Lighting Design Project

DARIUSZ KACPRZAK

Project requirements

1. Evaluation of existing lighting
2. Design of a new lighting system (compliant with AS/NZS 1680)
3. Achieve 10-year payback time (or shorter)

4. Design emergency lighting (compliant with F6/F8 clauses of New Zealand Building Code)
5. Report on CO_2 annual emission.

Other requirements

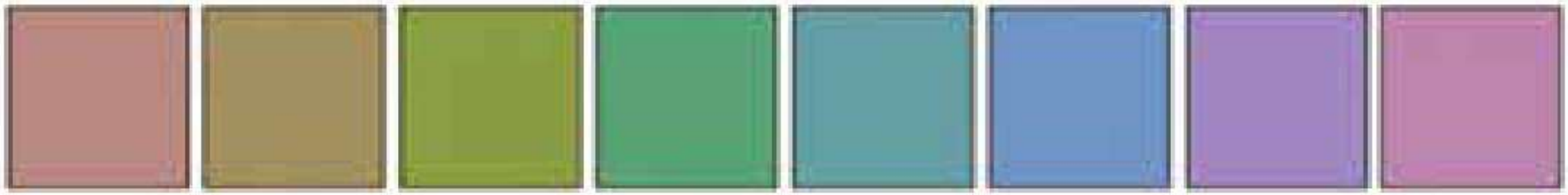
- What did the client say regarding other requirements?

Additional comments

- Issues with RED colour
- Vertical illuminance – for product display spaces
- Visual comfort is highly important
- Present concepts (including sketches)
- Software is your tool (not a generator of the solution)
- Consider how the space will look during day / night
- Corridors – Included some breakup spaces

a) Issues with RED colour

Understanding Colour Rendering Index (based on 8 colours)

