CASE STUDIES
OUTDOOR LIGHTING EXAMPLES: PLUS FAMILY

Public Lighting Unit System
CASE STUDIES

PLUS* [2011]  +  PLUS ME* [2012]

*ADVANCE LED LIGHTING DESIGN FOR URBAN PUBLIC LIGHTING
PARTNER: Politecnico di Milano - ENEA - Università di Milano - Università la Sapienza
DESIGN BRIEF

ENERGY EFFICIENCY
LOW COST PRODUCTION
OPEN SOURCE LIGHTING
(PATENT 
free)

LIGHTING PERFORMANCES

Street lighting categories
(UNI EN 13201 + UNI 11248)
PLUS
CE + S
PLUS ME
ME3
ME4
ME5 – ME6

Required lighting performances
Street lighting categories
(UNI EN 13201 + UNI 11248)
PLUS
CE + S
PLUS ME
ME3
ME4
ME5 – ME6
DESIGN AND RESEARCH ABOUT LIGHTING FIXTURES
CASE STUDIES DEVELOPED AT THE LABORATORIO LUCE, MILAN

**DESIGN BRIEF**

**COMPONENTS REDUCTION**

- **THERMAL DISSIPATION SYSTEM**
- **PCB**
- **PRINTED CIRCUIT**
- **LEDs**
- **FREE-FORM LENSES**
- **COVER IN PMMA**
- **MECHANICAL CONNECTIONS**

**BIDIMENSIONAL GEOMETRY FOR A LIGHT ENGINE /MODULE**

**INTERCHANGEABLE MODULE**

- **Required lighting performances**
- **Street lighting categories**
  - (UNI EN 13201):
    - PLUS
    - CE + S
    - PLUS ME
    - ME3
    - ME4
    - ME5 – ME6

- **Characteristics**
  - Prestations of light
  - Design solutions
  - Productivity feasibility
> DESIGN BRIEF
> STATE OF THE ART: LED SOURCES + LED LENSES + LED FIXTURE
> REQUIREMENT DEFINITION

DESIGN BY COMPONENTS

POLE + ELECTRONICS + LUMINOUS ENGINE ➔ MODULES

INTERCHANGEABILITY
PARASITING

*techno-shape*

*modules rhythm*
> DESIGN BRIEF

> STATE OF THE ART: LED SOURCES + LED LENSES + LED FIXTURE

> REQUIREMENT DEFINITION

Lighting performances
Design possibilities
Production feasibility

+ ELSE & LESS  formal transformation with material reduction

+ OPEN SYSTEM  system durability throughout modularity

+ RESPONSIBILITY  system efficiency

+ SIMPLICITY  assembling and production
MODULE WITH T-DW LENSES

> DESIGN PLUS MODULES

MODULE WITH T-DN LENSES
> DESIGN OPTICAL PERFORMANCES

PLUS
LEDIL STRADA SQUARED

AVAILABILITY
> DESIGN
Optical performance

T-DW LENSES

T-DN LENSES

DESIGN AND RESEARCH ABOUT LIGHTING FIXTURES  CASE STUDIES DEVELOPED AT THE LABORATORIO LUCE, MILAN [Daria Casciani]
DESIGN AND RESEARCH ABOUT LIGHTING FIXTURES  
CASE STUDIES DEVELOPED AT THE LABORATORIO LUCE, MILAN [Daria Casciani]

> DESIGN
Optical performance
Geometrical definition

> SIMULATING

> TESTING
redefining

LIGHT MASKING
LENS CONFIGURATION
PMMA FLAT SCREEN
DLOR = 81.51 %
CU = 0.49

LIGHT MASKING
LENS CONFIGURATION
PMMA BUBBLE SCREEN
DLOR = 85.25 %
CU = 0.36

LIGHT MASKING
LENS CONFIGURATION
PMMA LENS OFFSET SCREEN
DLOR = 85.96 %
CU = 0.53
DESIGN AND RESEARCH ABOUT LIGHTING FIXTURES
CASE STUDIES DEVELOPED AT THE LABORATORIO LUCE, MILAN [Daria Casciani]

