary

Pozitia suprafeței în spațiu:
Punct marcat: (0.000 m, 0.000 m, 0.760 m)

Raster: 64 x 64 Puncte

<table>
<thead>
<tr>
<th>$E_m$ [lx]</th>
<th>$E_{min}$ [lx]</th>
<th>$E_{max}$ [lx]</th>
<th>$u_0$</th>
<th>$E_{min}/E_{max}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>809</td>
<td>265</td>
<td>1395</td>
<td>0.328</td>
<td>0.190</td>
</tr>
</tbody>
</table>

Valoare în Lux, Scară 1 : 40
How to interpret the standard output generated by DIALux

- Quantities, units and their significance

<table>
<thead>
<tr>
<th>Quantity/Concept</th>
<th>Symbol</th>
<th>Unit</th>
<th>Formula</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luminous intensity</td>
<td>I</td>
<td>candela (cd)</td>
<td>I=Φ/ω</td>
<td>Luminous intensity is the intensity in a determined direction. Definition: Luminous flux per solid angle (ω).</td>
</tr>
<tr>
<td>Illuminance</td>
<td>E</td>
<td>Lux (lm/m²)</td>
<td></td>
<td>Illuminance refers to the luminous flux that hits a specific surface. Definition: Luminous flux per unit area (m²).</td>
</tr>
<tr>
<td>Luminance</td>
<td>L</td>
<td>(cd/m²)</td>
<td>L=I/A (L=I/Acosω)</td>
<td>This is defined as the luminous intensity in a specific direction from a surface of a light source, luminaire or lit surface, divided by the projected area.</td>
</tr>
<tr>
<td>Luminous flux</td>
<td>Φ</td>
<td>lumen (lm)</td>
<td>Φ=I/ω</td>
<td>Luminous flux refers to the total amount of light emitted from a light source. It is defined as the amount of light emitted when the light source’s radiant luminous flux, is evaluated against the eye’s sensitivity in daylight (JL-curve according to CIE).</td>
</tr>
<tr>
<td>Design lumen</td>
<td>Φ_b</td>
<td>lumen</td>
<td></td>
<td>Refers to the light source’s luminous flux that is emitted at an ambient temperature of 25 °C. The quoted luminous flux may differ from the light source’s maximum luminous flux.</td>
</tr>
<tr>
<td>Design efficiency</td>
<td>η_b</td>
<td></td>
<td></td>
<td>The design efficiency of the luminaire is used in lighting calculations together with the design lumen for the light source. The design efficiency includes the correction for BLF when measuring the luminaire and light source in an ambient temperature of 25 °C. η_b = η_measured x BLF.</td>
</tr>
<tr>
<td>Ballast Lumen Factor</td>
<td>BLF</td>
<td>–</td>
<td>–</td>
<td>Defines the luminous flux from a light source. It is measured with either a commercial ballast or a reference ballast, at an ambient temperature of 25°C.</td>
</tr>
<tr>
<td>Quantity</td>
<td>Symbol</td>
<td>Unit (SI)</td>
<td>Standard</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>--------</td>
<td>-----------</td>
<td>----------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Colour temperature</td>
<td></td>
<td>kelvin (K)</td>
<td>CIE 17.4</td>
<td>Colour temperature is the colour impression of a light source. A warm colour temperature is &lt;4000 K and a cold colour temperature is &gt;4000 K. A single unit of Kelvin (K) is equal to 0°C, e.g. 273.17 K = 0°C.</td>
</tr>
<tr>
<td>Colour reproduction index</td>
<td>Ra</td>
<td>R_a-index</td>
<td>CIE 17.4</td>
<td>Is the measurement of a light source's ability to reproduce colour compared to a reference light source at a predetermined colour temperature. An Ra index is used for graduation, which according to CIE, can be at the most 100 and shall for lighting workplaces be a minimum of 80.</td>
</tr>
<tr>
<td>Luminous efficacy - light source</td>
<td>H</td>
<td>(Im/W)</td>
<td>η=Φ/P</td>
<td>The luminous efficacy from a light source can be defined as the relationship between the luminous flux emitted by a light source and the electrical output it consumes. Luminous efficacy can also be described as a measurement of light source efficiency.</td>
</tr>
<tr>
<td>Luminous efficacy - system (light source + ballast)</td>
<td>H</td>
<td>(Im/W)</td>
<td>η=Φ/P</td>
<td>The system luminous efficacy from a light source can be defined as the relationship between the luminous flux emitted by a light source and the electrical output it consumes including ballast losses.</td>
</tr>
<tr>
<td>Glare</td>
<td></td>
<td></td>
<td>CIE: 31, 112, 117</td>
<td>Is a visual impairment caused by the extreme contrast or inappropriate distribution of luminance levels. Glare is normally subdivided into:- discomfort glare UGR/NB - disability glare TI/GR.</td>
</tr>
<tr>
<td>Uniformity</td>
<td></td>
<td></td>
<td>E_min/E_ave, L_min/L_ave</td>
<td>Ratio between the lowest value and the average value of brightness on a specific surface.</td>
</tr>
<tr>
<td>Luminaire luminance</td>
<td></td>
<td></td>
<td></td>
<td>The average luminance of a luminaire’s luminous parts measured and/or calculated in the C-plane at 15° intervals starting at 0°, and elevation angles (γ) of 65°, 75° and 85°. Usually the manufacturer will provide this data, based on the light source’s total nominal luminous flux in the luminaire.</td>
</tr>
<tr>
<td>Shielding angle (for luminaire’s light source)</td>
<td></td>
<td></td>
<td></td>
<td>The angle between the horizontal plane and the first line of sight at which any part of the luminaire’s light source becomes directly visible.</td>
</tr>
<tr>
<td>Cut-off angle (for luminaires)</td>
<td></td>
<td></td>
<td></td>
<td>The angle between the luminaire’s vertical axis &amp; the point at which the light source &amp; surfaces of high luminance are not visible.</td>
</tr>
<tr>
<td>Solid angle</td>
<td>ω</td>
<td>steradian (sr)</td>
<td>ω=A/r²</td>
<td>The angle subtended by an area at a point and equal to the quotient of the projected area on a sphere, centered on the point, by the square of the radius of the sphere.</td>
</tr>
</tbody>
</table>
General advice