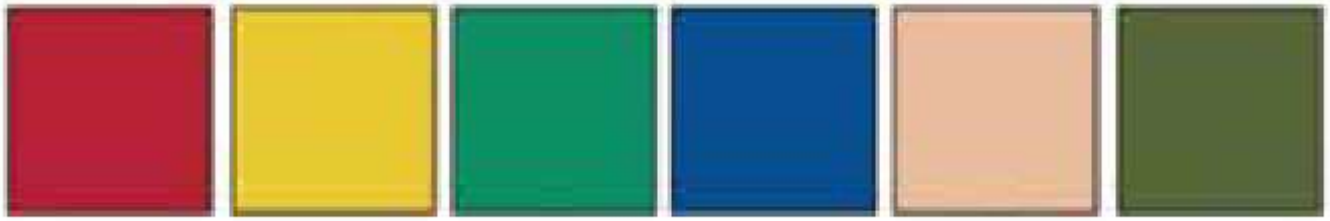


R_1=0.83 R_2=0.81 R_3=0.85 R_4=0.80 R_5=0.87 R_6=0.86 R_7=0.88 R_8=0.81

Average value Ra >0.8

a) Issues with RED colour

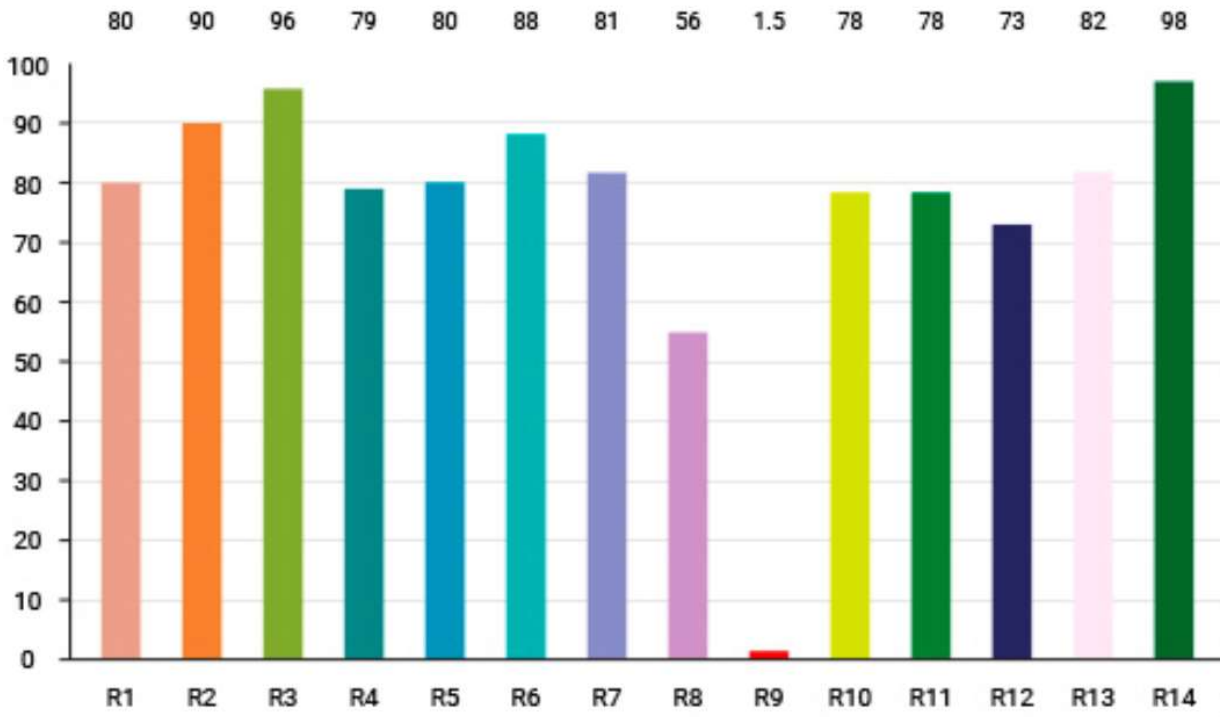
Understanding Colour Rendering Index (extended range based on 14 colours)



