

DESL

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Lighting design through simulations

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Introduction

LIGHTING

Private usage

Flats, Houses



Public usage

Companies, institutions, schools, shops etc.



Introduction

Lighting for private usage

Flats, Houses



- Luminaire is usually bought **without a light source.**
- User installs a (E27) light source (bulb).
- User **can change** a light source to get more/less luminous flux.
- **Easy adaptation** to the needs of the user.
- User's needs are **subjective.**
- Changes are **possible** after installation



Introduction

Lighting for public usage

**Companies, institutions,
schools, shops**



- Luminaire is usually delivered **with a light source.**
- User **cannot change** a light source to get more/less luminous flux.
- **Difficult** adaptation to the needs of the user.
- User's needs are **objective.**
- Practically **no changes possible** after installation.



Introduction

Lighting

Private usage

- **Easy adaptation** to the needs of the user.
- User's needs are **subjective**.
- Changes **are possible** after installation

Public usage

- **Difficult** adaptation to the needs of the user.
- User's needs are **objective**.
- Practically **no changes possible** after installation.

Simulations?

NO!

(Maybe rendering)

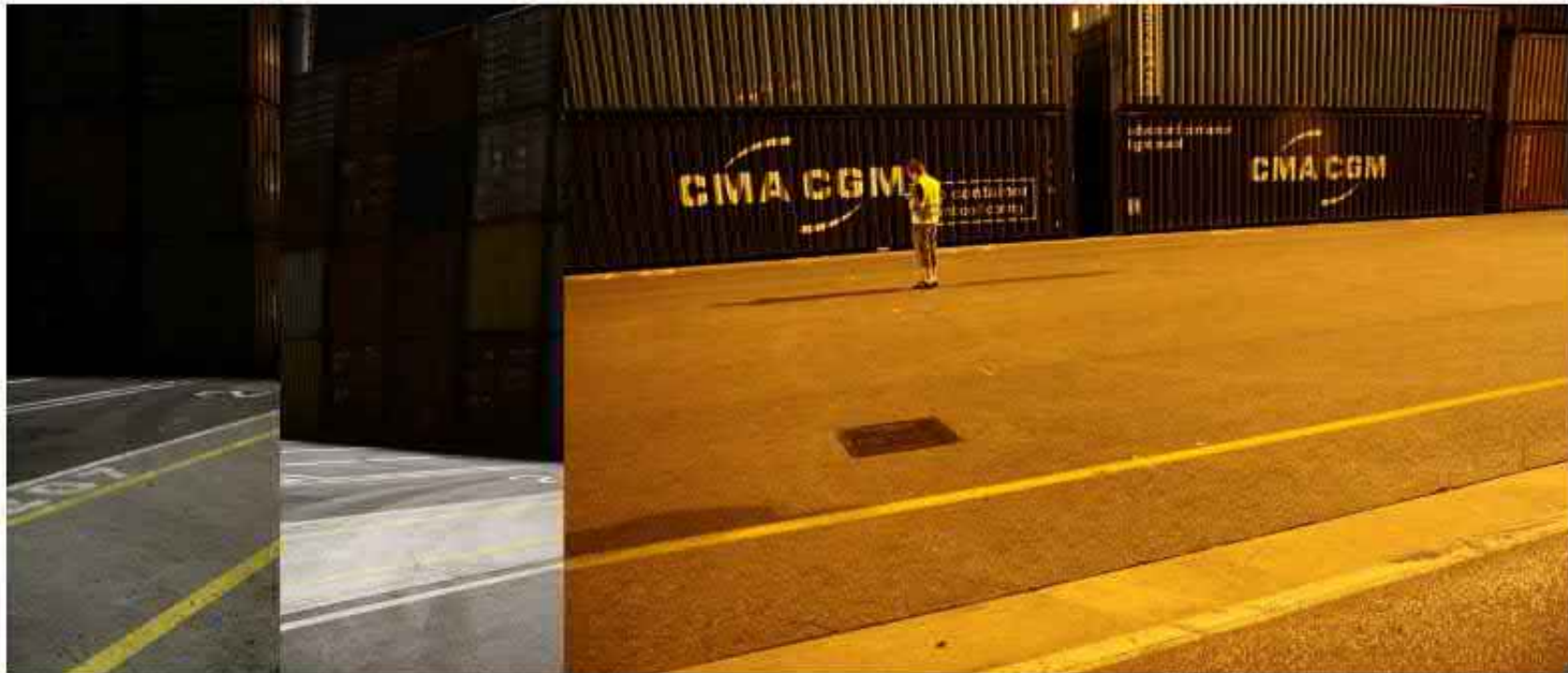
YES!

(Compulsory)



Why simulations?

- Evaluate the lighting in the planning/designing phase
- Eliminate further measurements if measurements could be dangerous.



Simulations - Steps

1. Identify lighting requirements.



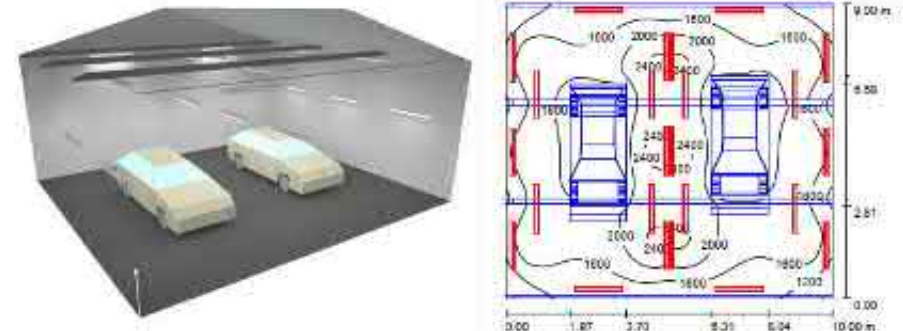
2. Select lighting equipment.



3. Model the physical space.



4. Setup and run simulation.



Step no. 1 - Identify lighting requirements

Space

- analysis of the physical space
- lighting requirements based on the type of **visual task**



Standards

- Provide **recommendations** and minimum **requirements**
 - Illuminance/luminance levels
 - Uniformity
 - Glare
 - Colour rendering index
 - Optional: CCT, dimming...



Step no. 1 - Identify lighting requirements

Standards provide minimum requirements for different lighting quality criteria

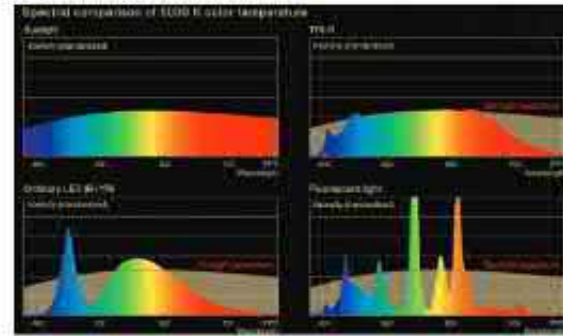
- **Lighting of workspaces - indoor**
 - EN 12464/1 Light and lighting - Lighting of work places
 - ISO 8995-1/CIE S 008 Lighting of work places
- **Lighting of workspaces - outdoor**
 - EN 12464/2 Light and lighting - Lighting of work places
 - CIE S 015 Lighting of outdoor work places
 - ISO/CIE 8995-3 Lighting of Work Places – Part 3: Lighting Requirements for Safety and Security of Outdoor Work Places
- **Street lighting**
 - EN 13201 Road lighting
 - CIE 115:2010 Lighting of roads for motor and pedestrian traffic
- **Daylight**
 - EN 17037 CEN European Daylight Standard ()



Step no. 2 - Select lighting equipment

Selection of:

- Light sources
 - spectra
 - CCT
 - CRI



- Luminaires



- Control equipment (not compulsory for simulations)



Step no. 2 - Select lighting equipment

Technical specifications of luminaires

Manufacturers (usually) provide technical information of luminaires in next formats:

- *LDT file – ELUMDAT file format*
- *IES file - Illuminating Engineering Society (IES) LM-63-02*

- ULD file – DIALux file format
- ROLF file – Relux File format
- ZPF file – ecoCALC, Vivaldi, DALEC, HILITE
- BIM object – REVIT,.....

**If your file is not online-
you don't exist**

DIALux
RELUX®

 **VIVALDI**
Lighting soft

ecoCALC

DALEC
Building Energy under Control



AUTODESK
REVIT



Step no. 2 - Select lighting equipment

Photometric data of luminaires (in the file)

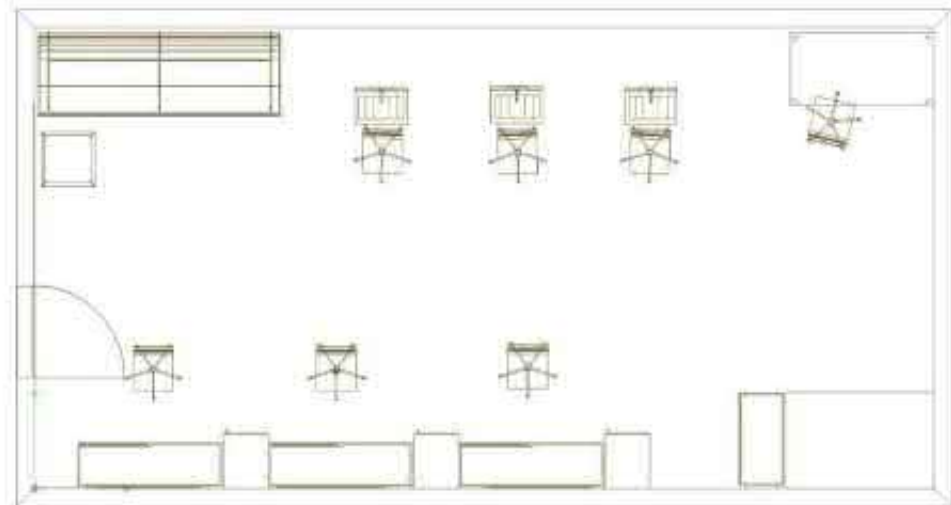
- spatial luminous intensity distribution
 - size of luminaire
 - size of luminous area
 - symmetry
 - luminous flux
 - colour temperature (CCT)
 - colour rendering index (CRI)
 - electrical power
- *LDT file*
– *IES file*
- logo of the company
 - image of the luminaire
 - 3D model of the luminaire
- ULD file
– ROLF file
– ZPF file
– BIM object



