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Retrofitting buildings – what about daylight?

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

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Henning Larsen Architects
Henning Larsen founded the company in 1959

Henning Larsen Architects employs 200 people from 20 different nations

65% of turnover derives from international projects

Projects in more than 20 countries

Offices in Copenhagen, Oslo, Munich, Riyadh and Istanbul
HARPA – Koncert Hall
REYKJAVIK / BUILT
IT UNIVERSITET
KØBENHAVN / BUILT
NEW HERLEV HOSPITAL
DANMARK / DESIGN STAGE
The sustainability department employs 12 engineers and architects.

Strong engagement in research Projects

New scientific knowledge on sustainability is applied in the early design phases.

Sustainable by design
“Sustainability is more than technology and daylight is more than architecture”
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Algreen Arkitekter v. Charlotte Algreen
RETROFITTING WITH DAYLIGHT
WHO BENEFITS AND INFLUENCES?

Authorities
- Environment
- Social capital

Owners
- Market value

Residents
- Quality of life
RETROFITTING WITH DAYLIGHT
URBAN SPACE
RETROFITTING WITH DAYLIGHT

3 implementation levels

1. Urban space
2. Buildings
3. Housing
RETROFITTING WITH DAYLIGHT

URBAN SPACE
“High-density cities and daylight are not necessarily conflicting entities”
RETROFITTING WITH DAYLIGHT
URBAN SPACE
RETROFITTING WITH DAYLIGHT

URBAN SPACE

New building volumes *increase* square meters
RETROFITTING WITH DAYLIGHT
URBAN SPACE

Demolitions increase daylight levels and create new routes and passages
RETROFITTING WITH DAYLIGHT
URBAN SPACE

Before

After
More m² can increase the sunlight level in urban areas and improve urban spaces
RETROFITTING WITH DAYLIGHT
URBAN SPACES

RESULT
+ 20% increase in square meters
+ 10-15% more sun on the facades
+ 15-20% more sun at ground level
+ Higher quality outdoor areas and green spaces
RETOFITTING WITH DAYLIGHT BUILDINGS
RETROFITTING WITH DAYLIGHT BUILDINGS

“Variation is the key word. Tall and low buildings distribute daylight and attract different residents, stimulating urban life.”
RETROFITTING WITH DAYLIGHT BUILDINGS

Light-coloured **facade materials** increase the daylight level in urban areas and backyards by up to 75%
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RETROFITTING WITH DAYLIGHT
BUILDINGS

**Sunlight design** increases sunlight and daylight levels in backyards and residences.
RETROFITTING WITH DAYLIGHT BUILDINGS

RESULT

+ 10-20% increase in daylight levels in urban areas and backyards
RETROFITTING WITH DAYLIGHT

HOUSING
RETROFITTING WITH DAYLIGHT
HOUSING

“The market value of an 80 m² apartment in Copenhagen increases with 20,000 €, with every floor above ground level, simply due to increased daylight”
RETROFITTING WITH DAYLIGHT HOUSING

6 strategies

1. Insulation and ventilation
2. Installing double glazing windows
3. Installing new windows
4. Increasing window size
5. Insulation, ventilation and increasing window size
6. Insulation, ventilation, increasing window size, and installing a French window
RETROFITTING WITH DAYLIGHT HOUSING

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RETROFITTING WITH DAYLIGHT HOUSING

Strategy 1: means

No insulation
U-value: 1.2 W/m²K
Natural ventilation

New insulation: 100mm
U-value: 0.27 W/m²K
Mechanical ventilation
RETROFITTING WITH DAYLIGHT HOUSING

Strategy 1: results

No insulation
DF=1.92%

New insulation: 100mm
DF=1.73%
RETROFITTING WITH DAYLIGHT HOUSING

Strategy 1: results

<table>
<thead>
<tr>
<th>Energy consumption, kWh/m²/y</th>
<th>No insulation</th>
<th>New insulation: 100 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity use in building operation</td>
<td>165</td>
<td>101</td>
</tr>
<tr>
<td>Cooling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating</td>
<td></td>
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<tr>
<td>Heated water</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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RETROFITTING WITH DAYLIGHT HOUSING

Strategy 1: results

RESULT

-40% decrease in energy consumption
-10% decrease of daylight
RETROFITTING WITH DAYLIGHT HOUSING

Strategy 4: means

**Window**
- 1 layer
- Window percentage: 33%
- U-value: 4.2 Wm²K
- LT: 89%
- G-value: 0.85
- Proportions of glass: 0.60%

**French window**
- 2 layer
- Window percentage: 49%
- U-value: 1.7 Wm²K
- LT: 78%
- G-value: 0.68
- Proportions of glass: 0.70%
RETROFITTING WITH DAYLIGHT HOUSING

Strategy 4: results

Window
DF=1.92%

French window
DF=2.48%
RETROFITTING WITH DAYLIGHT HOUSING

Strategy 4: results

![Energy consumption graph showing comparison between window and French window with values 165 kWh/m²/y and 126 kWh/m²/y respectively.](image)
RETROFITTING WITH DAYLIGHT HOUSING
Strategy 4: results

RESULT
- 25% decrease in energy consumption
+30% increase of daylight
“Performance-based architecture addresses the importance of outdoor climate, as well as indoor climate. We need new knowledge and methods to substantiate this”
Thanks
www.henninglarsen.com