LITESTAR 4D
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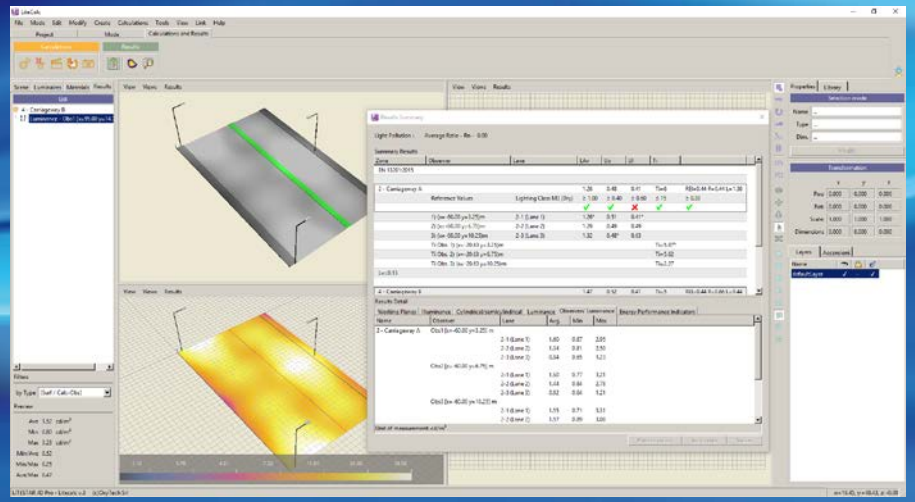
EN 13201:2015

The new standard for road lighting



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The former EN 13201:2003 Standard

The EN 13201 Standard published in 2003 included 4 sections:

EN 13201-1	Selection of lighting classes
EN 13201-2	Performance requirements
EN 13201-3	Calculation of performance
EN 13201-4	Methods of measuring lighting performance

The new Standard EN 13201:2015

The new Standard, approved in December 2015, includes the revision of sections 2, 3 and 4 and the introduction of section 5 for energy assessment

EN 13201-1	Selection of lighting classes
EN 13201-2	Performance requirements
EN 13201-3	Calculation of performance
EN 13201-4	Methods of measuring lighting performance
New **EN 13201-5**	Energy performance indicators

EN 13201-2 – Redefinition of road classes

Road classes as per **EN 13201-2:2003** have been reviewed in **EN 13201-2:2015**:

EN 13201-2:2003		EN 13201-2:2015
ME	Class for urban or extra-urban roads,with mainly motorized traffic where luminance values can be calculated	**M**
CE	Class for motorized, pedestrian roads where there are zones of conflict or where luminance values cannot be calculated: commercial roads, historical city centers, roundabouts, junctions, roads with pedestrians and cyclists, underpasses	**C**
S + A	Classes for areas mainly for pedestrian or cycling use, residential roads, areas adjacent to the carriageway such as emergency lanes, parking area, sidewalks	**P + HS**
EV + ES	Additional classes where it is important to calculate semi cylindrical or vertical illuminances, that is where recognition of faces and vertical surfaces takes on considerable importance	**SC + EV**

EN 13201-2 – Redefinition of road classes

Replacement of classes **ME** with classes M

Class	Luminance of the carriageway for the dry road surface condition			Disability glare TI	Lighting of surroundings
	L_{av} [cd/P2]	U_o	U_l	TI [%]	SR
ME1	2	0.4	0.7	10	0.5
ME2	1.5	0.4	0.7	10	0.5
ME3a	1	0.4	0.7	15	0.5
ME3b	1	0.4	0.6	15	0.5
ME3c	1	0.4	0.5	15	0.5
ME4a	0.75	0.4	0.6	15	0.5
ME4b	0.75	0.4	0.5	15	0.5
ME5	0.5	0.35	0.4	15	0.5
ME6	0.3	0.35	0.4	15	No requirements