Step no. 3 – Model of a space

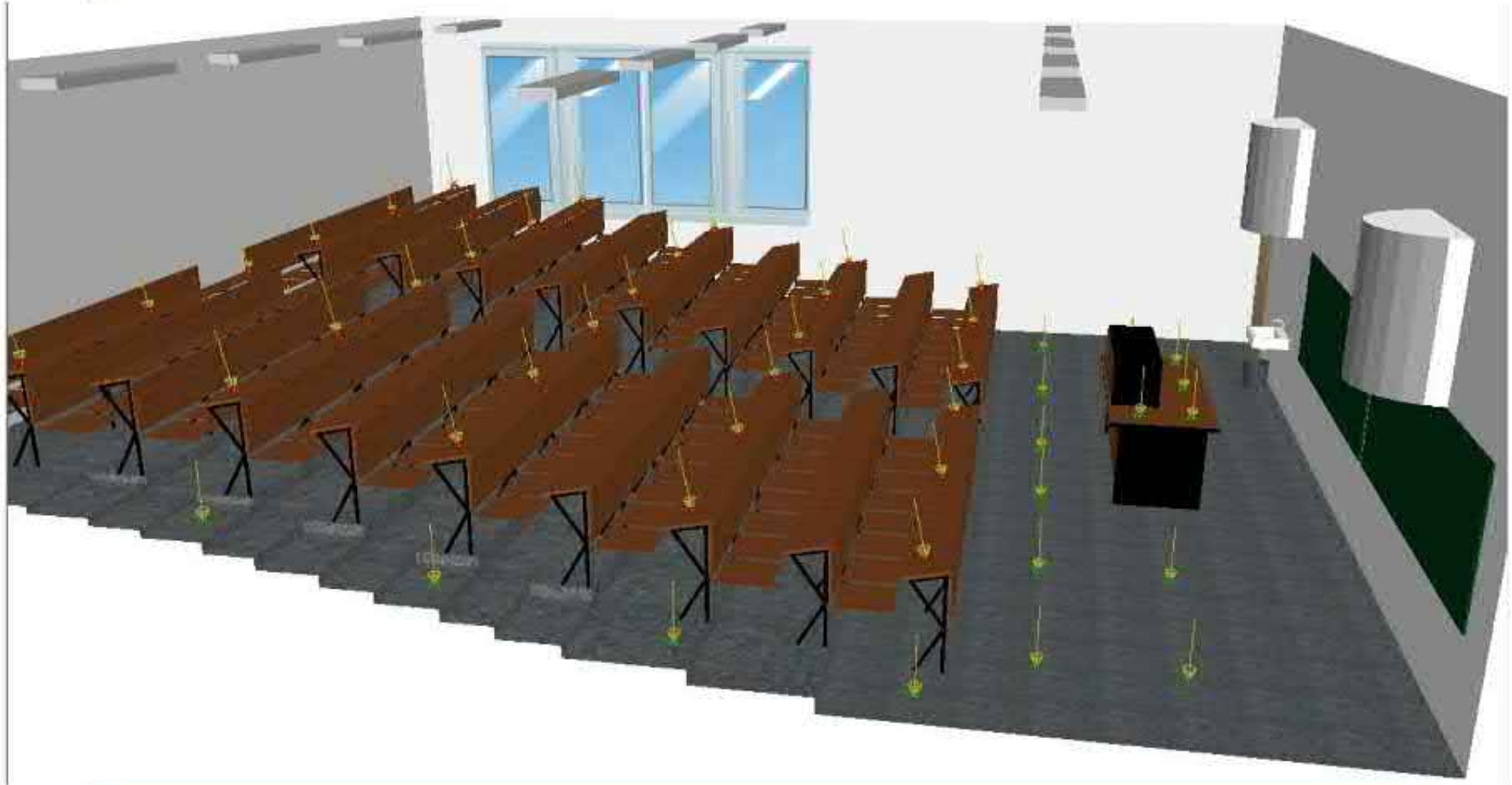
Creating of a space depends on the visual task

- Indoor workspace
- Outdoor workspace
- Street lighting
- Outdoor lighting (parks, gas stations...)



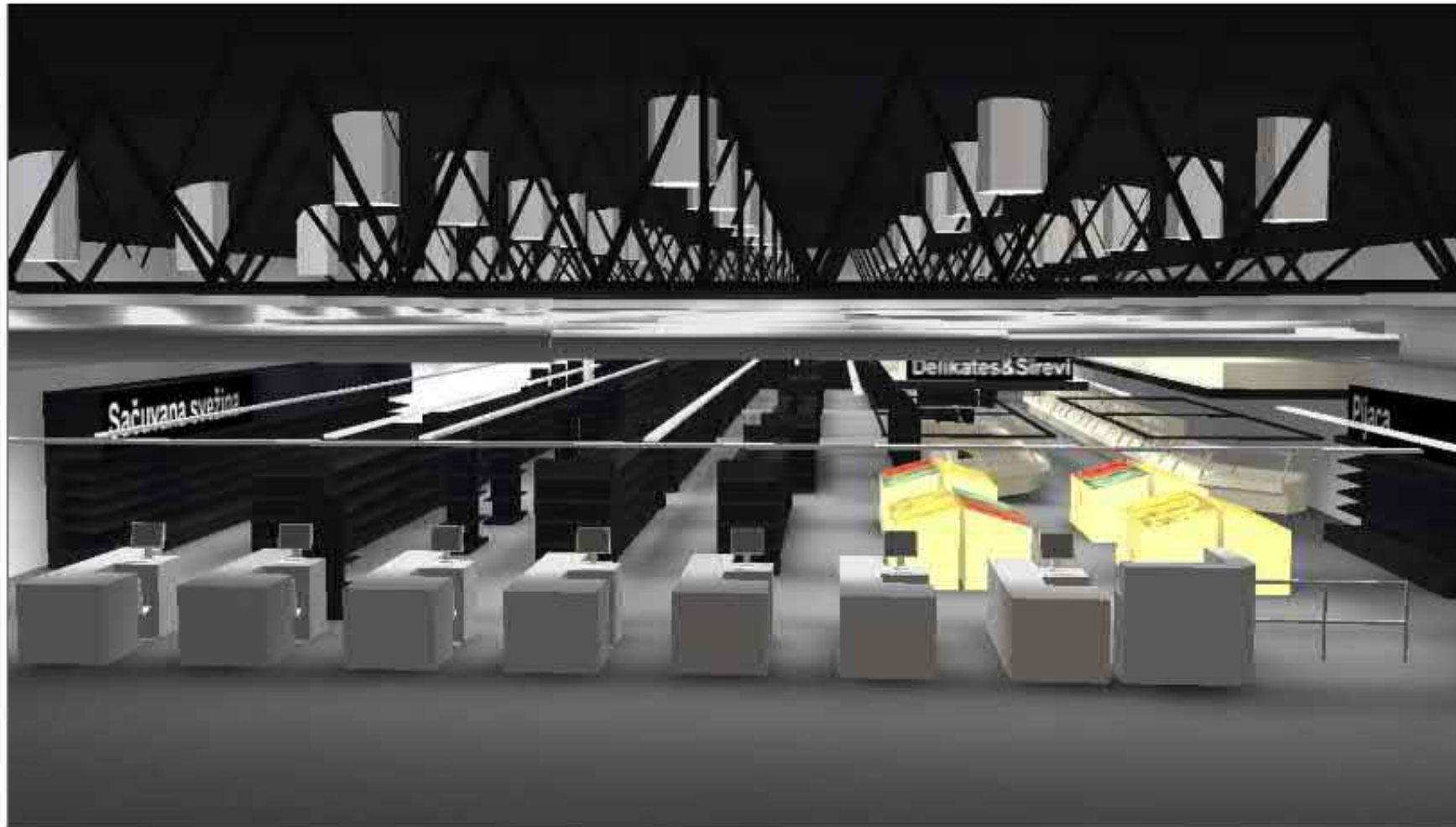
Step no. 3 – Model of an indoor workspace

Space



Step no. 3 – Model of an indoor workspace

Shop



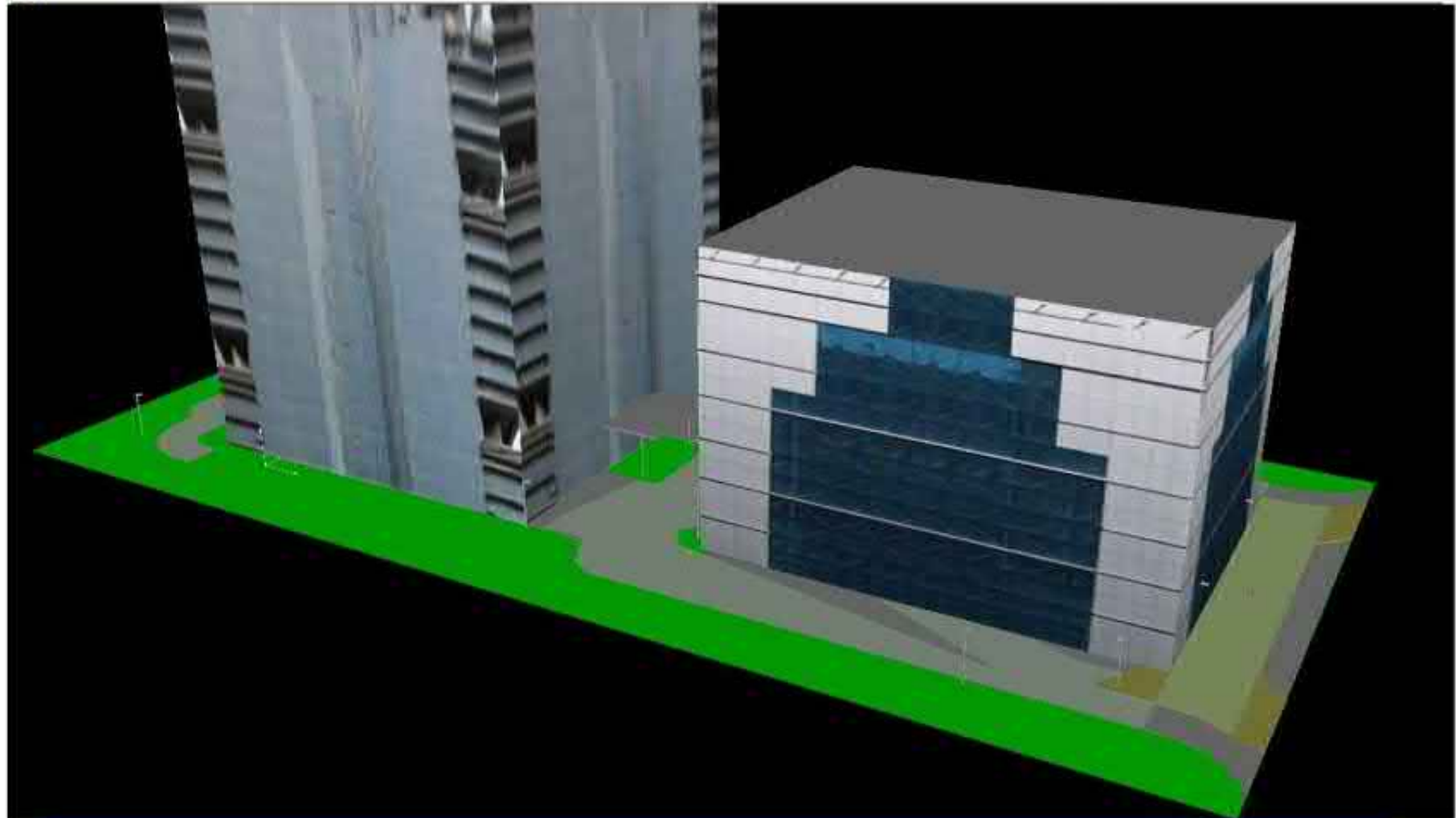
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Step no. 3 – Model of an outdoor workspace

