INCREASING THE ENERGY EFFICIENCY OF GLASS FAÇADES

TU Delft - Faculty of Architecture
Content

- Introduction
- Analyses
- Design
- Conclusions & recommendations
Introduction
Inspiration

- Increasing use of glass in architecture
- Increasing need for energy reduction and sustainable energy
Problem definition

“How to use photovoltaic cells to improve current glass façades, so that they comply with the technological and social demands required five years from now?”
Analyses

- PhotoVoltaic cell (PV-cell)
- Building Integrated PhotoVoltaics (BIPV)
- Slat
## PV-cell

<table>
<thead>
<tr>
<th>Technology</th>
<th>Crystalline silicon</th>
<th>Thin film</th>
<th>GaAs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>mono</td>
<td>poly</td>
<td>a-Si</td>
</tr>
<tr>
<td>Cell efficiency&lt;sup&gt;1)&lt;/sup&gt;</td>
<td>16-22%</td>
<td>14-16%</td>
<td>8-11%</td>
</tr>
<tr>
<td>Price/m²&lt;sup&gt;3)&lt;/sup&gt;</td>
<td>~660-720€</td>
<td>~550-600 €</td>
<td>~ € ?</td>
</tr>
</tbody>
</table>

**Sources:**
1. D. Fraile – European Photovoltaic Industry Association (EPIA)
2. B. Ehlen – Energieonderzoek Centrum Nederland (ECN)
3. D. Moor – Ertl Glas AG/ertex solar

Final presentation - Janneke van Kilsdonk - 9th April 2010
PV-cell – polycrystalline silicon

PV cell

Module
Building Integrated PV (BIPV)

- On-roof system
- In-roof system
- Skylight
- External building wall
- Semi-transparent façade
- Shading system
BIPV - types

- On-roof system
- In-roof system
- Skylight
- External building wall
- Semi-transparent façade
- Shading system
BIPV - choice

On-roof system
In-roof system
Skylight
External building wall
Semi-transparent façade
Shading system
BIPV – reference projects sun shading

GEG office building
BIPV – reference projects sun shading

Townhall Oss
BIPV – reference projects sun shading

ECN
BIPV – reference projects sun shading

Keuringsdienst
Slat

- Efficiency PV-cell
- Sun shading function
- User comfort
Slat – Efficiency PV-cell

summer

winter

156 mm

d = 361 mm
Slat – Sunshading function

Extension of slat

l = 360 mm

d
Slat – User

Daylight View Glare
Slat – final design

Positioning automatic, but user can always overrule the system.
Slat – final design
Design

- Concepts
- Materialization and detailing (BIPV)
- Final design
Concepts

200 mm
Concepts

a) Frame
b) Fischer
c) Glass
d) Hybrid
Concept: a) Frame
Concept: b) Fischer
Concept: c) Glass
Concept: d) Hybrid
# Concepts – Comparison

<table>
<thead>
<tr>
<th></th>
<th>One piece</th>
<th>Produced by glass product manufacturer</th>
<th>Market ready as soon as possible</th>
<th>Weight</th>
<th>Easy transportable</th>
<th>Easy to dismount/disassemble</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Fischer</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Glass</td>
<td>0</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Hybrid</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0</td>
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</table>
Concept – choosen Fischer
Materialization and detailing

- Connection support
- Rotating mechanism
- Connection slat-support
- Connection facade element
Connection support
Rotating mechanism
Rotating mechanism

Kraanspoor
Rotating mechanism
Connection slat-support
Connection facade element

Sources:
Final design

synergy
Design: synergy
Mounting order
Mounting order
Mounting order
Mounting order
Mounting support
Mounting support
Mounting support
Mounting support
Connection façade element

Standard curtain walling

BRS glazing fins
View from outside
View from inside
View from inside
View from inside
Conclusions & recommendations
Conclusions

- Optimal rendement
- Good sun shading system
- Designed from user perspective
- Innovative by integrating 3 aspects above
- Freedom for architect how to connect the element
Recommendations

- Choosing foil extension slat
- Integration with decentralized climate installation
- Feedback user energy generation
Questions?