EN 13201-2 – Redefinition of road classes

Replacement of classes ME with classes **M**

Class	Luminance of the carriageway for the dry road surface condition			Disability glare TI	Lighting of surroundings
	L_{av} [cd/P2]	U_o (U_{ow})	U_l	f_{TI} [%]	EIR
M1	**2,00**	**0.40 (0,15)**	**0.70**	**10**	**0,35**
M2	**1.50**	**0.40 (0,15)**	**0.70**	**10**	**0,35**
M3	**1,00**	**0.40 (0,15)**	**0.60**	**15**	**0,30**
M4	**0.75**	**0.40 (0,15)**	**0.60**	**15**	**0,30**
M5	**0.50**	**0.35 (0,15)**	**0.40**	**15**	**0,30**
M6	**0.30**	**0.35 (0,15)**	**0.40**	**20**	**0,30**

The classes have been redefined to “harmonize” as much as possible the norm to the laws and regulations of the various states of the UE and align with the CIE 115:2010 (ed.2)

EN 13201-2 – Redefinition of road classes

Replacement of classes **CE** with classes **C** for zones of conflict

Class	Illuminance of the carriageway for the dry road surface condition	
	E_{av} [lx]	U_o
CE0	50	0.4
CE1	30	0.4
CE2	20	0.4
CE3	15	0.4
CE4	10	0.4
CE5	7.5	0.4

Class	Illuminance of the carriageway for the dry road surface condition	
	E_{av} [lx]	U_o
C0	50	0.4
C1	30	0.4
C2	20	0.4
C3	15	0.4
C4	10	0.4
C5	7.5	0.4

+

	TI
	15
	15
	15
	20
	20
	20

Lambert Law can be used for the calculation of TI in Class C areas

EN 13201-2 – Redefinition of road classes

Introduction of the new classes **P** and **HS** for pedestrians and cyclists on pedestrian or cycling use areas, or emergency lanes adjacent to the carriageway

Class	Horizontal Illuminance		Additional requirements	
	Horizontal Illuminance	Minimum horizontal illuminance	Minimum vertical illuminance	Minimum semi cylindrical illuminance
	$E_{h\,av}$ [lx]	E_{min} [lx]	$E_{v\,min}$ [lx]	$E_{sc\,min}$ [lx]
P1	15,0	3,00	5,0	5,0
P2	10,0	2,00	3,0	2,0
P3	7,50	1,50	2,5	1,5
P4	5,00	1,00	1,5	1,0
P5	3,00	0,60	1,0	0,6
P6	2,00	0,40	0,6	0,2

+

TI
20
25
25
30
30
35

Class	Hemispherical Illuminance	
	Hemispherical illuminance	Overall Uniformity
	$E_{hs\,av}$ [lx]	U_0
HS1	5,00	0,15
HS2	2,50	0,15
HS3	1,00	0,15
HS4		

They replace classes **S** and **A** in EN 13201-2:2003

Lambert Law can be used for the calculation of TI in Class P areas

EN 13201-2 – Redefinition of road classes

Introduction of the new class **SC** for pedestrian areas in which recognition of faces and a sense of security take on considerable importance. Class **EV** remains unchanged

Class	Semicylindrical Iluminance
	$E_{sc\ min}$ [lx]
SC1	**10,0**
SC2	**7,50**
SC3	**5,00**
SC4	**3,00**
SC5	**2,00**
SC6	**1,50**
SC7	**1,00**
SC8	**0,75**
SC9	**0,50**

It replaces Class **ES** in former EN 13201-2:2003

Class	Vertical Illuminance
	$E_{v\ min}$ [lx]
EV1	**50**
EV2	**30**
EV3	**10,0**
EV4	**7,50**
EV5	**5,00**
EV6	**0,50**