R_9=0.21 R_{10}=0.81 R_{11}=0.85 R_{12}=0.80 R_{13}=0.87 R_{14}=0.86

a) Issues with RED colour

Typical value of CRI



a) Issues with RED colour

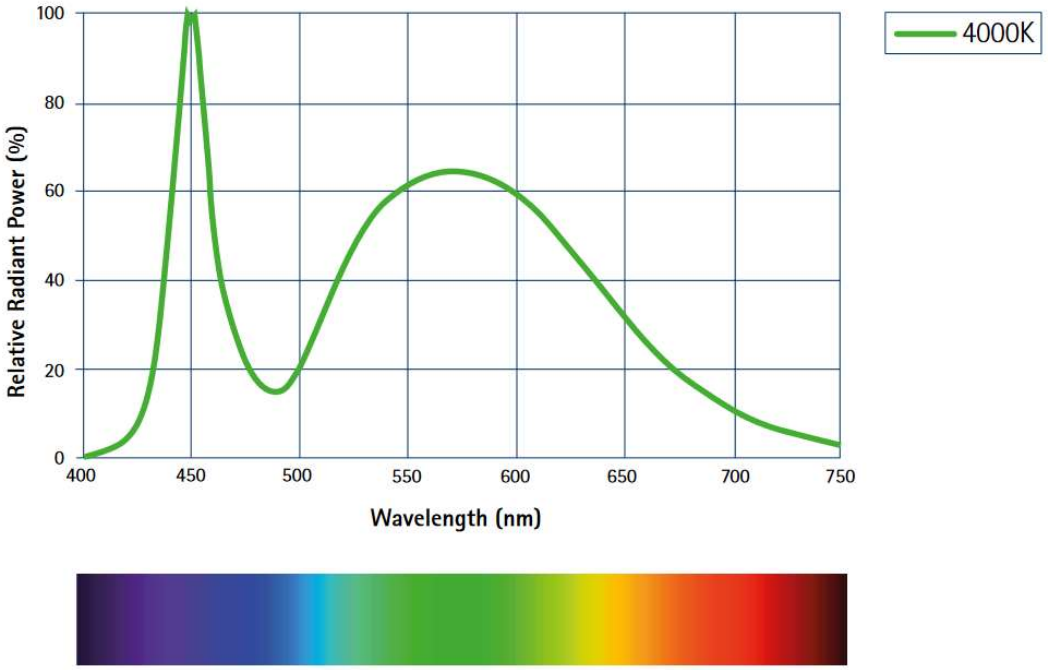
Colour Rendering Index

Low R9

High R9

a) Issues with RED colour

Understanding the cause of poor red colour rendering

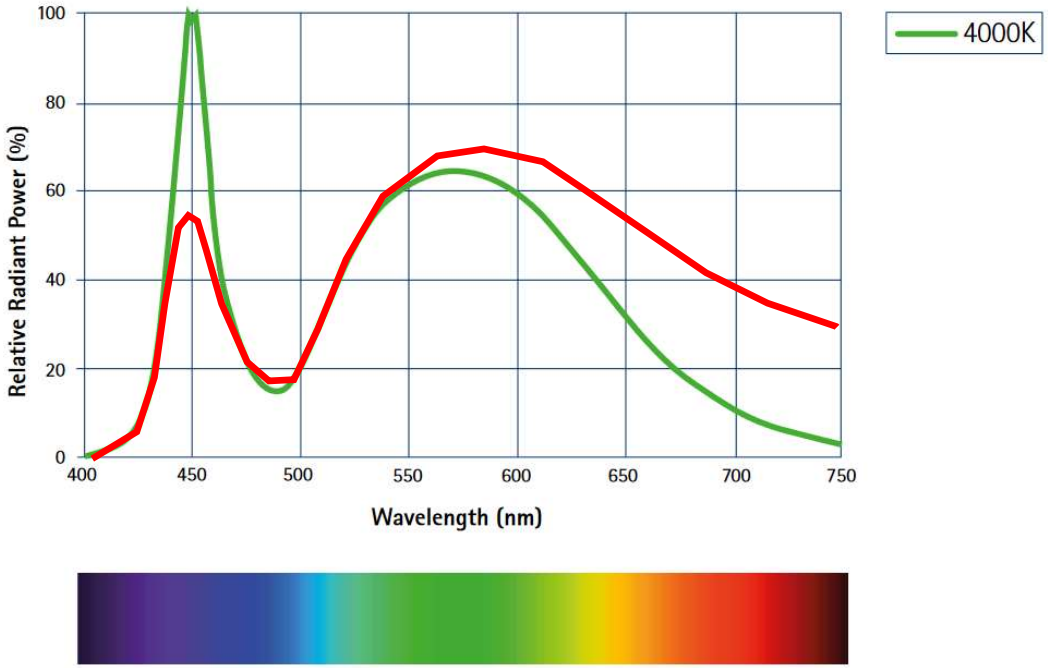


Sensitive projects
- Hospitals
- Wine display
- Cloth display
- Art display
- Cosmetics
- Packaging

