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Federation of National Manufacturers Association for Luminaires and Electrotechnical Components for Luminaires in the European Union

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Joint CELMA / ELC LED Forum
Light+Building Fair
14 April 2010

The CELMA Guide to LED Luminaire Design:

Using the example of an outdoor luminaire

Steffen Holtz

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From a CELMA Guide…

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CELMA Guide for OEM's and Producers of LED Based Luminaires

2nd Edition, April 2010

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...to an Outdoor Luminaire

Slide 3

shz1 delete "the example of"
sholtz; 26/02/2010

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Design: in-House or Subcontracted?

First fundamental decision:

- Do you have sufficient experience and resources at your own? ✓
- Or will you take the benefit of an expert partner? ✗

1. First Fundamental Decision 3

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Standard LED Module or Customized LED Solution?

Second fundamental decision:

- Do you want to integrate a standard LED module? ✗

- Or do you want to use a customized LED solution? ✓

2. Second Fundamental Decision..... 3

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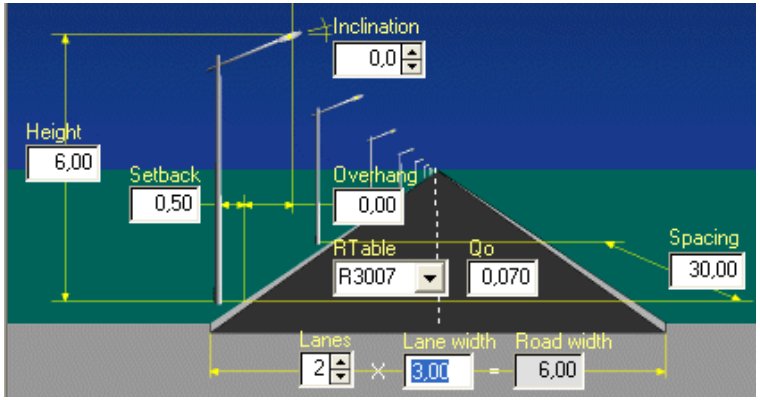
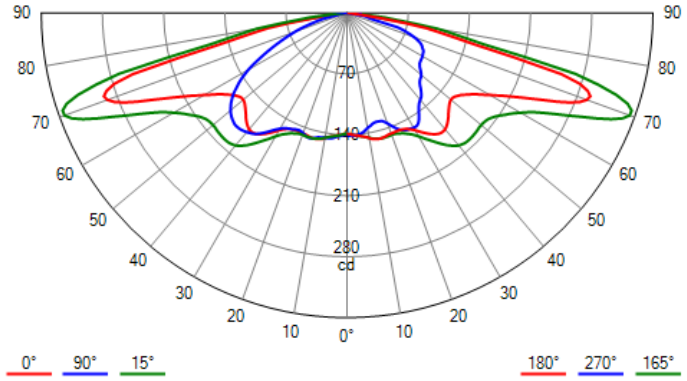
Light Distribution and Required Flux

What lighting distribution/Light level are you targeting?





- Average Luminance: ≥ 0.5 cd/m²
- Longitudinal Homogeneity: ≥ 70 %
- Overall Homogeneity: ≥ 40 %

Total luminaire flux:
2400 lm

32 LEDs

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CRI +Colour Temperature

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Choosing Correlated Colour Temperature (CCT) and CRI

CCT	Cool white (5000 K-10000K)	Neutral white (3700 K-5000 K)	Warm white (3000 K-3700 K)
Efficacy (at T_j=25 °C)	High (102 lm/W)	Medium (89 lm/W)	Low (94 lm/W)
Cultural acceptance	Asia, North and South Ameria	Southern Europe	Northern and Central Europe
Colour Rendering Index (CRI)	75	75 CRI has minor importance for exterior lighting	80

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Ambient Temperature of LED luminaires

Lifetime specifications + ambient temperature (T_a)

Targets:

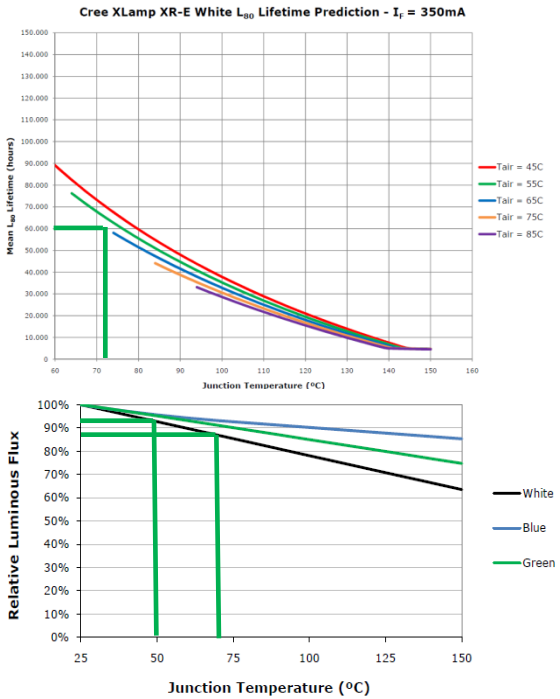
$L_{80} \geq 60\,000$ h

$T_a \geq 30$ °C

→ $T_j \leq 72$ °C

→ ΔT (T_j-T_a) ≤ 42 °C

→ Thermal losses 5-12 %



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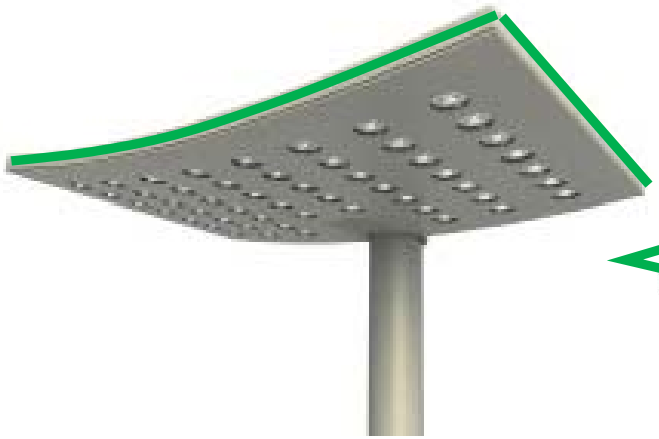
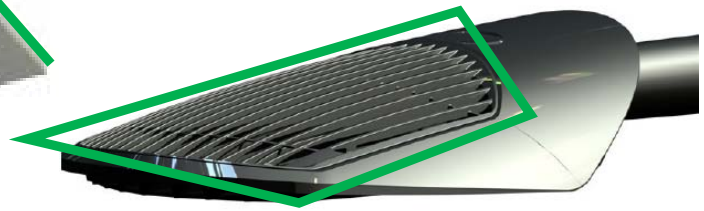
Thermal Design of LED Luminaires

How to keep the LEDs cool?



Large luminaire surface in thermal contact with the LEDs



Top Luminaire surface with exterior fins

Sealed optical unit with fins inside the luminaire body

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Efficacy

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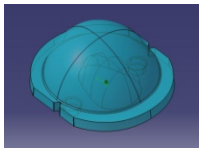
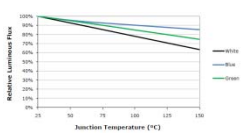
LED efficacy: **89 lm / W**

Electrical efficiency: **90 %**



Optical efficiency: **82 %**
(lens+glass protector)



Thermal efficiency: **95 %**
(at T_j = **55°C**)

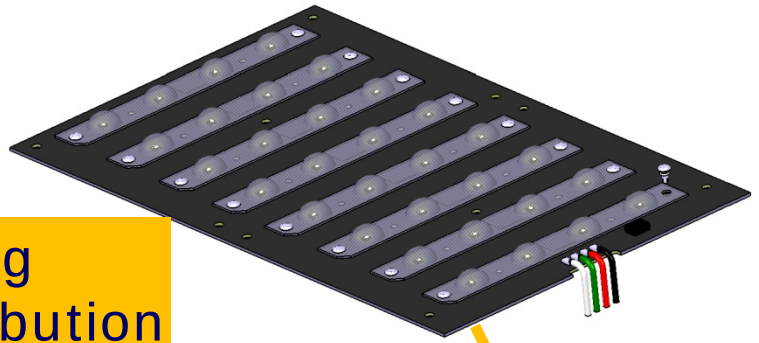
Luminaire Efficacy:

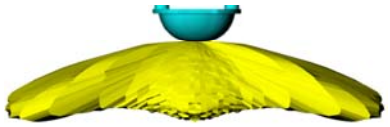
62 lm / W

Secondary Optics

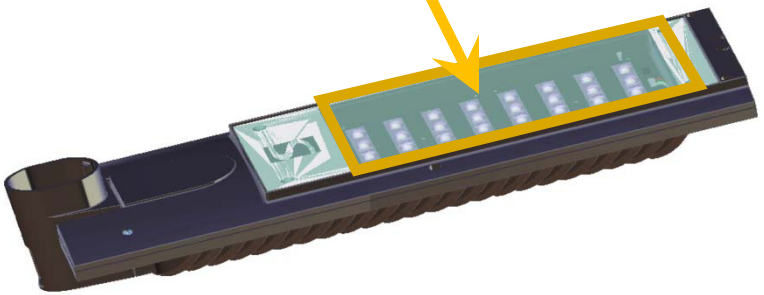
Different potential optical/photometric approaches

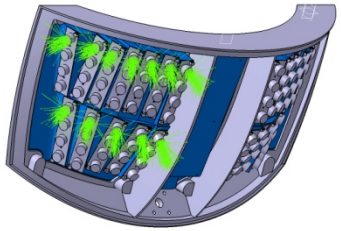
Reflector





Free form lens, providing the complete light distribution





Oriented LEDs and optics

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Driving the LEDs

Two possible ways of driving 32 LEDs

24 V, individual current controllers

+ 24 V, touchable voltage
+ Low requirements on insulation inside the luminaire
-Efficiency max 85 %
-Cost

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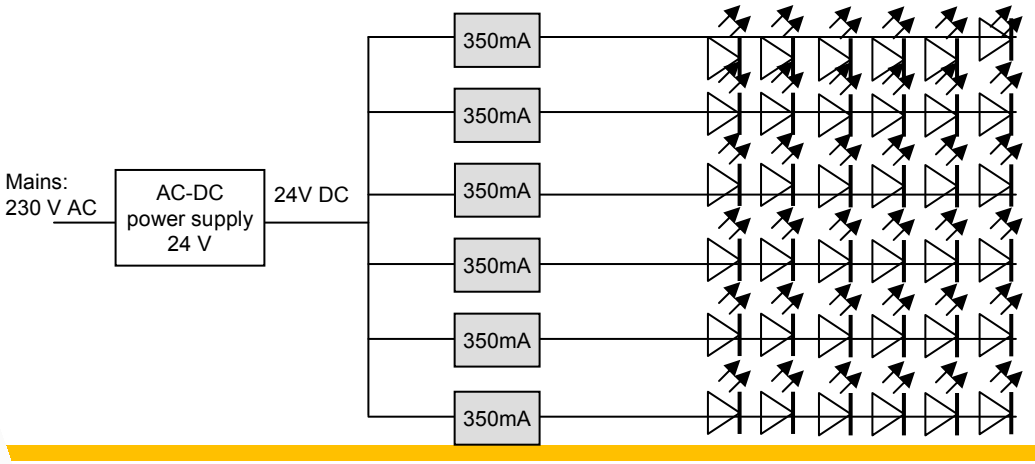
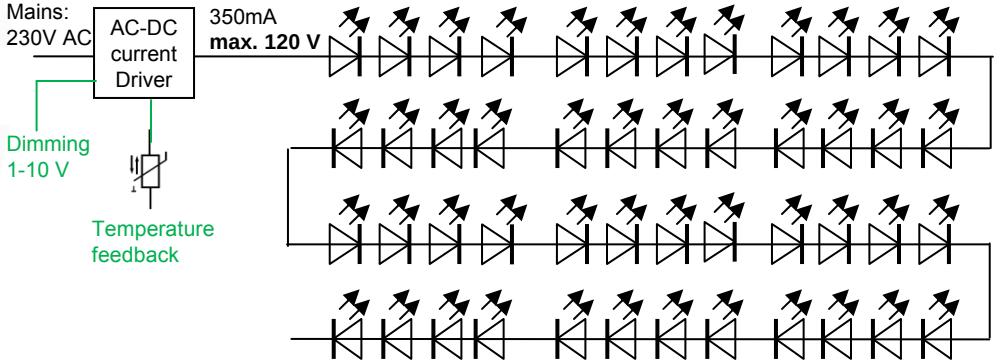