Class **EV** remains unchanged with respect to former EN 13201-2:2003

EN 13201-3 – Refining of TI calculation

A change has been introduced in the formula for the TI calculation

$$f_{TI} = 65 \frac{L_v}{(L_{i\,av})^{0,8}} \%$$

where

$$L_v = \sum_{K=1}^{n\ luminaires} L_{vk}$$

$$L_{vk} = 9{,}86 \cdot \left[1 + \left(\frac{A_y}{66{,}4}\right)^4\right] \frac{E_k}{\theta_k^2}$$

for $1{,}5^\circ < \Theta k \leq 60^\circ$

$$L_{vk} = E_k \cdot \left(\frac{10}{\theta_k^3} + \left[\frac{5}{\theta_k^2}\right] \cdot \left[1 + \left(\frac{A_y}{62{,}5}\right)^4\right]\right)$$

for $0{,}1^\circ < \Theta k \leq 1{,}5^\circ$

This formula has been introduced to take into consideration the rare cases in which the luminaires are very close to the line of sight

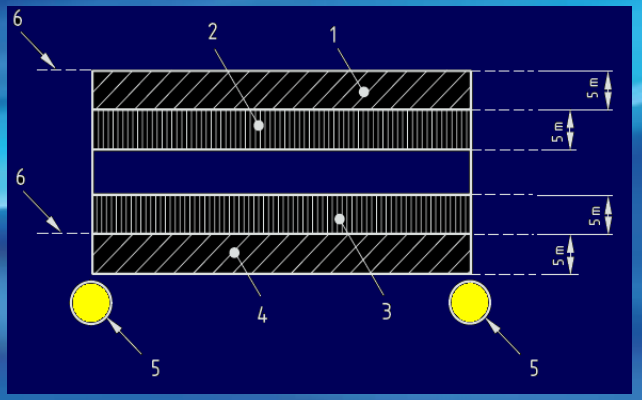
EN 13201-3 - SR > EIR

Replacement of parameter **SR** with the new EIR

- **SR = Surround Ratio**

SR is the horizontal illuminance value of the areas adjacent to the carriageway in relation to the corresponding values present on the carriageway.

$$SR = \frac{E_{h\,av\ (Strip\ 1)} + E_{h\,av\ (Strip\ 4)}}{E_{h\,av\ (Strip\ 2)} + E_{h\,av\ (Strip\ 3)}}$$



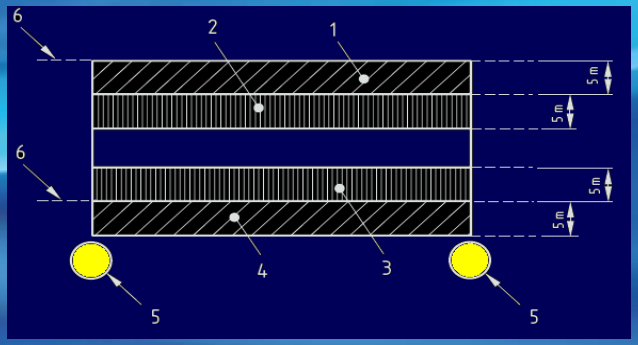
EN 13201-3 - SR > EIR

Replacement of parameter SR with the new **EIR**

- **EIR = Edge Illuminance Ratio - R_{EI}**

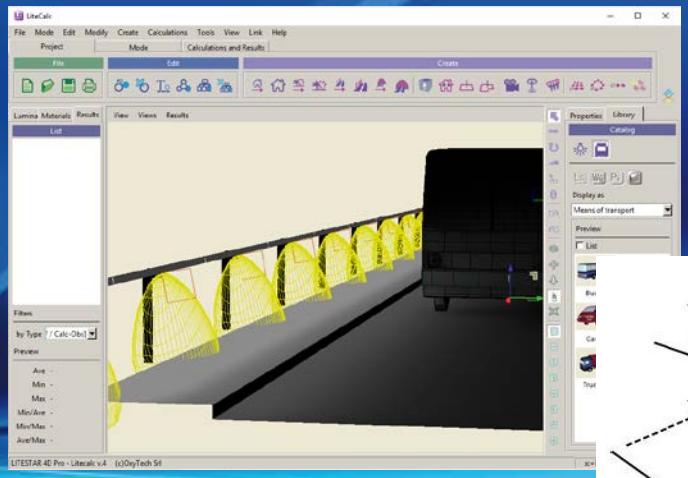
The EIR is the minimum from the evaluation on each side of the carriageway of the ratio of the average horizontal illuminance on the longitudinal strip adjacent to the edge of the carriageway, and lying off the carriageway, divided by the average horizontal illuminance on the corresponding longitudinal strip lying on the carriageway

$$R_{EI} = \text{Minimum} \left(\frac{E_{h\,av\ (Strip\ 1)}}{E_{h\,av\ (Strip\ 2)}} ; \frac{E_{h\,av\ (Strip\ 4)}}{E_{h\,av\ (Strip\ 3)}} \right)$$