- The following points should be considered in order to create low energy usage in a lighting installation:
  - selection of light sources with optimal luminous efficacy for the required colour reproduction.
  - energy efficient lighting system with installed lighting output suitable for the required task.
  - efficient luminaires with the correct light distribution and good cut-off properties.
  - efficient utilisation of daylight.
  - efficient utilisation of artificial and natural light through the selection of a light interior colour scheme.
  - control of lighting through presence detection.
  - possibility of localised control by the individual.
  - high frequency operation with dimming.
  - well planned maintenance of the lighting installation to obtain a high maintenance factor.
Workplace lighting

• The values stated in the collection of tables, refer to the lowest illuminances in the workspace of a visual object, that can be either horizontal, vertical or placed at an angle.

• The demands on illuminances used in the workplace, should be regularly reviewed to overcome the following situations:
  • difficult working conditions
  • activities that demand great accuracy or high productivity
  • impairment of visual efficiency
  • viewing objects with fine detail or in low contrasts of light
  • using DSE terminals for long periods of time
Principles for establishing the working area and surrounding calculation surfaces

Relations between different illuminances and uniformity demands

<table>
<thead>
<tr>
<th>Illuminance within the working area</th>
<th>Illuminance within the immediate surroundings</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥750 lx</td>
<td>500 lx</td>
</tr>
<tr>
<td>500 lx</td>
<td>300 lx</td>
</tr>
<tr>
<td>300 lx</td>
<td>200 lx</td>
</tr>
<tr>
<td>≤ 200 lx</td>
<td>200 lx</td>
</tr>
</tbody>
</table>

Uniformity $\left( \frac{E_{\min}}{E_{\text{ave}}} \right) \geq 0.7$

Uniformity $\left( \frac{E_{\min}}{E_{\text{ave}}} \right) \geq 0.5$

Table of uniformity demands and the relation between illuminances within the immediate surroundings of the working area.

Example of the workspace for a typical workplace.

Working area $(l_a \times w_a)$
Size and position are established by the light planner.

Immediate Surrounding area $(l_o \times w_o)$
The size to be established by the light planner.

