Improved lighting quality by sustainable LED solutions in industry lighting considering daylight based controls

Increased planning effort for integrated solutions illustrated by an example of an realized industry project
Planning considerations for integrated LED solutions

Standards and codes

Energy efficiency

Lifecycle consideration

Flexibility

Biological aspects to increase well-being and performance
Industry logistic hall
Basic conditions

The case study shows a new construction logistic hall of a medium-sized engineering company based in Germany.

Requirements for the new logistic hall were driven by innovation and energy-consciousness.

The companies’ facility manager demanded an energy efficient and easy to use lighting and control system requiring low level maintenance.
Industry logistic hall
Basic conditions

Hall 3
New construction already finished
-> “design guideline” for retrofitting hall 1 and 2

Hall 1
- Retrofitting in progress
- Same Solution planned as hall 1
- Intensive use of daylight by control system
- Replacement of T16 solution by LED

Retrofitting production hall 1
Retrofitting production hall 2
New construction logistic hall 3
Industry logistic hall
Basic conditions

Hall 3 new construction

2383 sqm total area
2200 sqm logistic area
180 sqm Storage
320 sqm skylights
364 sqm glas façade with sun shading roof
Artificial lighting planning conditions
Standards and achieved quality

Requirements Logistics (EN12464):
Av. Illum. 300lx; UGR 22; U1 0,6; Ra 60

Calculation Results:
Av. Illum. 348lx
U1: 0,61

Luminaire:
Tecton LED 53W
UGR 22
Ra 80
Daylight planning conditions
Standards and achieved quality

**Location:** longitude 48°, altitude 10.2°

- **Date:** 21.03. 12:00

- **Overcast sky CIE**

- **Reflectivity:** 70/50/20

- **Facade:**
  - Sun protection glas; transmission 60%
  - Factor for pollution 0,8
  - Factor for partitioning 0,8

- **Skylights:**
  - Sun protection glas; transmission 60%
  - Factor for pollution 0,8
  - Factor for partitioning 0,8
Daylight planning conditions
Standards and achieved quality

Requirements DIN 5034 and ASR 3.4:
DLF for working spaces with skylights: > 4

Calculation Results:
DLF av: 6.3
DLF max: 8.9
Illuminance (21.06) av: 727lx
Illuminance (21.06) max: 1024lx
### Economic conditions
#### Energy efficiency and cost

**Basis for economic comparison:**
(according to client information)

- **Working time:** 7.00 – 18.00 Mo-Fr
- **Burning hours:** 2868 h/y
- **Electricity tariff:** 15 cent/kWh
- **Evolution of energy tariff:** 5% per year
- **Lifetime of installation:** 20 years

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**Proposal 1:**
- **Tecton T16 1x80W**
  - 60 lm/W
- **246 pcs.**
- **Illuminance:** 340lx MF 0,73

**Proposal 2:**
- **Tecton LED 53W**
  - 99 lm/W
- **250 pcs.**
- **Illuminance:** 348lx MF 0,61

**Proposal 3:**
- **Tecton LED 53W + DL controls**
  - 99 lm/W
- **250 pcs.**
- **Illuminance:** 348lx MF 0,61
Estimation of saving potential for daylight based control:

Calculation of dimming curves for artificial light with overcast sky for 21.03 (double-weighted), 21.06 and 21.12
Economic conditions
Energy efficiency and cost

Calculation results

Investment costs vs. running costs of solution (absolute)

- Tecton T16
- Tecton LED
- Tecton LED + daylight based controls

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Economic conditions
Energy efficiency and cost

Calculation results

Total energy costs over lifetime

- Tecton T16 1x80W: €300,229
- Tecton LED 53W: €168,472
- Tecton LED 53W + DL Controls: €31,224
Economic conditions
Energy efficiency and cost

Calculation results

Course of overall costs of solution over lifetime

- Tecton T16 1x80W
- Tecton LED 53W
- Tecton LED 53W + DL Controls

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Economic conditions
Energy efficiency and cost

Lifecircle
Case study: Lifecircle in industry application with 5000 burning hours / year

20 years; same number of LED luminaires

Option: increasing numbers of LED luminaires

Option: replacement of LED luminaires after 11 years
Case study: Lifecircle in industry application with 5000 burning hours / year

Valuea T16 6x80W, Aura Longlife Lampe

Graft LED L70/50.000h ➔ L40/100.000
Increased number of luminaires

Graft LED L70/50.000h replacement after 10 years
Flexibility by luminaire concept

Changing luminaire type, light distribution or adding emergency light component by flexible track system
Flexibility by control concept

Creating independant Luxmate groups for future room setups requiring e.g. different fire zones.
Flexibility by control concept

Possible future room setup

Luxmate groups (Logistic 300lx)
Storage 200lx
Biological aspects

Improved light quality and daylight use during working hours have positive influence on health and well-being.
Thank you for your attention!