a) Issues with RED colour

Improving red colour – high CRI

- High CRI options
  - CRI 0.9
  - CRI 0.95
  - CRI 0.97



a) Issues with RED colour

Colour temperature 3000K , 4000K, 5000K

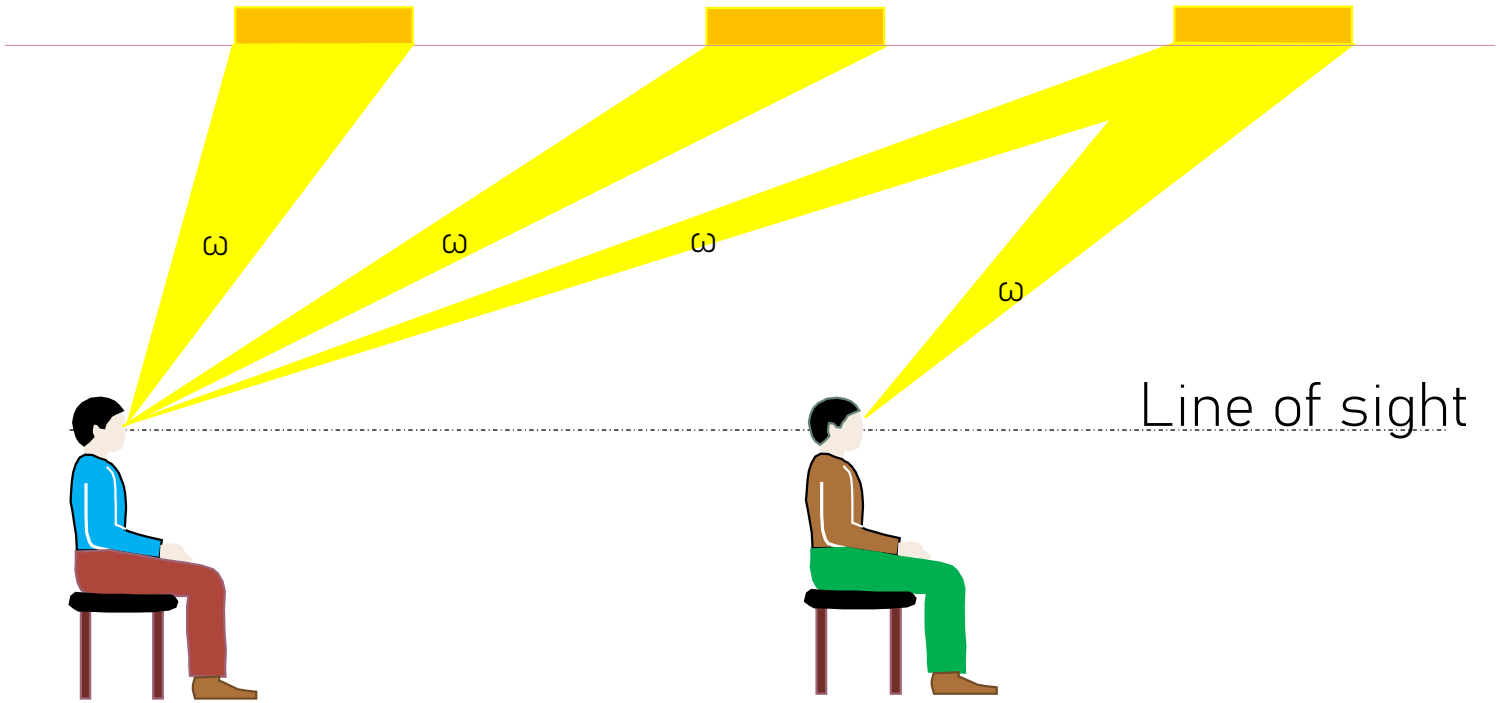
3000K	4000K	5000K
		
Efficacy 130 lm/W	Efficacy 135 lm/W	Efficacy 140 lm/W

Comfort

- Cave effect
- Glare (UGR – Unified Glare Rating)
- Illuminated walls and ceiling to reduce contrast

Glare affects comfort

Understanding glare



$$UGR = 8log\frac{0.25}{L_b}\sum\frac{L^2\omega}{p^2}$$

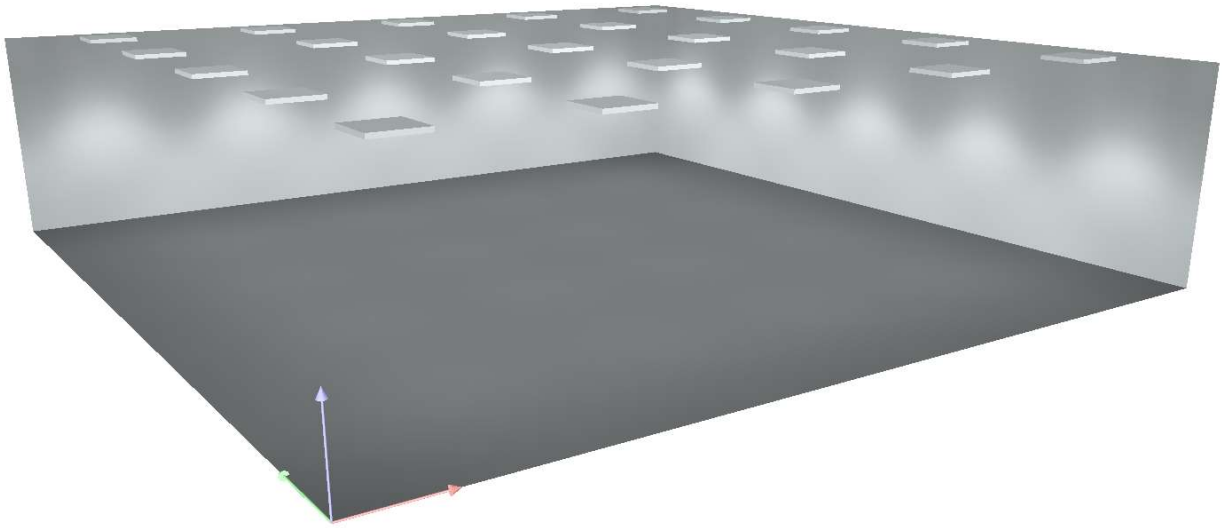
L_b – Background luminance (cd/m^2)

L – Luminance of the light emitting surface of each luminaire in the direction of observer's eye (cd/m^2)

ω – Solid angle of the light emitting surface of each luminaire in the observer's eye (sr)

p – Gurth position index for each luminaire, represents displacement of each luminaire from line of sight. It gets bigger the further the luminaire is from the line of sight.