Space



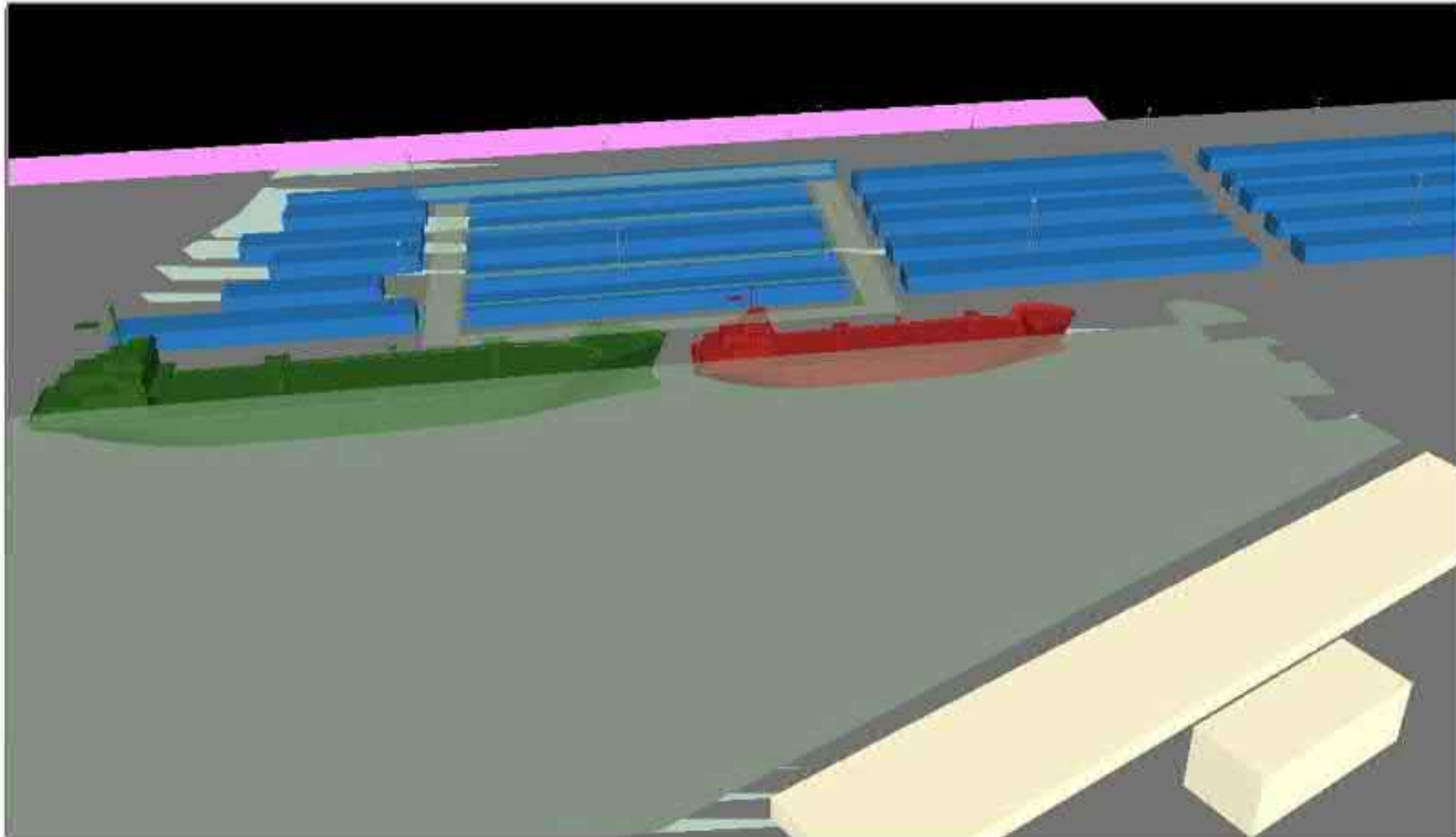
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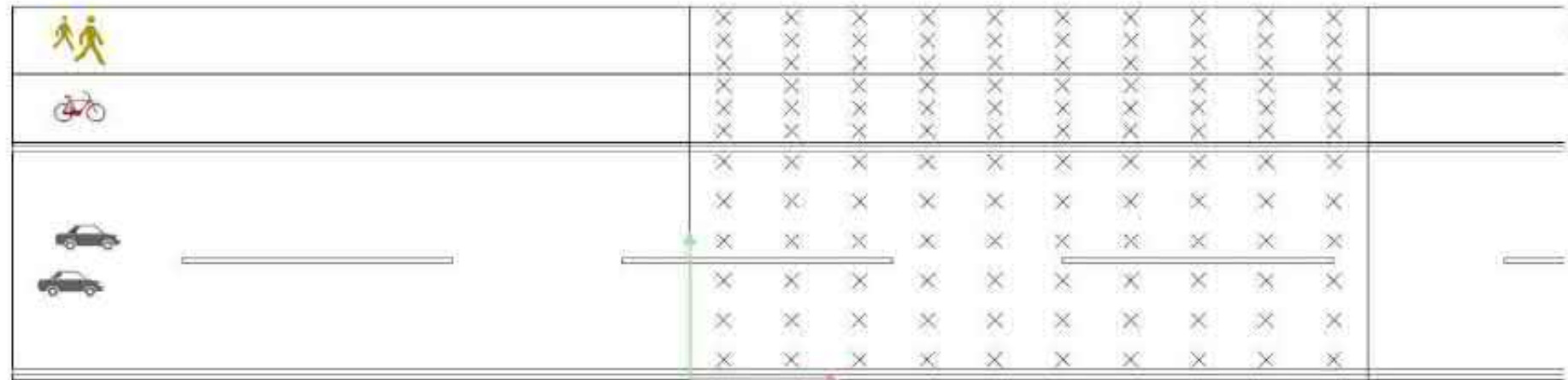
Step no. 3 – Model of an outside area

Space



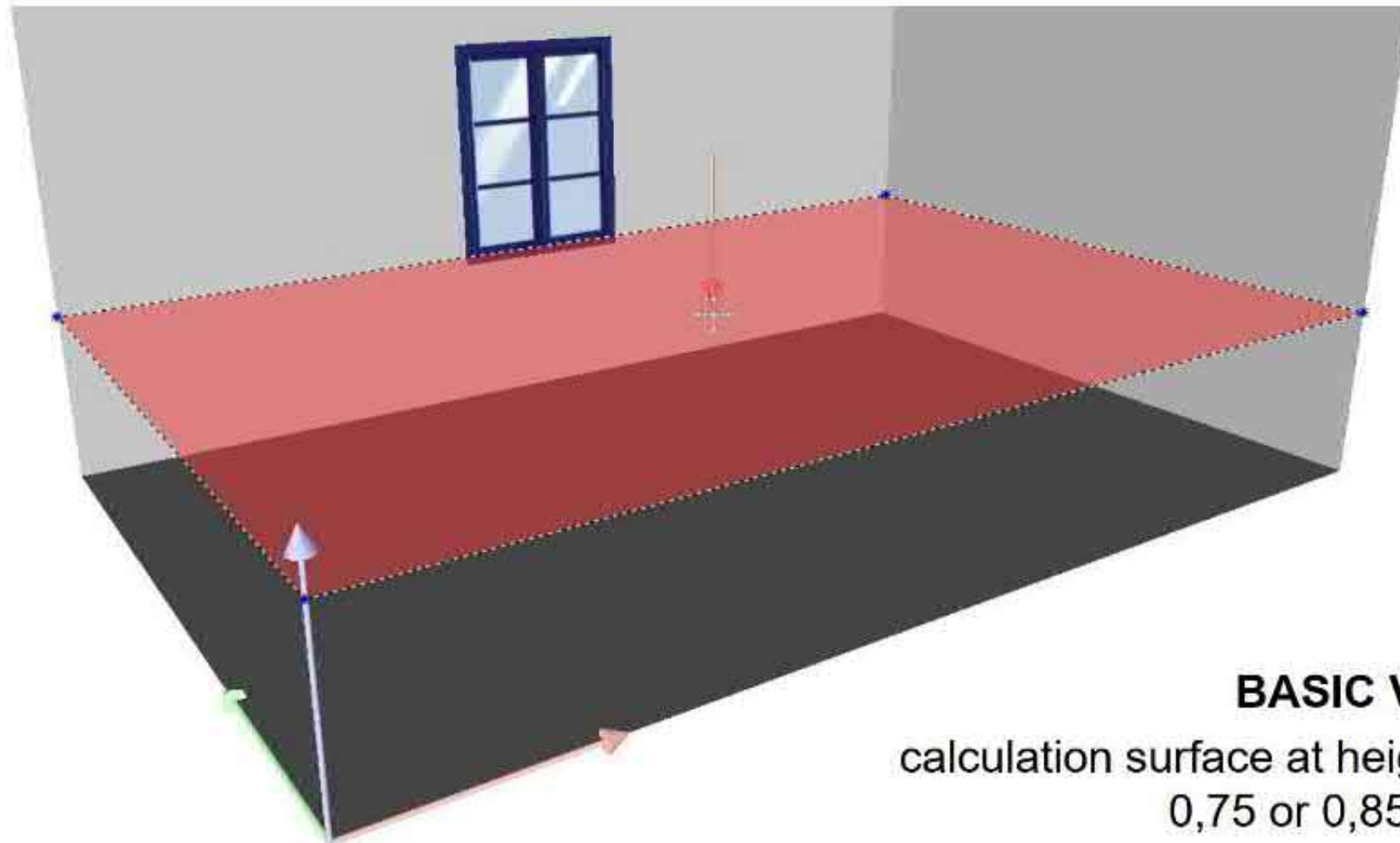
Step no. 3 – Model of a street

Space



Step no. 3 – Model of a space

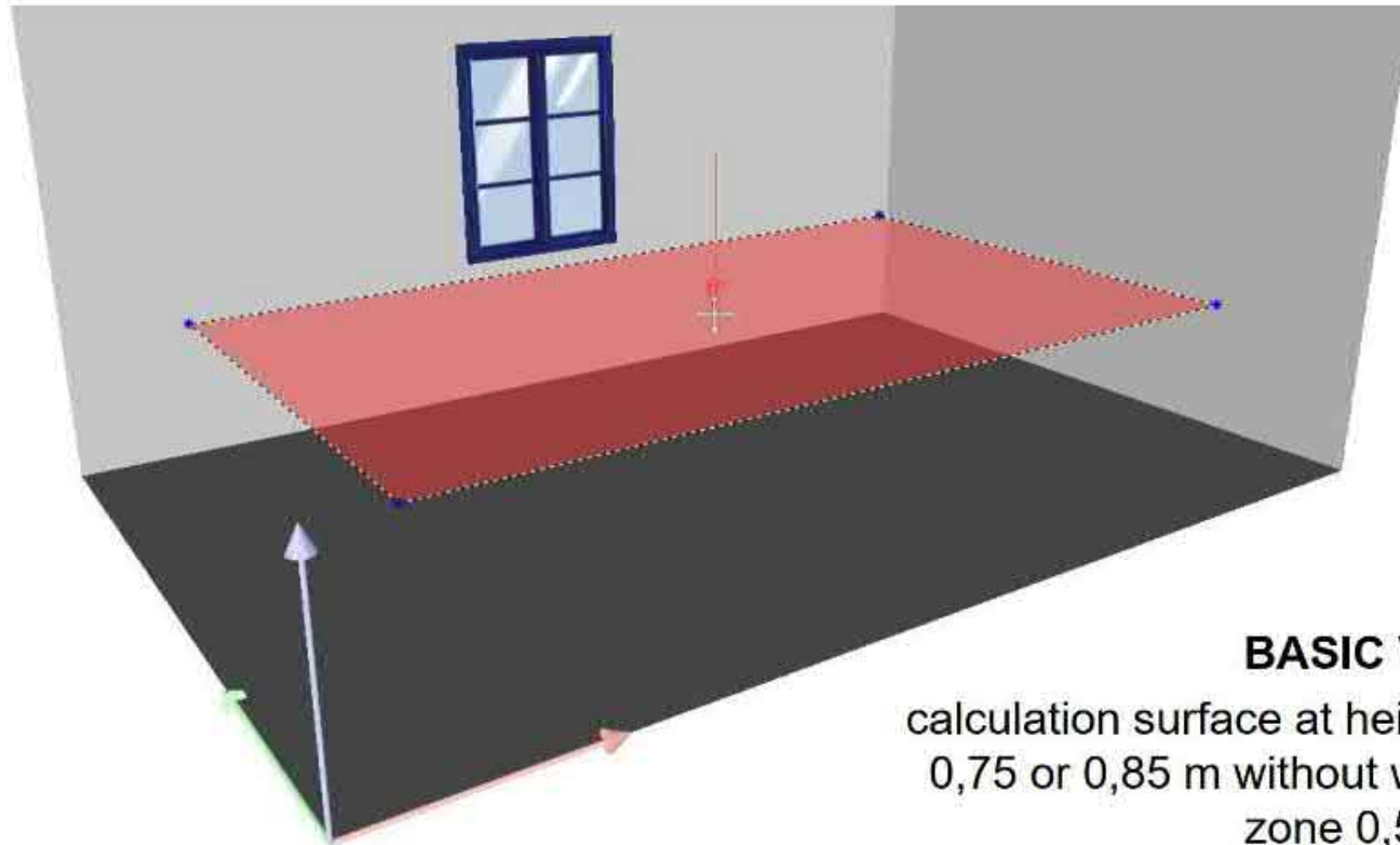
Add **visual tasks** (calculation surfaces)



