Lighting Retrofit Case Studies in Brasília

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BRAZIL

- South America
- **8,515,767,049 km²**
- 201.7 million of hab.
- Biggest country in South America, 5th in area and population in the world
- Very different climatic conditions in the territory
Brazil: renewable fuel on energy (hydroeletric and etanol)
Electricity consumption in Brazil

47.6% of consumption is in buildings

Source: Balanço Energético Nacional 2013 (Year 2012)
Energy consumption on public sector

- Consumption and energy prices are growing!!!
- Rains are scarce!

Fonte: BEN, 2013
Final uses of energy in non residential buildings in Brazil:

- 20% a 35% ARTIFICIAL LIGHTING
- 40% a 55% AIR CONDITIONING (Geller, 1991; Correia, 2007)

Large part of energy consumed to provide environmental comfort!
PBE EDIFICA
Energy efficiency labelling of buildings

New or existing buildings

From August 2014, obligatory to Federal public buildings!

- Building skin (30%)
- Lighting (30%)
- Air conditioning (40%)

IEA SHC Task 50: “Advanced Lighting Solutions for Retrofitting Buildings”
Brasilia

- 1960
- Planned by Lucio Costa and Oscar Niemeyer

Designed for 500,000 hab -> 2,200,000 hab (2015)
Climate – tropical savanna (Aw)
Latitude 15,55 S
Long. 48 W
*dry winter, humid summer

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<tr>
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<th>jan</th>
<th>fev</th>
<th>mar*</th>
<th>abr</th>
<th>mai</th>
<th>jun**</th>
<th>jul</th>
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<td>C-NE</td>
<td>E</td>
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<td>C-NW</td>
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</table>
Building skin

Tropical architecture?
RETROFIT...

Before

Original brise soleil

After...

Glazing facades

Setor Bancário Sul - Brasília
## Case studies

<table>
<thead>
<tr>
<th>BUILDING NAME</th>
<th>DATE OF MONITORING</th>
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<tbody>
<tr>
<td>0. TCU</td>
<td>02/07/2014 eliminated</td>
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<tr>
<td>1. TJDFT</td>
<td>1.1. 25 and 27/06/2014 (winter -clear sky)</td>
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<tr>
<td></td>
<td>1.2. 16/01/2015 (summer – overcast sky)</td>
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<td>2. MMA</td>
<td>2.1. 27/02/2015 (summer – overcast sky)</td>
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<td></td>
<td>2.2. 30/06/2015 (winter – clear sky)</td>
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<tr>
<td>3. MME</td>
<td>Not monitored – DATA JUST FOR COMPARISON with MMA</td>
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IEA SHC Task 50: “Advanced Lighting Solutions for Retrofitting Buildings”
Case Studies

1. Forum of the Environment and Public Finance (TJDF-T)

New building - designed by arch. Siegbert Zanettini (2011)
Bilateral daylighting access
Positive facades
orientation (Nord/South)
External solar shading systems
Monitored room

• Illuminances
• Luminances

June 9 hs
• Directionality
User’s satisfaction:

• 60 questionaires (June and January-Slightly different)

Internal curtains always closed, artificial lighting on
2. Ministry of Environment (MMA) and Ministry of Energy (MME)
Case studies in Esplanade of Ministries – Brasilia

Ministry of Environment (MMA)  Ministry of Energy (MME)

Total area: 19.873 m² (17.52 x 102.75 m)  9 floors + 3 underground

EAST FACADE: NO EXTERNAL SOLAR PROTECTION  
WEST FACADE: BRISE SOLEIL

IEA SHC Task 50: “Advanced Lighting Solutions for Retrofitting Buildings”
Lighting retrofit MMA (monitored)

- Luminaires with T5 fluorescent lamps 4 x 28W

NO LIGHTING CONTROL SYSTEMS

Control solar film on facades
New divisories
- 7th floor – original
- 6th floor - retrofitted

Lighting retrofit MME (comparison)

Same lighting fixtures and other

AUTOMATED LIGHTING CONTROLS with possibility of individual dimming (each luminaire)
26.02.2015 9 a.m
Global hor illuminance
50.800 lux
Difuse 23.700 lux

26.02.2015 15 p.m.
Global hor il. 38.000 lux
Difuse 12.000 lux
MMA - Monitored rooms – 7th floor (pre retrofit)
ILLUMINANCES: MMA

Ambiente: Sala 724
Dia: 27/02/15 e 04/03/15 (medicação noturna)

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<tr>
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IEA SHC Task 50: “Advanced Lighting Solutions for Retrofitting Buildings”

7L
DIRECTIONALITY: MMA
SALA 724 – ESFERA PERTO DA JANELA

Horário: 09:34 h

Olhando para a janela

Olhando contra a janela

\[ E_{\text{max}} = 1320 \text{ lux} \ (4605 \text{ cd/m}^2) \]
\[ E_{\text{min}} = 94 \text{ lux} \ (327 \text{ cd/m}^2) \]
\[ E (v) = 4277 \text{ cd/m}^2 \]
\[ E (s) = 594 \text{ lux} \ (2072 \text{ cd/m}^2) \]
\[ (v)/E (s) = 2.06 \] (entre 2.0 e 2.5) – Forte
• Luminances

Users try to control glare
User’s satisfaction:

- 120 questionnaires in **four different situations:**
  - East facade pre and post retrofit
  - West facade pre and post retrofit
MME

• In 2013, a new effort was made to improve the lighting system: sensors, dimming in all lamps, automated and individual controls (lamps dimming) – Eco-System (Quantum) LUTRON

• Savings prevision: 9% /year

TO BE EVALUATED...
Preliminary results

• *In all buildings: glare, privacy, sun spots* are reasons to use curtains all the time

• Standard curtains are very bad for daylighting use... (there is no possibility to use daylighting from upper part of windows)
Preliminary Results

• *High influence of users behaviour* on energy consumption – even if they have very sophisticated lighting automated controls, they use very few daylighting (artificial lighting always on, closed curtains)

• *Artificial lighting always on*, even when curtains are opened
THE TEAM...

Márcia and Ludmilla

Marina R.

Marina P.

Julia
THANK YOU!
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