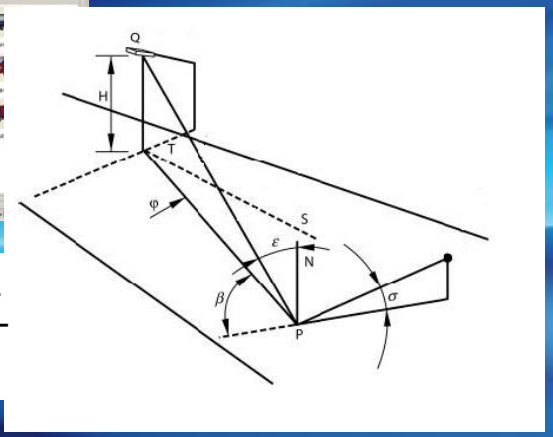


EN 13201-3 – Extension of the r-table

The r-table displaying the reduced reflection coefficients has been extended to take into consideration lighting installations at heights less than 2 m



$$L = \frac{I \times r \times \Phi \times MF \times 10^{-4}}{H^2}$$



tan ε	β in degrees																		
	0	2	5	10	15	2	2	3	3	4	4	6	7	9	10	12	13 5	15	16 5	18 0
0	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0,25	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0,5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0,75	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1,25	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1,5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1,75	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2,5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3,5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4,5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5,5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6,5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
7	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
7,5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
8	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
8,5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
9	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
9,5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
10,5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
11	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
11,5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
12	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
12,5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
13	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
13,5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
14	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
14,5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
15	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
15,5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
16	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
16,5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
17	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
17,5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
18	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
18,5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
19	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
19,5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

EN 13201-3 – Rounding up

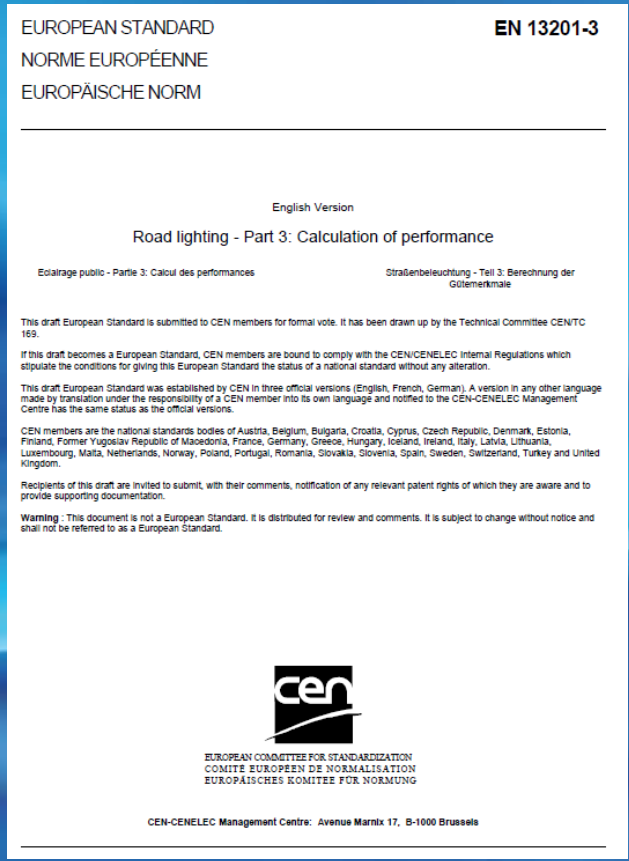
A table stating the management of the decimal places in the presentation of numerical results has been introduced