BASIC V1:
calculation surface at height
0,75 or 0,85 m

Step no. 3 – Model of a space

Add **visual tasks** (calculation surfaces)



BASIC V2:

calculation surface at height
0,75 or 0,85 m without wall
zone 0,5 m

Step no. 3 – Model of a space

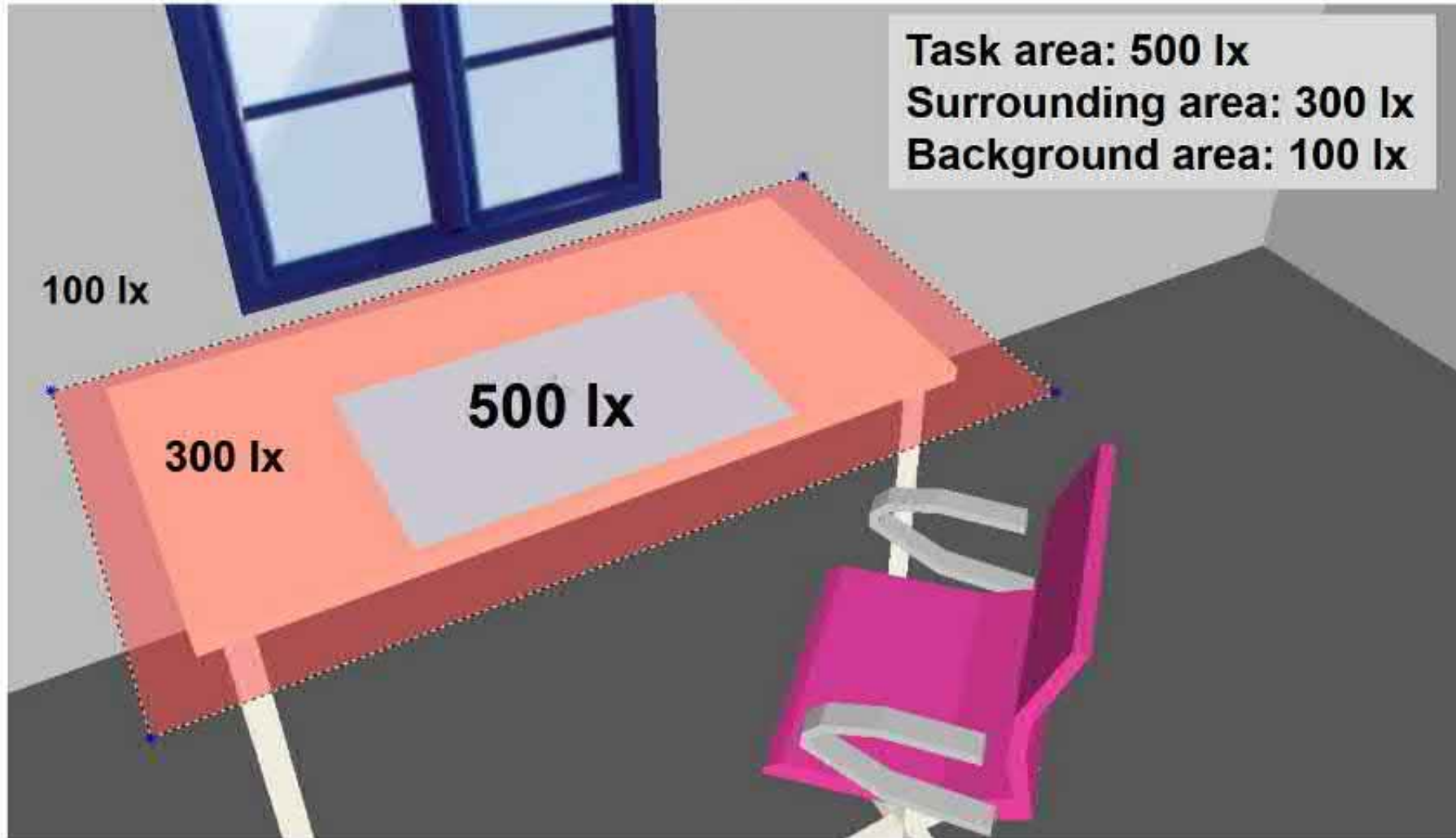
Add **visual tasks** (calculation surfaces)



INTERMEDIATE:
calculation surface over desk

Step no. 3 – Model of a space

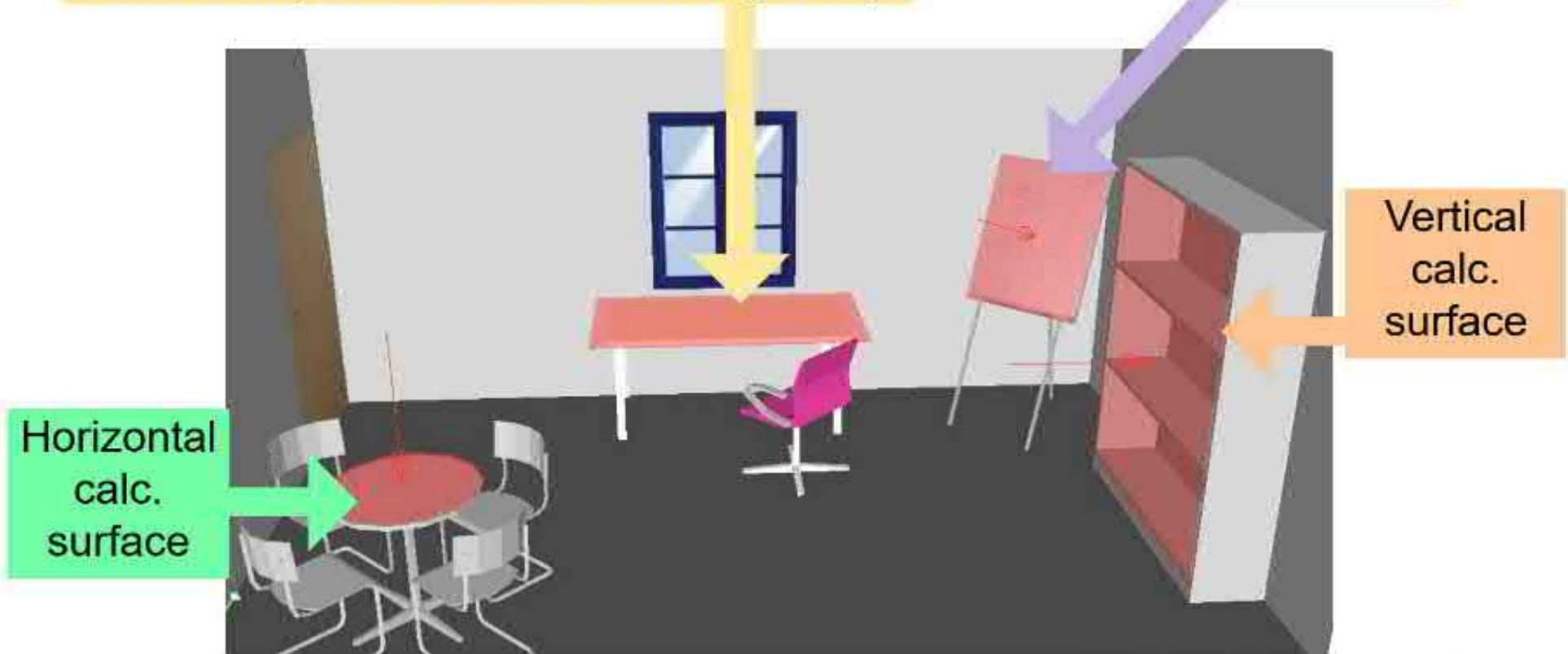
Add **visual tasks** (calculation surfaces)



Step no. 3 – Model of a space

Add **visual tasks** (calculation surfaces)

Task area (task area + surrounding area)



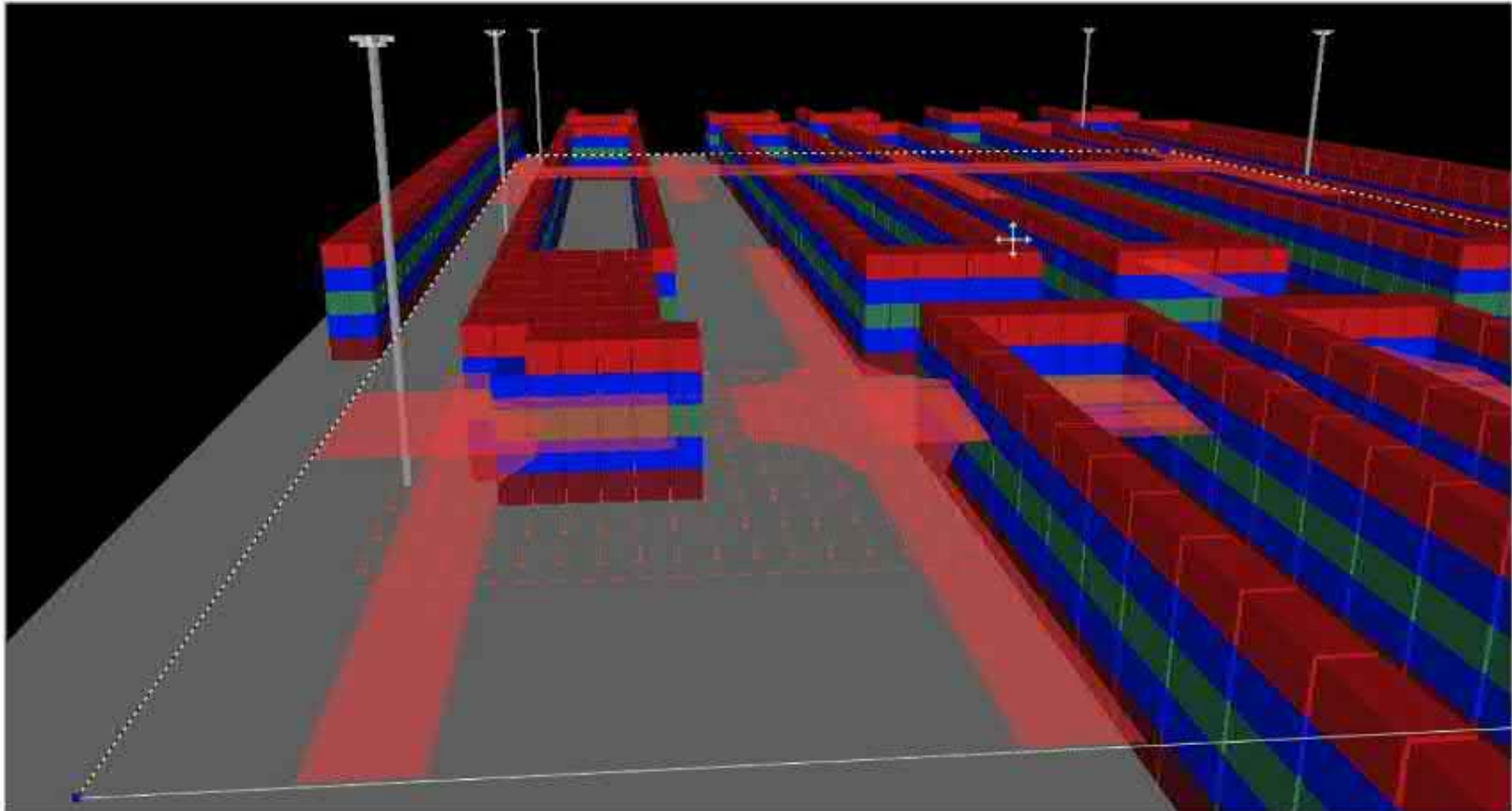
Real Professional:

Calculation surfaces over all visual tasks



Step no. 3 – Model of a space

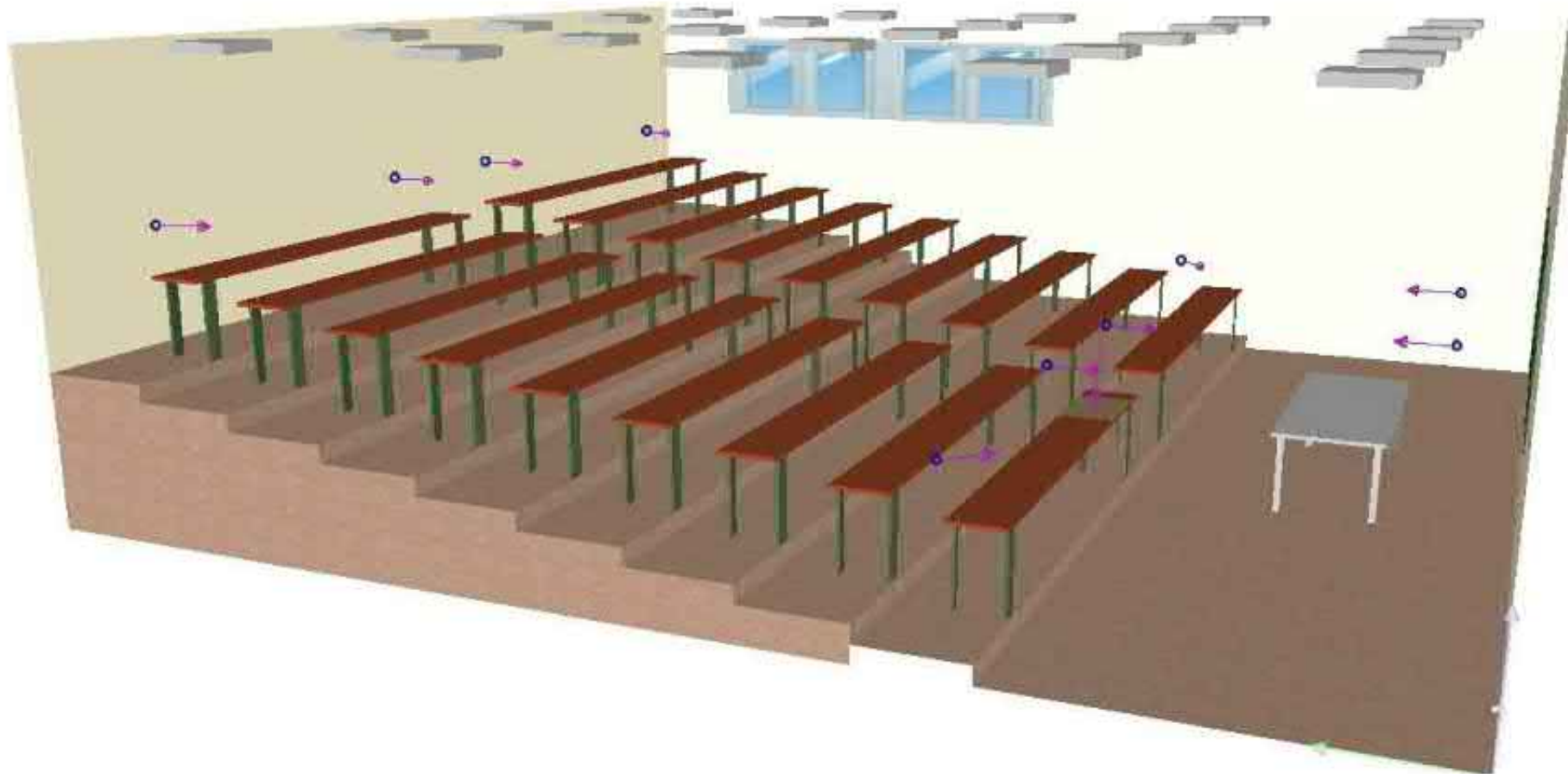
Add **visual tasks** (calculation surfaces and/or points)



Step no. 3 – Model of a space

Add other lighting quality descriptors

Add calculation points for UGR



Sitting position

Standing position

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Step no. 3 – Model of a space

Add calculation points for **cylindrical / semi-cylindrical / hemispherical** illuminance



Step no. 3 – Model of a space - luminaires

Add luminaires

Select luminaires:

- From downloaded plug-in.
- From producer's web page.
- From a file.

Insert:

- Single luminaire.
- Field of luminaires (rectangle).
- Line of luminaires.
- Field of luminaires (circle).

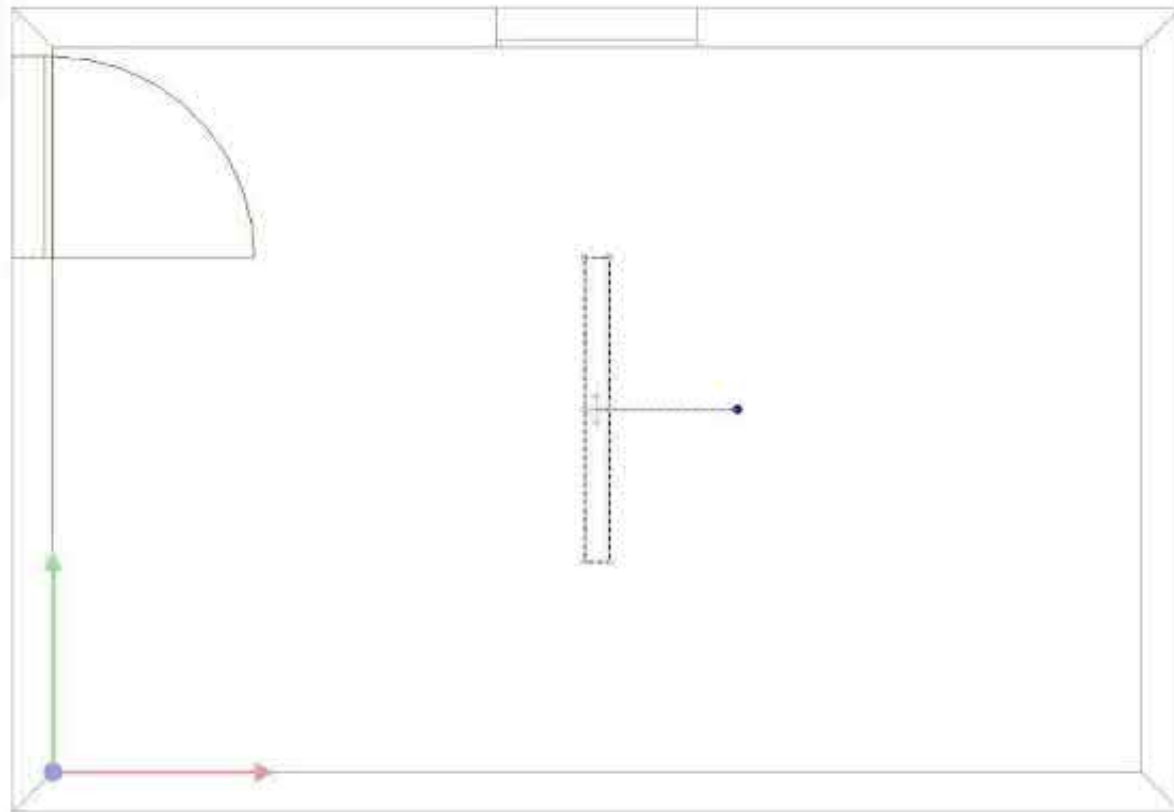
Plan lighting

-  Select Luminaires
-  Insert Single Luminaire
-  Insert Luminaire Field
-  Insert Line Arrangement
-  Insert Circle Arrangement



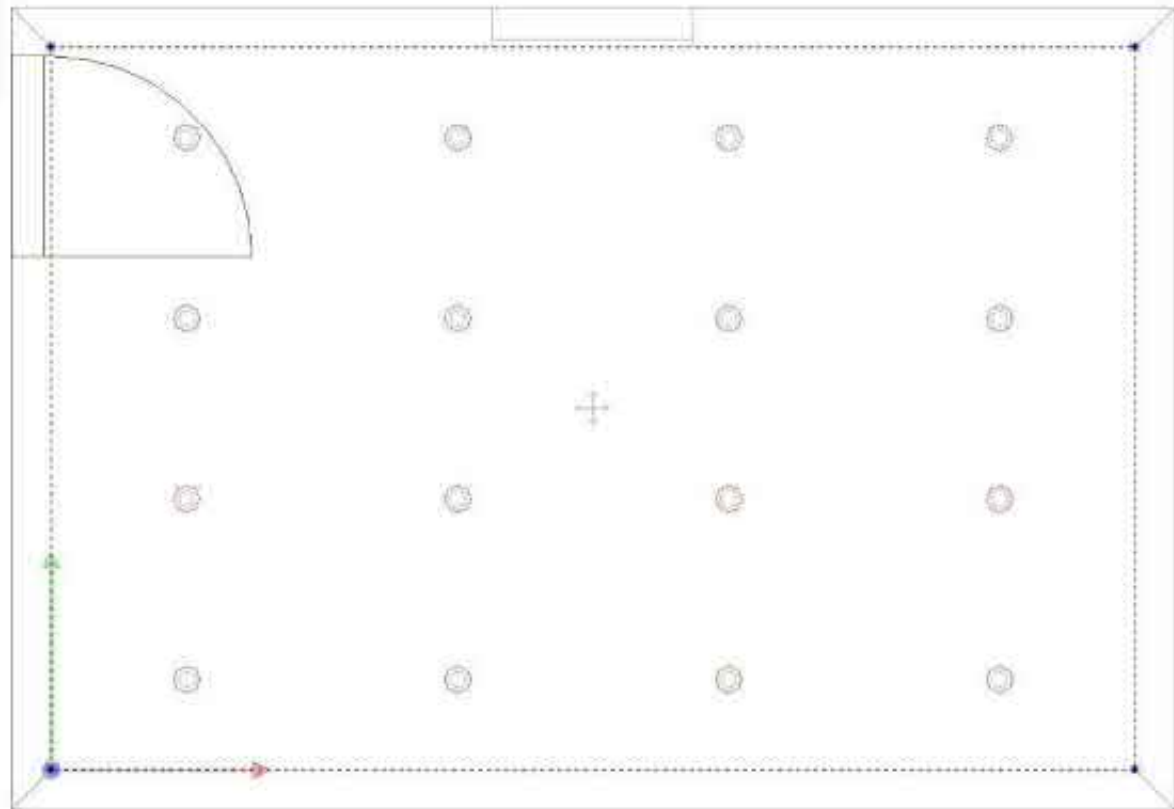
Step no. 3 – Model of a space - luminaires

- Insert Single Luminaire
- Insert Luminaire Field
- Insert Line Arrangement
- Insert Circle Arrangement



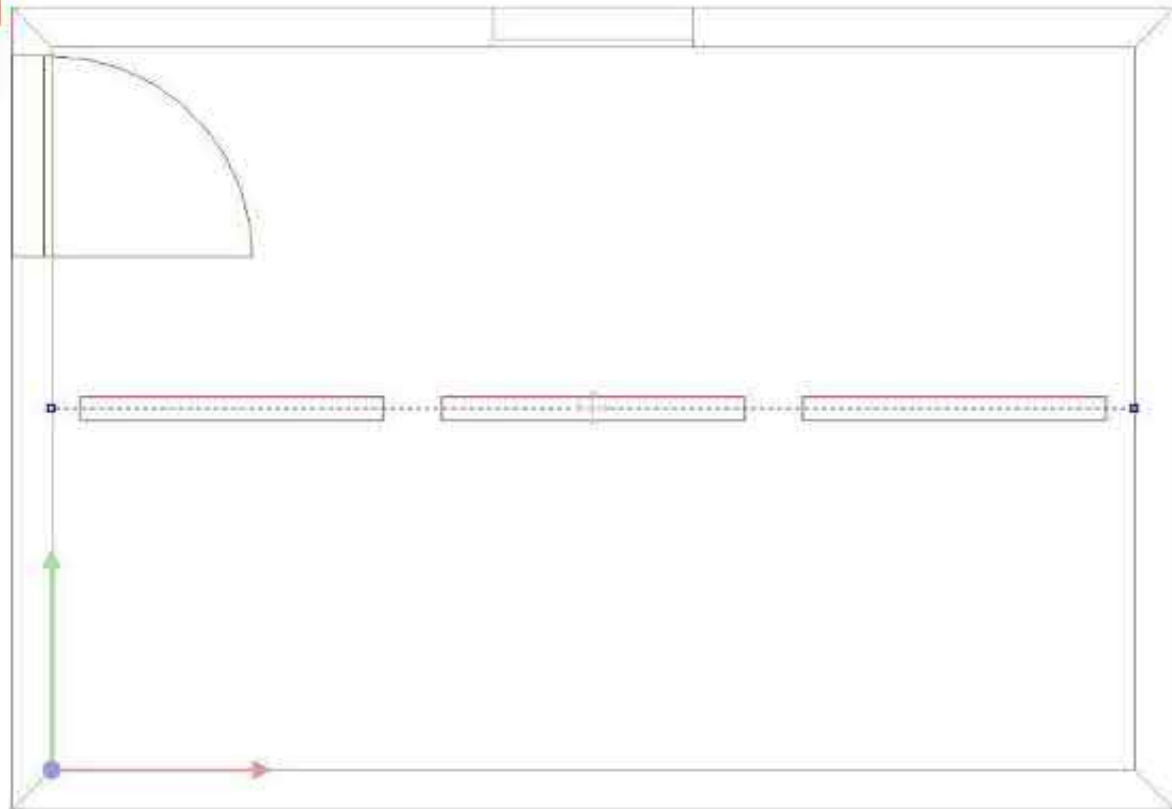
Step no. 3 – Model of a space - luminaires