4 MODULES
(T-DW LENSES)
SQUARE APPLICATION
FLUX 4492 LUMEN*

2 MODULES
(T-DW + T-DN LENSES)
STREET APPLICATION
FLUX 2211 LUMEN*

* VALUES DERIVED FROM MEASURED ONES

> DESIGN
Optical performance
Geometrical definition

> SIMULATING

> TESTING
DESIGN AND RESEARCH ABOUT LIGHTING FIXTURES
CASE STUDIES DEVELOPED AT THE LABORATORIO LUCE, MILAN [Daria Casciani]
1.80 m

Modulo sentiero
Doppia illuminazione
2T-DW

1.00 m

Plus Module
For Paths

Scalability
> DESIGN PLUS MODULES

2 DIFFERENT PHOTOMETRIES
12 LEDS + LENSES
DIMENSIONS: 122 x 206 x 35 mm
LUMINOUS FLUX (T-DN): 1088 LUMEN*
LUMINOUS FLUX (T-DW): 1123 LUMEN*

*MEASURED VALUES
DESIGN AND RESEARCH ABOUT LIGHTING FIXTURES
CASE STUDIES DEVELOPED AT THE LABORATORIO LUCE, MILAN [Daria Casciani]

> DESIGN
Thermal performance
Geometrical definition

> SIMULATING
Natsink software
DESIGN AND RESEARCH ABOUT LIGHTING FIXTURES
CASE STUDIES DEVELOPED AT THE LABORATORIO LUCE, MILAN [Daria Casciani]
DESIGN AND RESEARCH ABOUT LIGHTING FIXTURES

CASE STUDIES DEVELOPED AT THE LABORATORIO LUCE, MILAN [Daria Casciani]

> DESIGN

Thermal performance
Geometrical definition

> SIMULATING

\[ T_{\text{AIR}} = 25^\circ C \]
\[ T_{\text{J}} = 56.5^\circ C \]
\[ T_{\text{LED}} = 46^\circ C \]
> DESIGN

Thermal performance
Geometrical definition

> SIMULATING

\[ T_{\text{AIR}} = 25^\circ C \]
\[ T_J = 64^\circ C \]
\[ T_{\text{LED}} = 53^\circ C \]
LENS HOLDER PMMA

12 LEDIL STRADA
Squared T-DN + T-DW LENS
PMMA Plexiglass

12 LED CREE XP-G
FLUX 130 lumen @ 350 mA
CCT 4000 - 5300 K

SEAL FOR IP PROTECTION
(RUBBER EPBM)

MCPCB

HEAT SINK
(aluminium)

SMART MODULE
(communication with Power Supply)

WIRE TO WIRE CONNECTION
MOLEX (Splash Proof)

> DESIGN PLUS
COVER
Anodized Aluminum (die-casting)
Volume: 68.4123 cm³ - Weight: 185 g

LENS HOLDER
Frosted PMMA (laser cutting)
Volume: 7.930 cm³ - Weight: 9.5 g

DOUBLE-FACE TAPE
3M (die-cutting)

ON-BOARD ELECTRONIC MODULE

LEDIL LENS STRADA SQUARED
(PMMA UV STABLE Technology) TAPE

IP SEAL
EPBM RUBBER (die-cutting or laser cutting)
MCPCB

WIRE TO WIRE CONNECTION
Molex Splash Proof

IP SEAL
EPBM RUBBER (die-cutting)

THERMAL HEATSINK
Anodized Aluminum (die-casting)
Volume: 167.140 cm³ - Weight: 451.3 g
### PROs
- Components reductions
- Thickness reduction
- Material reduction
- Minimum Volume
- Better DLOR
- Better CU
- Energy efficiency
- **Best heat sink system**
  (double aluminium - no air)

### CONTRAs
- Lower Maintainance Factor
- Uncertain Lens performances with UV
- Worse DLOR
- Worse CU
- Bigger dimension
- Higher volume and weight

---

**Plexiglass (R) UV STABLE Technology**
DESIGN AND RESEARCH ABOUT LIGHTING FIXTURES
CASE STUDIES DEVELOPED AT THE LABORATORIO LUCE, MILAN
[Daria Casciani]
DESIGN AND RESEARCH ABOUT LIGHTING FIXTURES

CASE STUDIES DEVELOPED AT THE LABORATORIO LUCE, MILAN [Daria Casciani]

PROTOTYPE

Realization
Design Verification Test:
Optical + Thermal Performance