Parameter	Management of decimals in the results	
	Parameter description	Number of decimal places
L_{av}	Average luminance	**2**
U_o	Overall uniformity	**2**
U_l	Longitudinal uniformity	**2**
f_{TI}	Threshold increment	**0**
R_{EI}	Edge illuminance ratio	**2**
$E_h < 10$ lx	Horizontal illuminance below 10 lx	**2**
$10 \leq E_h \leq 20$ lx	Horizontal illuminance between 10 e 20 lx	**1**
$E_h \geq$	Horizontal illuminance above 20 lx	**0**

EN 13201-3 – Miscellaneous

The EN 13201-3:2015 Standard also includes the following new features:

- Flow-chart of the different parameter calculations (E_h, L, f_{TI}, R_{EI} ….)
- Clear definition of variables



EUROPEAN STANDARD **EN 13201-3**

NORME EUROPÉENNE

EUROPÄISCHE NORM

English Version

Road lighting - Part 3: Calculation of performance

Eclairage public - Partie 3: Calcul des performances

Straßenbeleuchtung - Teil 3: Berechnung der Gütemerkmale

This draft European Standard is submitted to CEN members for formal vote. It has been drawn up by the Technical Committee CEN/TC 169.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

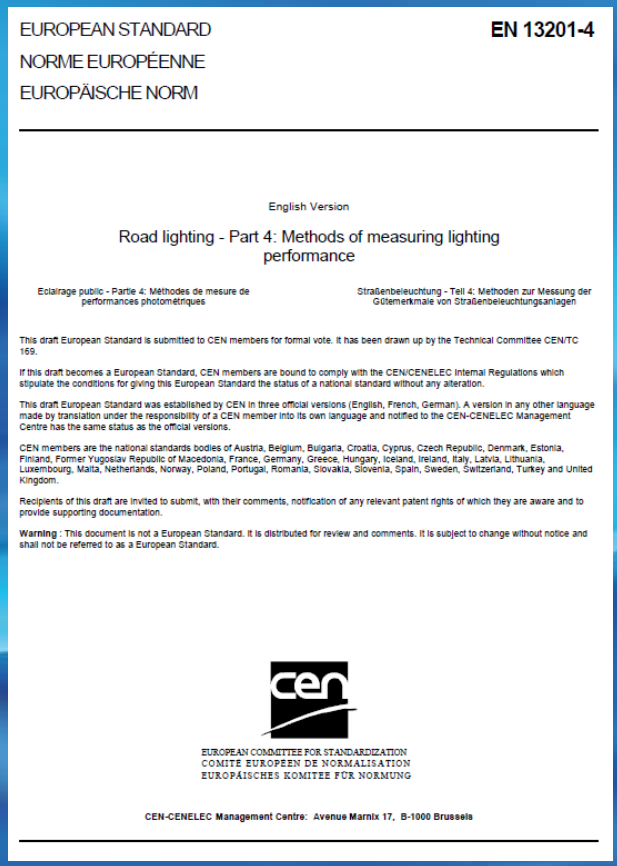
EN 13201-4 – Field measurements

The new EN 13201-4:2015 Standard introduces:

- The concept of approximate value
- Field Measurement uncertainty evaluation

The measurement uncertainty can be considered as having three groups of components:

- The metrological characteristics of the measurement system and the influence of measurement procedures
- The influence of the nominal characteristics and layout of the road lighting installation being measured
- The influence of the instantaneous characteristics of the road lighting installation being measured, and of the weather and environmental conditions



EUROPEAN STANDARD **EN 13201-4**

NORME EUROPÉENNE

EUROPÄISCHE NORM

English Version

Road lighting - Part 4: Methods of measuring lighting performance

Eclairage public - Partie 4: Méthodes de mesure de performances photométriques

Straßenbeleuchtung - Teil 4: Methoden zur Messung der Gütemerkmale von Straßenbeleuchtungsanlagen