- Insert Single Luminaire
- Insert Luminaire Field
- Insert Line Arrangement
- Insert Circle Arrangement



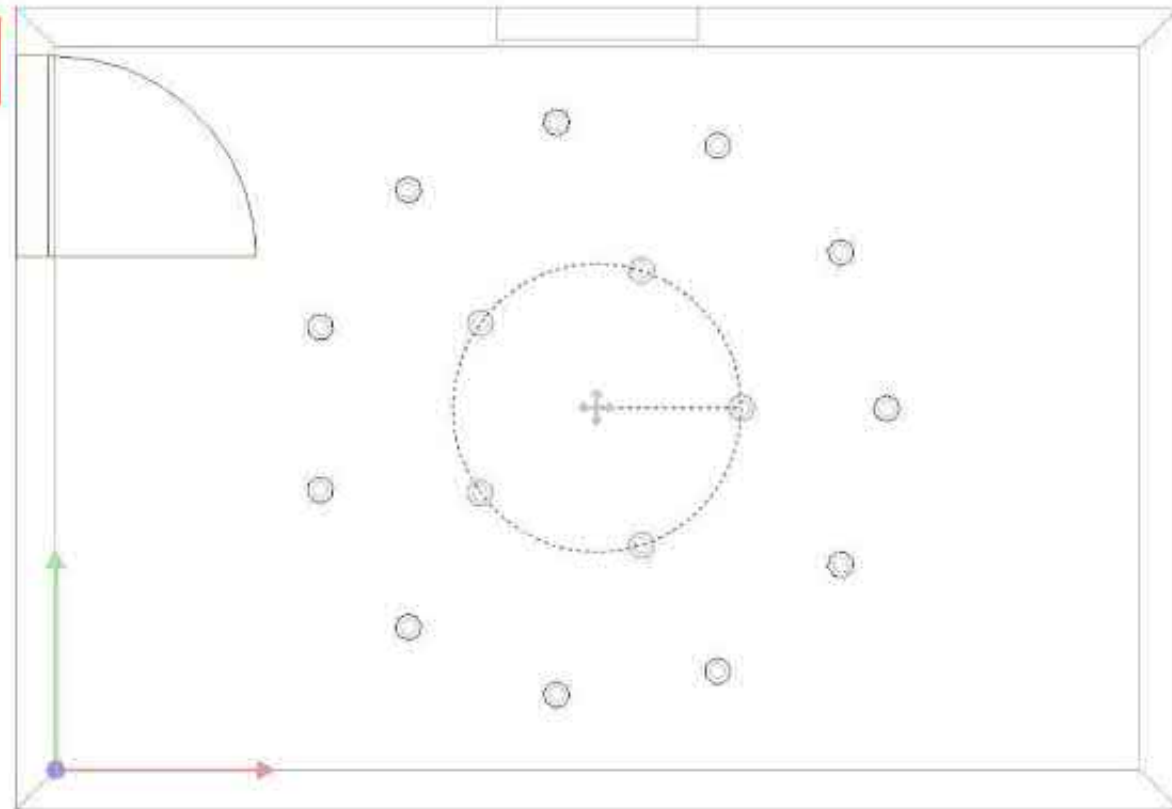
Step no. 3 – Model of a space - luminaires

- Insert Single Luminaire
- Insert Luminaire Field
- Insert Line Arrangement
- Insert Circle Arrangement



Step no. 3 – Model of a space - luminaires

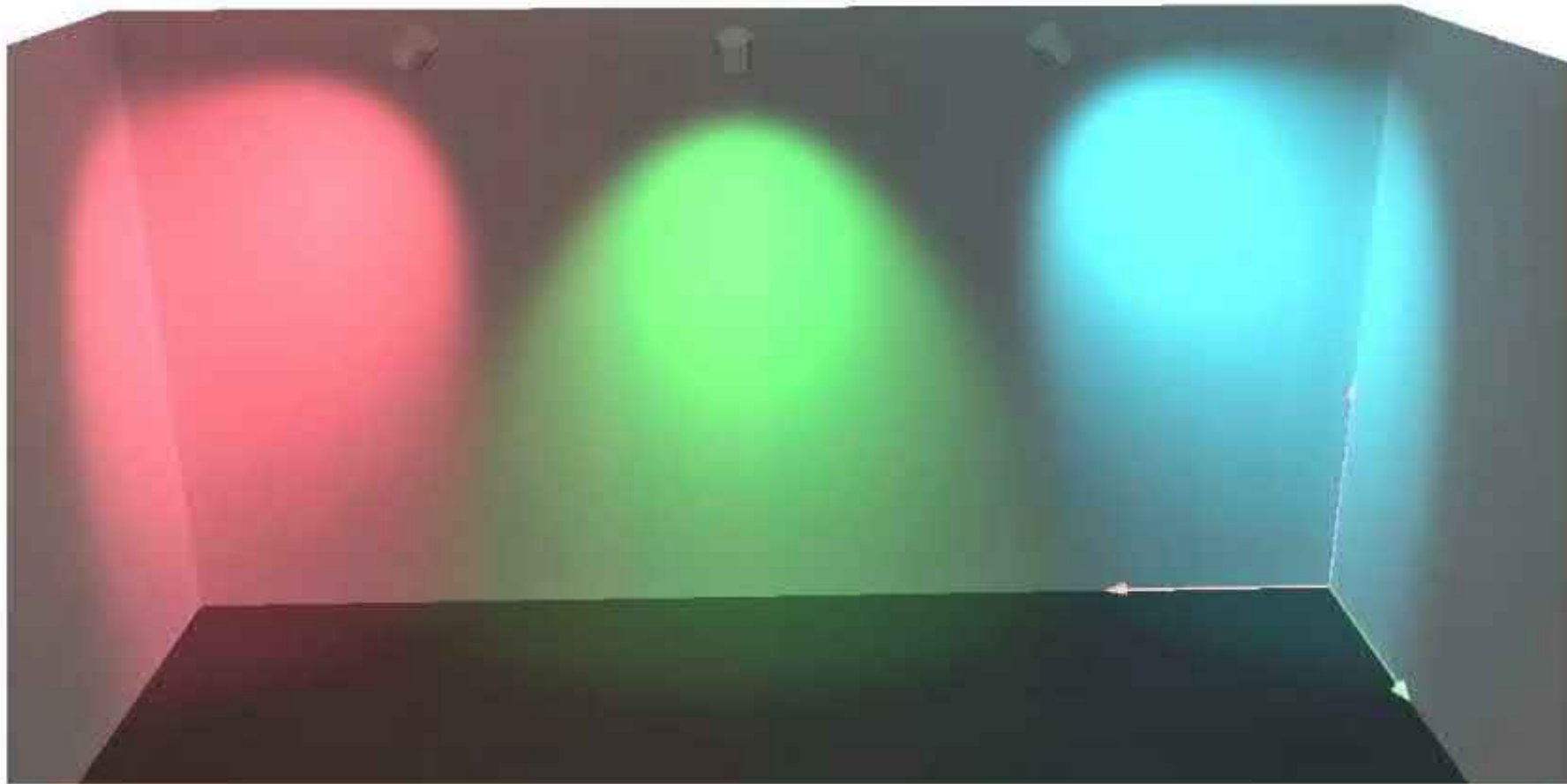
- Insert Single Luminaire
- Insert Luminaire Field
- Insert Line Arrangement
- Insert Circle Arrangement**