$(l_a+2x\geq0.5m) \times (W_a+2x\geq0.5m)$

Outer surrounding area
0.5 metres from the room’s walls.
Glare

- Glare can be divided into:
  - Disability glare
  - Discomfort glare
- Calculation of the glare index
  The degree of discomfort glare for indoor installations can be estimated by calculating the glare index according to the UGR method. The UGR glare index for discomfort glare is ranked on a scale, which in practice runs from 13 to 28 where the higher the glare index the higher the level of glare. The smallest change in the glare index denoting a significant difference is 3.
- Reflections from reflective materials or reflective glare can usually be prevented with the following actions:
  - Suitable luminaire positioning.
  - Selecting luminaires with low luminous intensity and effective screening.
  - Selecting matt materials for reflective surfaces.
  - Selecting luminaires with a larger surface area.
  - Select light colours for ceilings and walls.
Luminance distribution and luminance limitations

• A well-balanced luminance for adaption is essential to increase:
  • The visual clarity.
  • Contrast sensitivity (ability to detect small differences in luminance).
  • The effectiveness of the eye’s ocular functions (e.g. accommodation, convergence, pupillary contraction, eye movements, etc.).

• The following should be avoided:
  • High luminances that can cause glare.
  • Large luminance contrasts that cause visual tiredness where the eye tries to continuously adapt.
  • Low luminance contrasts, which result in a staid atmosphere that does not stimulate.

<table>
<thead>
<tr>
<th>Room surface</th>
<th>Reflectance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling</td>
<td>0,6-0,9</td>
</tr>
<tr>
<td>Walls</td>
<td>0,3-0,8</td>
</tr>
<tr>
<td>Workspaces</td>
<td>0,2-0,6</td>
</tr>
<tr>
<td>Floor</td>
<td>0,1-0,5</td>
</tr>
</tbody>
</table>
Visual evaluation of lighting systems in work areas

<table>
<thead>
<tr>
<th>Concept</th>
<th>Description</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light level</td>
<td>- whether it is dark or light in the room or at the workplace?</td>
<td>dark - light</td>
</tr>
<tr>
<td>Light distribution</td>
<td>- how is the light distributed in the room or at the workplace?</td>
<td>varied - equally</td>
</tr>
<tr>
<td>Light colour</td>
<td>- is the light colour experienced as warm or cold?</td>
<td>warm - cold</td>
</tr>
<tr>
<td>Colour</td>
<td>- how are the colours and objects viewed?</td>
<td>distorted - natural</td>
</tr>
<tr>
<td>Glare</td>
<td>- does unpleasant glare occur?</td>
<td>troublesome - not noticeable</td>
</tr>
<tr>
<td>Shadows</td>
<td>- whether they are hard or soft?</td>
<td>hard - soft</td>
</tr>
<tr>
<td>Reflections</td>
<td>- whether they are intense or diffuse?</td>
<td>intense - diffuse</td>
</tr>
</tbody>
</table>
Light distribution curve

Symmetrical light distribution
A 28W fluorescent lamp (2600 lm) gives, in a straight down direction, approximately 375 cd/km.

Asymmetrical light distribution
At a maximum luminous intensity angle of 25° a 28W fluorescent lamp gives approximately 580 cd/km.

Combined diagram for spotlights

Isolux diagram

Cut-off angle
Half beam intensity angle
Luminous intensity [cd]
Illuminance (lx)

Half beam angle
Shielding angle
42°
35°
Interpretation of the calculation result.

1. Scrutinize carefully
   • To prevent glare - check the luminance conditions in the room.

2. Maintenance factor
   • Has the maintenance factor been adapted to a maintenance plan for the lighting installation?
   • NOTE - the maintenance factor affects the lighting system’s energy consumption.

3. Calculation conditions
   • Have the conditions for the lighting calculations been checked?
   • Has the size of the working area and immediate surroundings been established?
   • Has the calculation area for the peripheral area been defined?
   • Have the room surfaces’ reflectance values been checked?
   • Has the luminaire’s average luminance been checked in rooms used for monitor work?

4. Uniformity demands.
   • When calculating the illuminance uniformity i.e. the ratio between the minimum value and the average value in the working area and the immediate surroundings, it is important that the distance between the calculation points is documented. For normal working areas a maximum spacing of 0.25 metres between calculation points applies.

5. Graduation implication
   • Use the scales for illuminances and luminances stated in the standard EN 12464-1.

6. UGR-glare index.
   • Check, where appropriate, that the system’s average glare index conforms to the value stated in the standard.
Bibliography

• Lighting planning
  • http://www.fagerhult.sk/products/technical-info/documents/FAGERHULT_belysningsplanering_UK.pdf

• Dialux basic tutorial:
  • http://www.youtube.com/watch?v=oOITu-qMk6A