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CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

EN 13201-5 – Energy Performance Indicators

The new EN 13201-4:2015 Standard introduces the assessment of the energy performance of a particular lighting system through 2 specific indicators:

- D_P - PDI - Power Density Indicator
- D_E - AECI - Annual Energy Consumption Indicator

They apply for all traffic areas covered by the series of

Classes M, C and P as defined in EN 13201-2

Both parameters shall be always presented and used together

EN 13201-5 – Energy Performance Indicators

The new EN 13201-4:2015 norm introduces the assessment of the energy performance of a particular lighting system through 2 specific indicators:

- D_P - PDI - Power Density Indicator

$$D_P = \frac{P}{\sum_{i=1}^{i=n_{area}} E_{i\,av}\ A_i}$$

$$[\ W / (\ lx \cdot m^2\ )\ ]$$

It corresponds dimensionally to the inverse of luminous efficacy [lm/W]

EN 13201-5 – Energy Performance Indicators

D_E determines the power consumption during the year according to the areas being illuminated and the regulation systems used

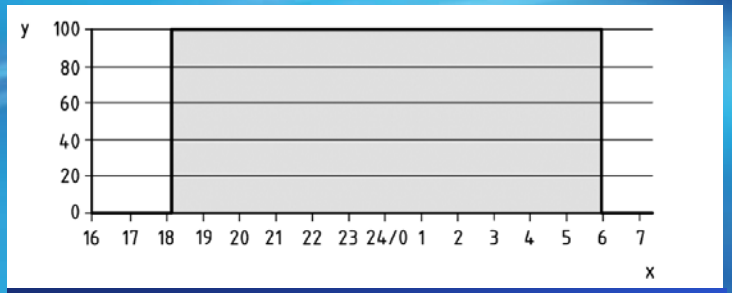
- D_E - AECI - Annual Energy Consumption Indicator

$$D_E = \frac{\sum_{j=1}^{j=m\ \text{periods}} P_j\, t_j}{A}$$

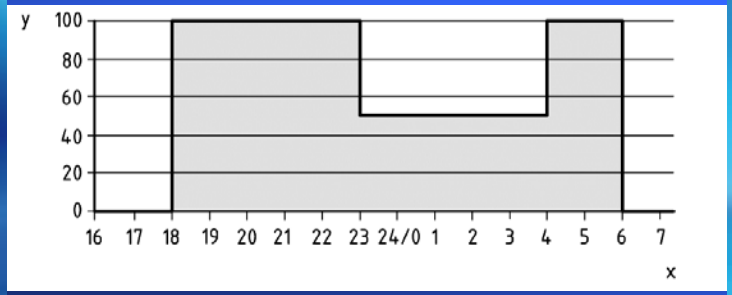
$$[\,W \bullet h / m^2\,]$$

EN 13201-5 – Energy Performance Indicators

D_E is a very useful indicator to help check the regulation systems efficacy in installations with respect to those without (full power operation)



Full power operational profile without regulation systems



Bi-power profile

Tri-power detector-driven operational profile

EN 13201-5 – Energy Performance Indicators

EN 13201-5:2015 introduces 2 additional metrics to help find the best energy saving solution:

- η_{inst} – Installation luminous efficacy

$$\eta_{inst} = C_L \cdot f_M \cdot U \cdot R_{LO} \cdot \eta_{ls} \cdot \eta_P$$

[lm / W]

This parameter is useful to define the installation luminous efficacy: the higher, the better

- q_{inst} – Installation lighting factor

$$q_{inst} = \frac{L_{av}}{Q_0 E_{av}}$$

Dimensionless

This parameter helps lighting designers to find the best luminance solution with the lowest illuminance value according to the lighting class M selected

$q_{inst} > 1$ for a good result

Thank you !

OxyTech

Via Vico 54 – I-20010 Cornaredo Europe

Tel. +39 0293563258 – Fax +39 0293563235

WebOxy: www.oxytech.it

Ref. D1030H-08ai – Rv00 270316 - UK