Step no. 3 – Model of a space - luminaries

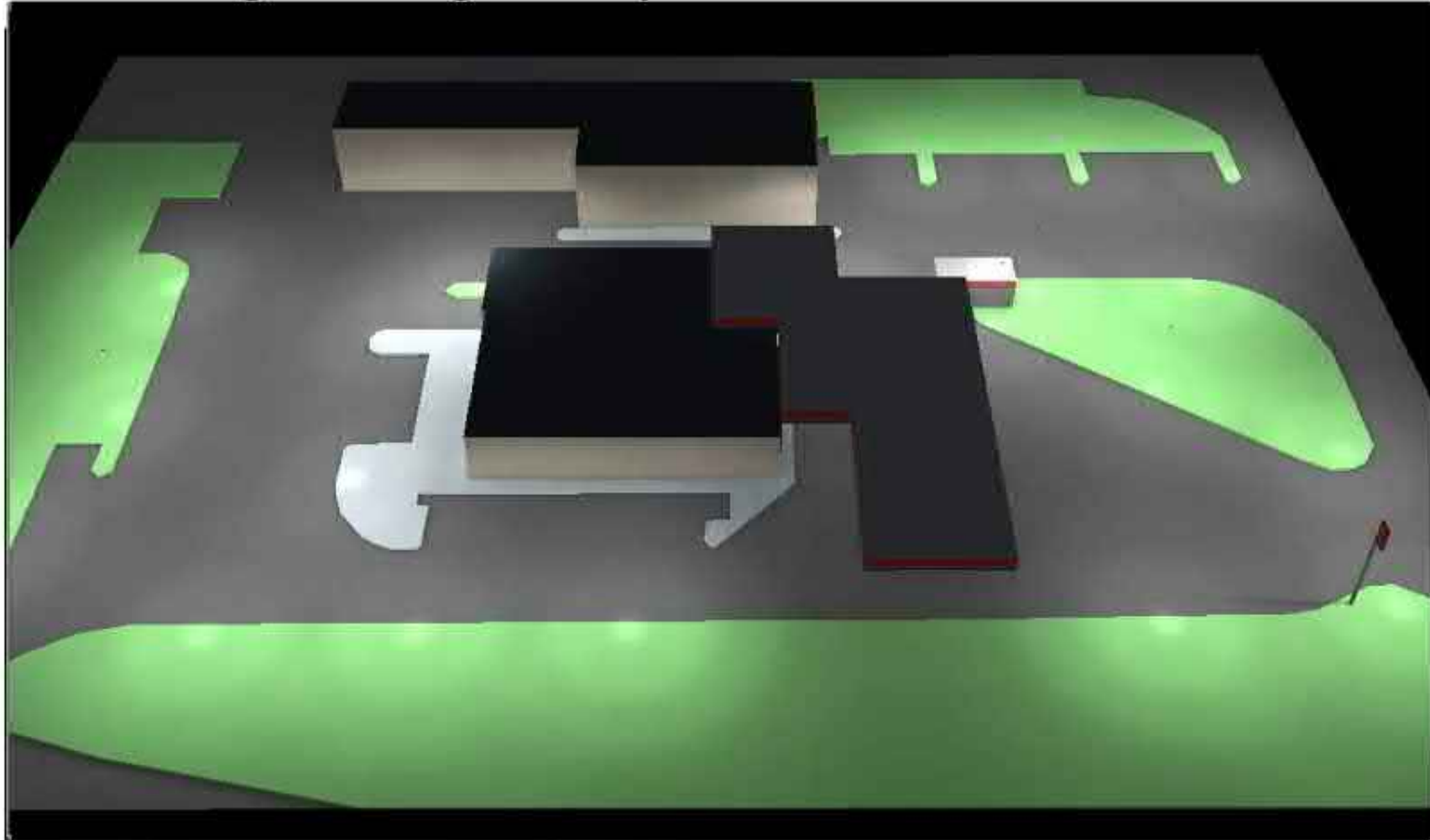
Add **light** properties to luminaires

CCT or even COLOUR



Step no. 4 – Setup and run simulation

Rendering with light outputs



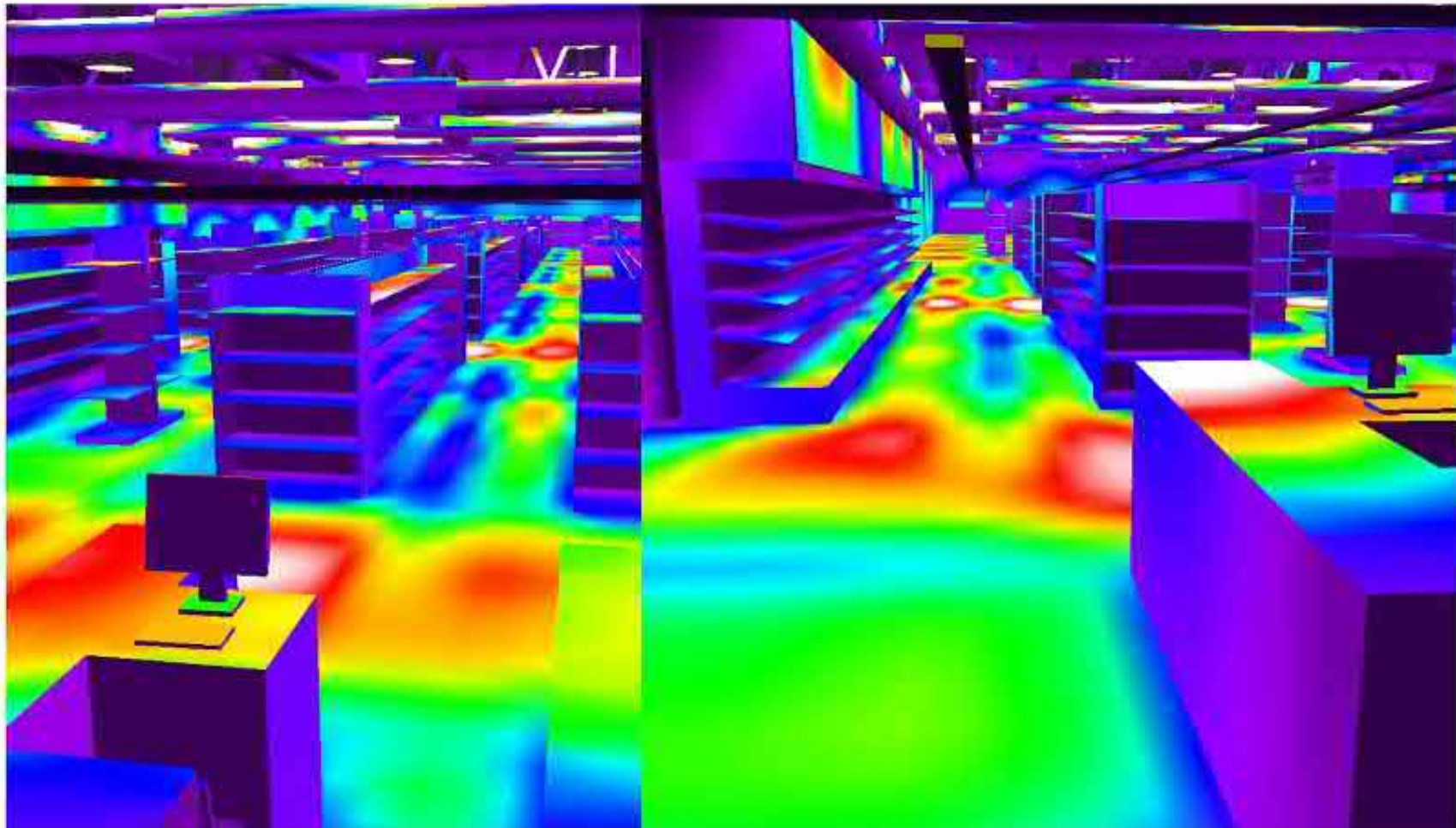
Step no. 4 – Setup and run simulation

Rendering with light outputs



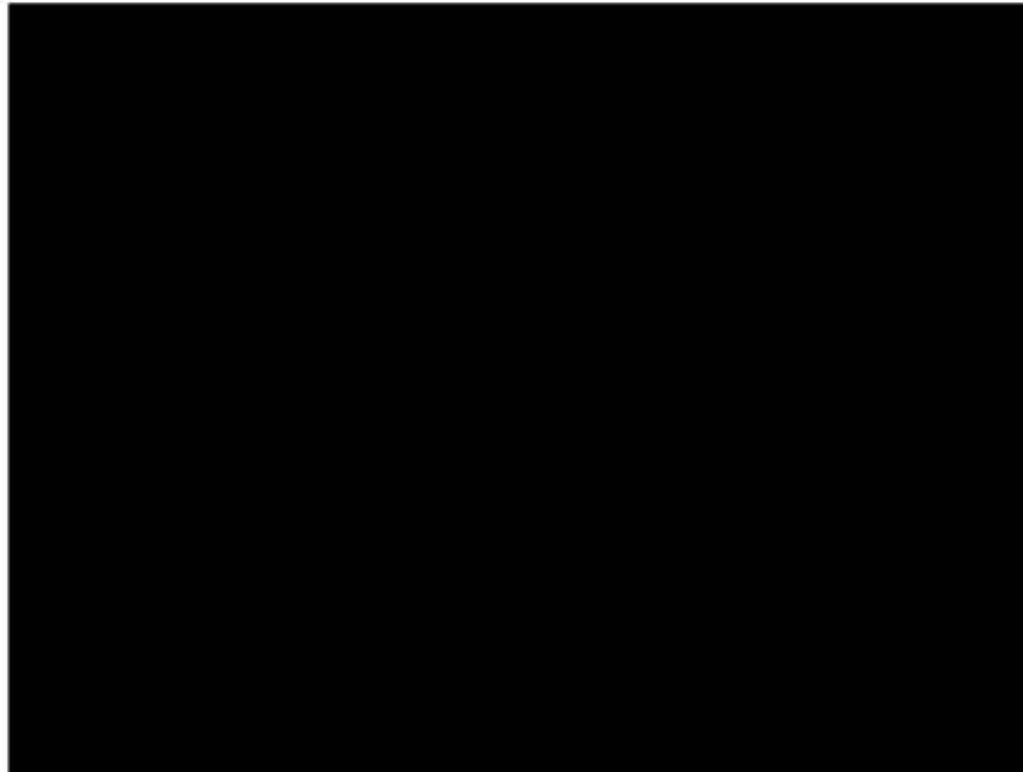
Step no. 4 – Setup and run simulation

Rendering with illuminance values in false colours



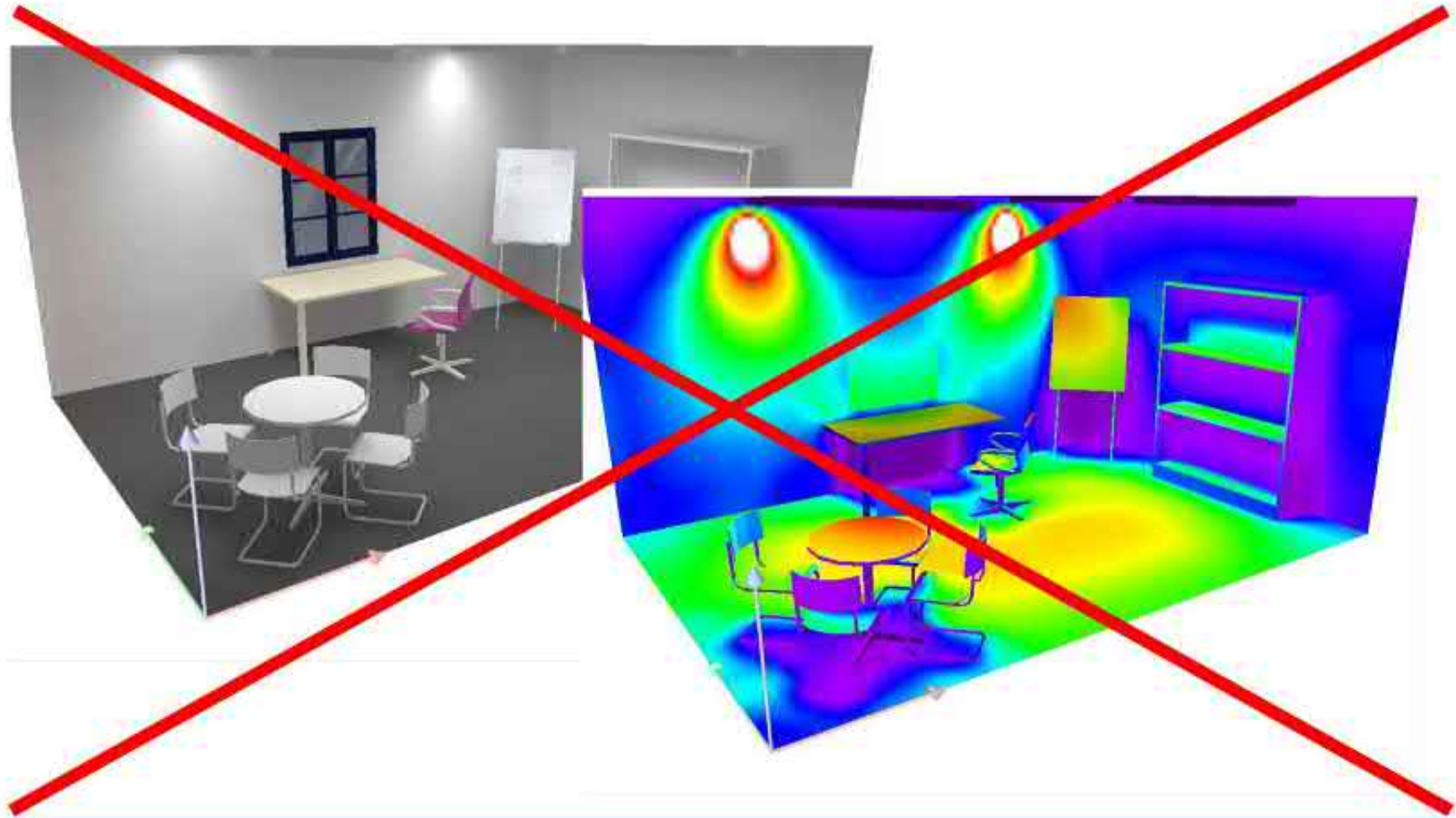
Step no. 4 – Setup and run simulation

Export as a video



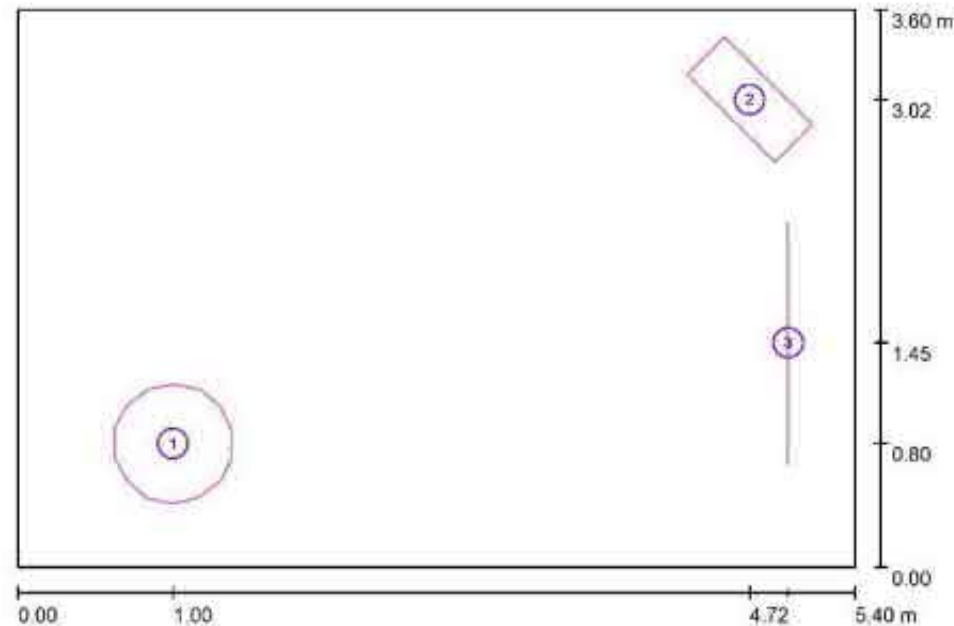
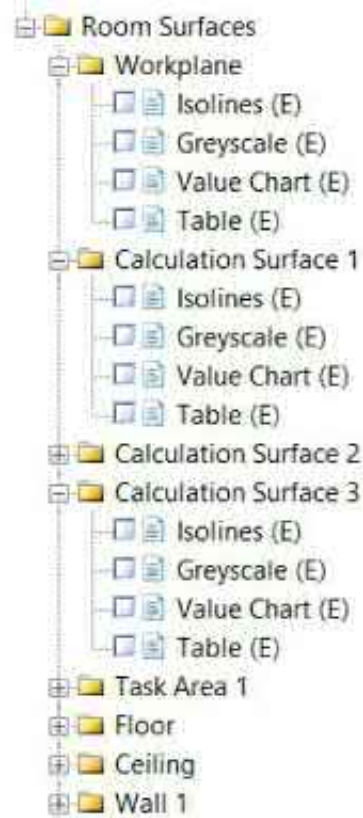
Step no. 5 – Analyse the results.

For real engineers?



Step no. 5 – Analyse the results.

For real engineers!



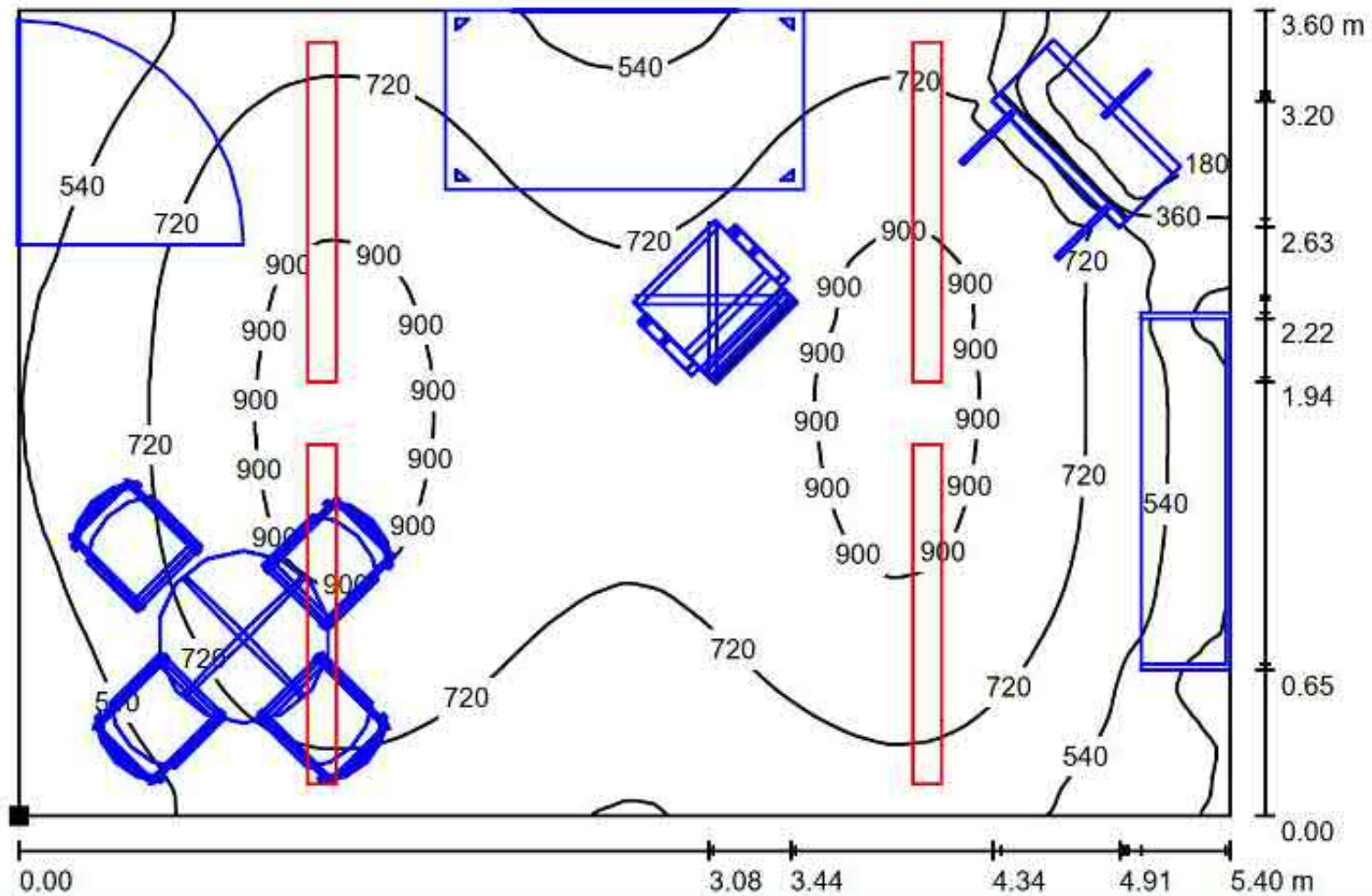
Calculation Surface List

| No | Designation | Type | Grid | E_{gr} [lx] | E_{min} [lx] | E_{max} [lx] | $u0$ | E_{min} / E_{max} |
|----|-----------------------|---------------|---------|---------------|----------------|----------------|-------|---------------------|
| 1 | Calculation Surface 1 | perpendicular | 8 x 8 | 754 | 648 | 847 | 0.860 | 0.765 |