Design to minimise power

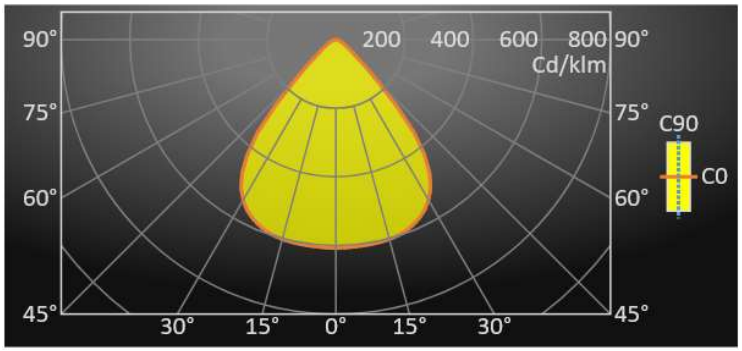


Design approach

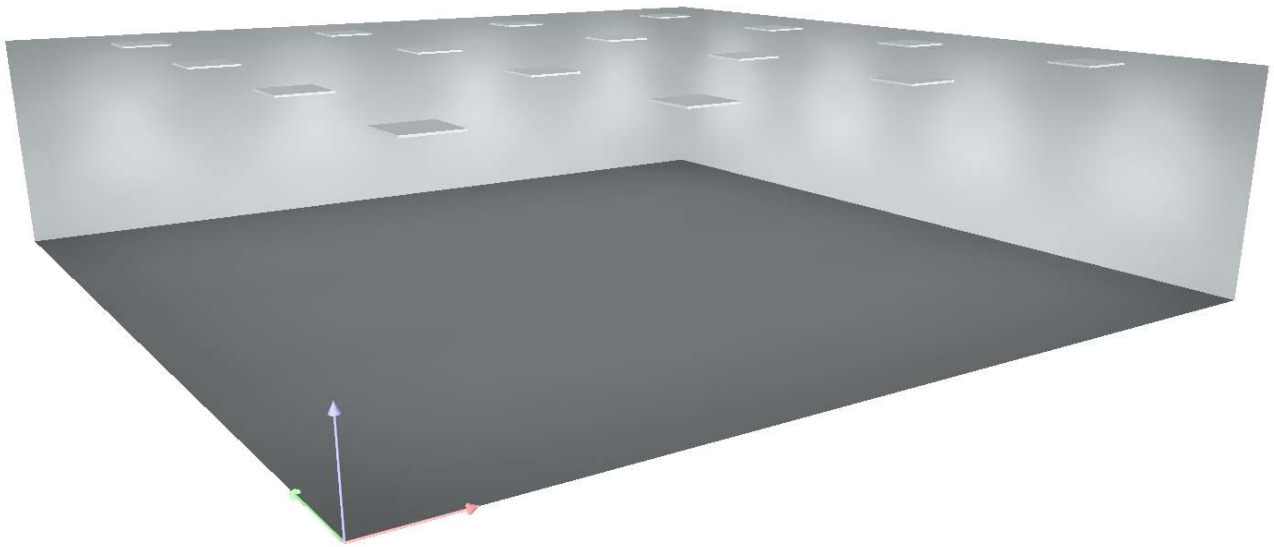
- 25 low power luminaires
- Narrow beam
- Light delivered mainly to the calculation surface

Design to minimise power

- Investment costs 25 x $300 = $7,500
- LLMF 0.99 at 50% hours
- Narrow Beam
- Illuminance Eav = 369lx
- Uniformity u0 = 0.6
- Glare UGR 16
- Illuminance:
  - Walls / Working plane 0.3
  - Ceiling / working plane 0.18
- Power density 2.89 W/m^2