120 V, integrated solution

120 V SELV
+ Efficiency ~ 90 %
+ Cost
o reduced requirements on insulation inside the luminaire
-120 V SELV, non touchable voltage



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Integration into Luminaire Design

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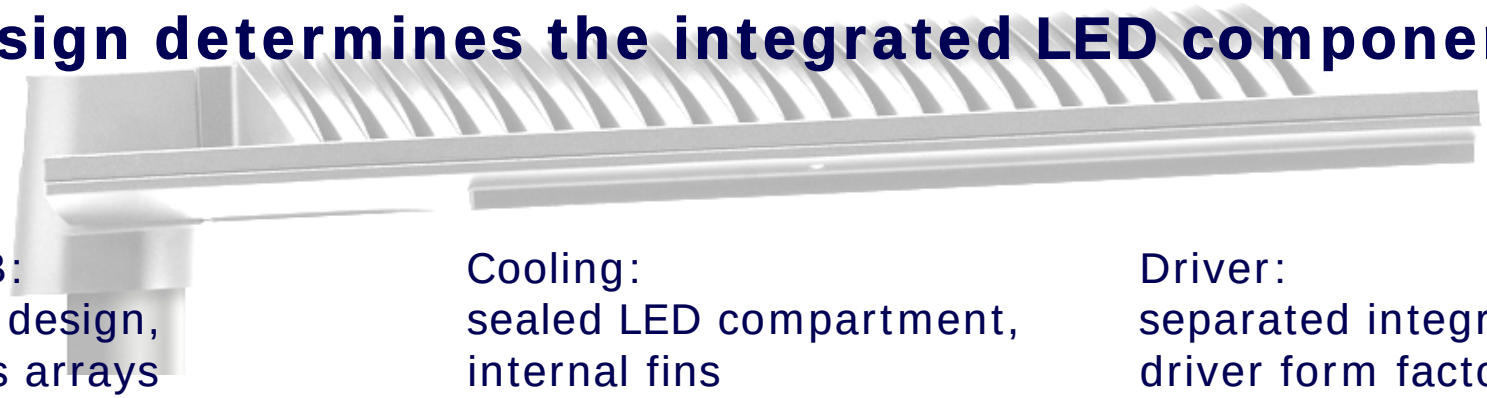
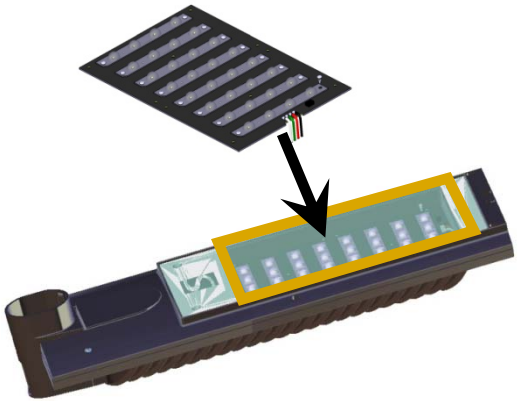
Design determines the integrated LED components

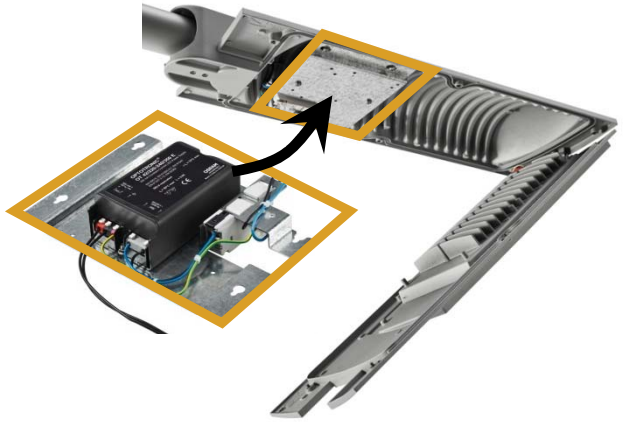


PCB:
flat design,
lens arrays



Cooling:
sealed LED compartment,
internal fins

Driver:
separated integration,
driver form factor!



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Conclusion

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Available on your USB stick
& on www.celma.org!

The CELMA Guide will help you to ask the right questions when designing an LED luminaire

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Thank you very much

for your kind attention!

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