| 2 | Calculation Surface 2 | perpendicular | 16 x 16 | 640 | 515 | 822 | 0.805 | 0.627 |
| 3 | Calculation Surface 3 | perpendicular | 32 x 32 | 437 | 295 | 579 | 0.676 | 0.511 |



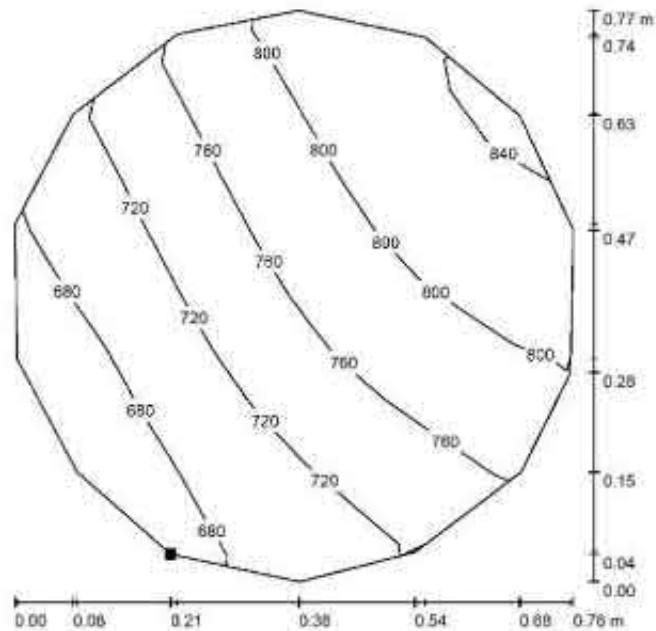
Step no. 5 – Analyse the results.

For real engineers!



Step no. 5 – Analyse the results.

For real engineers!



Position of surface in room:
Marked point: (0.212 m, 0.448 m, 0.740 m)



Values in Lux, Scale 1 : 7

Grid: 6 x 6 Points

E_{avg} [lx]
754

E_{min} [lx]
648

E_{max} [lx]
847

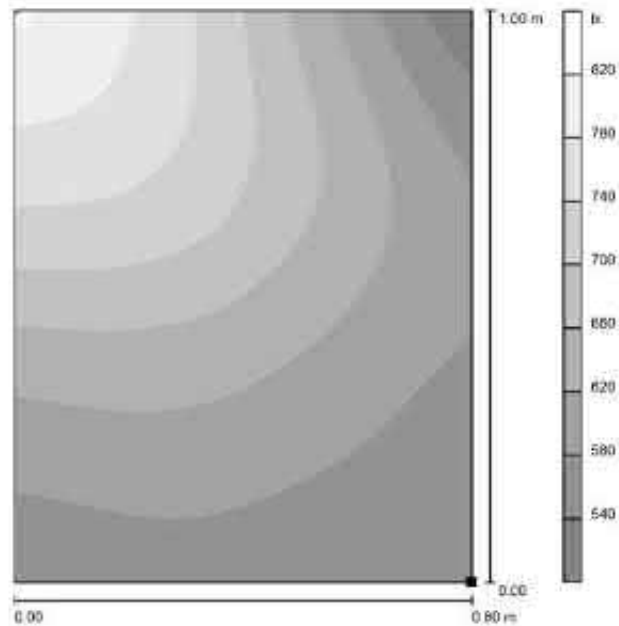
$u0$
0.860

E_{min} / E_{max}
0.765



Step no. 5 – Analyse the results.

For real engineers!



Position of surface in room:
Marked point: (4.682 m, 2.616 m, 0.831 m)



Scale 1:0

Grid: 16 x 16 Points

E_{min} [W]
640

E_{min} [W]
615

E_{max} [W]
822

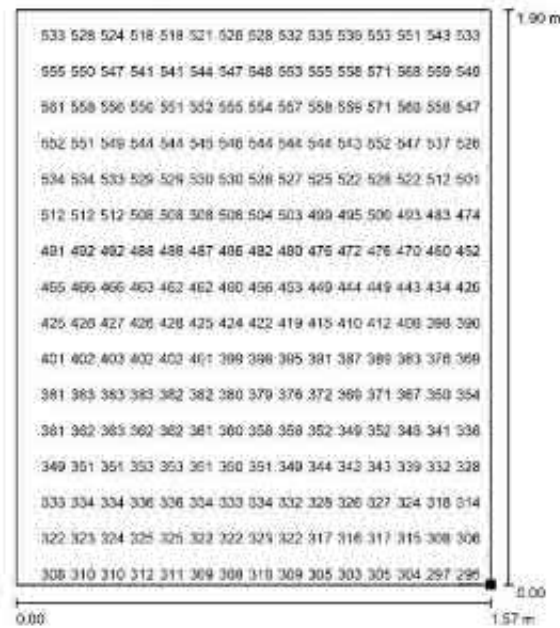
$u0$
0.805

E_{min} / E_{max}
0.627



Step no. 5 – Analyse the results.

For real engineers!



Not all calculated values could be displayed.
Position of surface in room:
Marked point: (4.967 m, 0.668 m, 0.093 m)



Values in Lux, Scale 1 : 1E

Grid: 32 x 32 Points

E_{av} [lx]
437

E_{min} [lx]
295

E_{max} [lx]
579

$u0$
0.676

E_{min} / E_{max}
0.511



And

Questions?