Design to minimise investment costs

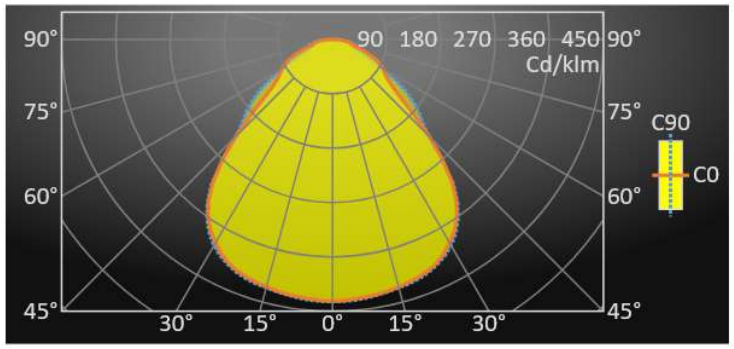


Design approach

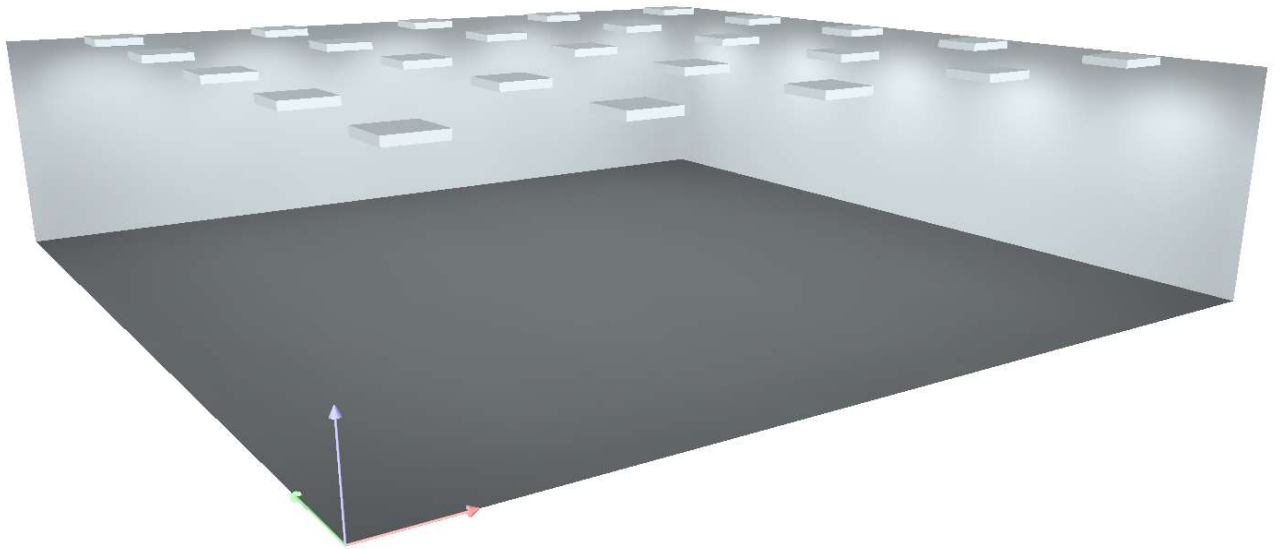
- 16 high power luminaires
- Wide beam
- Light delivered mainly to the calculation surface

Design to minimise investment costs

- Investment costs 16 x $300 = $4,800
- LLMF 0.90 at 50% hours
- Wide Beam
- Illuminance Eav = 358lx
- Uniformity u0 = 0.57
- Glare UGR 16
- Illuminance:
  - Walls / Working plane 0.4
  - Ceiling / working plane 0.2
- Power density 3.57 W/m^2



Design to maximise comfort



Design approach

- 25 medium power luminaires
- Very wide beam
- Light delivered to the calculation surface and walls

Design to maximise comfort

- Investment costs 25 x $300 = $7,500
- LLMF 0.98 at 50% hours
- Very Wide Beam
- Illuminance Eav = 376lx
- Uniformity u0 = 0.61
- Glare UGR 19
- Illuminance:
  - Walls / Working plane 0.54
  - Ceiling / working plane 0.21
- Power density 3.93 W/m^2