POLYCARBONATE MEDIA FACADES

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The problem statement

My fascination when applying to TU Delft (media facades)

• Facade companies’ opening in NL investing in media facades
• Marketing importance and advertisement
• Media facade for an office building by Rollecate
• Upgrade polycarbonate facades
Building examples (case studies)

Rodeca

Rollecate office
Criteria

What is the state of the art technology to design a multimedia facade and which are the ways to improve it?

- **Transparent** material (not a totally blocked view)

- Good quality **graphics** (videos and images)

- Competitive **price** (comparison)

- **Maintenance** and reversibility (fixing possibilities)

- **Day** and **night** use (intensity of lights)
First part of the research

- Related to media facade technologies and costs

- What technology do they use? (LEDs and OLEDs)

- LEDs and OLEDs (lifetime, efficiency, cost, brightness)
LEDs and OLEDs

- Limited lifetime of the organic materials (carbon)/thinner layer/sensitive to oxygen/UV exposure (degradation). Life span of LEDs 50,000h - OLEDs 15,000h

- Efficiency (how well a light source produces visible light) of OLEDs is 100lm/W under test while on LEDs 200lm/W in production

- Manufacturing processes are too expensive and under testing constantly
LEDs and OLEDs

• Brightness of LEDs already 1,700 nits and will reach 8,000 while OLEDs recently developed the first PMOLED with 1,000 nits

• OLEDs are more appropriate for small applications to achieve high contrast and resolution
Addressable RGB strip

What is the technology to produce animated images with LEDs?

- **GND = Ground** (close the circuit)
- **Di = Data in** (data input for the controller chips)
- **5V = Volts** (power supply)

Chips between LEDs take commands from a microcontroller.
Media facade technologies

LED bars are 8 to 14 mm thick

King’s Road Tower, Jedahh

SUMMARY

Minimum distance from viewer

<table>
<thead>
<tr>
<th>Pitch (mm)</th>
<th>Night use</th>
<th>Shadow</th>
<th>Day use</th>
</tr>
</thead>
<tbody>
<tr>
<td>30x30</td>
<td>400 Nits</td>
<td></td>
<td>18 m</td>
</tr>
<tr>
<td>50x50</td>
<td>1500 Nits</td>
<td></td>
<td>30 m</td>
</tr>
<tr>
<td>100x100</td>
<td>5000 Nits</td>
<td></td>
<td>90 m</td>
</tr>
</tbody>
</table>

Brightness (incl glass TL)
1 nits = 1 cd/m²

Standard system
• Black grid
• Maintenance
Media facade technologies

<table>
<thead>
<tr>
<th>Specification</th>
<th>V4xH5.0</th>
<th>V5xH5.0</th>
<th>V6xH5.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical LED Pitch</td>
<td>40mm</td>
<td>50mm</td>
<td>60mm</td>
</tr>
<tr>
<td>Horizontal LED Pitch</td>
<td>50mm</td>
<td>50mm</td>
<td>60mm</td>
</tr>
<tr>
<td>NIT m²</td>
<td>7766-9527</td>
<td>6213-7621</td>
<td>5172-6351</td>
</tr>
<tr>
<td>Open Area</td>
<td>56.2%</td>
<td>58.1%</td>
<td>59.4%</td>
</tr>
<tr>
<td>Viewing Distance</td>
<td>35m/115ft</td>
<td>35m/115ft</td>
<td>42m/138ft</td>
</tr>
<tr>
<td>Weight (lbs per ft²)</td>
<td>1.9</td>
<td>1.77</td>
<td>1.7</td>
</tr>
<tr>
<td>Rods Between LED Tubes</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

*Table data February 2013

mediamesh

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Sleeves woven into mesh
Resin
LED
Aluminium profile

P= cable pitch
X= horizontal pixel spacing
Y= vertical pixel spacing

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• Maintenance
• Additional element
Powerglass

- Transparent wires but limitation in pixel pitch, graphics and serviceability
Cost of media facades

Filters:
• good quality graphics,
• day-night use,
• top companies
• light transmission allowance

Depends mainly on pixel pitch and brightness

GKD 7.000€/m²
Bus Authority 557m² - 4 million €
Pixel pitch 50 mm
Brightness 4,730 nits

LEUROCOM 7.000€/m²
Imaginarium 23m² - 160,000 €
Pixel pitch 25 mm
Brightness 5,000 nits
Rollecate media facade cost

**Brakel Atmos**
- 32 m² 203,000 €
- 6,000 €/m²
- Pixel pitch 45 mm
- Brightness 5,000 nits

**Philips**
- 63 m² 213,000 €
- 3,400 €/m²
- Pixel pitch 50 mm
- Brightness 1,040 nits

Day and night use

Night use
1st design attempt

- Glass integrated LEDs with no mullions
- Minimise the connections between the panels and **spider glazing** solution
- Use of transparent PCB circuits for more light transmission
2D planar component
Issues

- Spider glazing is used to **minimize** dimensions of panels while here are 1,5 x 3 m

- This façade system allows **deformation** up to 50mm so cables on the slab will be damaged

- **Maintenance** issues for the LEDs (whole panel needs to be changed)

- No **sun shading** integrated

- **Limitation** in pixel pitch with the intermediate mullions
Second part of the research (Polycarbonate structural sheets)

Polymers containing carbonate groups

Production: extrusion technology up to 30 m length

- impact resistance
- optical properties
- temperature and fire resistance
Multiwall systems

- Click system
- Curtain wall
- Several thickness
- Versatility for any facade
- Colour variety
PCSS vs Glass

- **Brittle resistance** 20 times more
- **Ultimate strength** 2 times more
- Better **thermal resistance** (U-value up to 0.83 – like triple glazed with argon and low-e coatings)
- **Lighter weight** 10 times
- **Cold bending**
- **Cheaper** solution
- Light and **simple framing**
Glass vs PCSS

- Transparency
- Better fire resistance and lifespan
  (Softening point 600°C)
- Less deformation so better Young’s modulus
PCSS Reference projects

- Filter selection for walls
- Under structure
- Quicker and easiest installation for maintenance
Design stage *(polycarbonate & LEDs)*

- Same product **lifespan** (10 years PCSS and 12 hours per day for LEDs)
- **Pixel pitch variety** starting from 12 mm
- **Temperature** checks for the combination
- Easy separation for **reuse** (polycarbonate is a thermoplastic and LEDs can be recycled)

<table>
<thead>
<tr>
<th>Pixel pitch (mm)</th>
<th>Minimum viewing distance (m) Multiply by 1400 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>17</td>
</tr>
<tr>
<td>25</td>
<td>35</td>
</tr>
<tr>
<td>35</td>
<td>50</td>
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<tr>
<td>50</td>
<td>70</td>
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<tr>
<td>65</td>
<td>90</td>
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<tr>
<td>80</td>
<td>115</td>
</tr>
<tr>
<td>95</td>
<td>135</td>
</tr>
</tbody>
</table>
1st design

• 50 mm pixel pitch

• 5.600 nits

• Media facade for a raised shopping mall

• Example in Delft central square for distances

• Click fix system

• 50 mm thickness (most commonly used) 1 x 9 m

• U value 0,83 W/m²K

• Led strips every 4th chamber
Corner details to avoid interruption of image
2\textsuperscript{nd} design

- 25 mm pixel pitch
- 22,400 nits
- Curved media facade for a public building 5 x 18 m
- 25mm thickness PCSS 1 x 18 m
- Example in Delft City Hall
- Grip locked system
Fiberglass insulation 40 mm
Main data converter
Microcontroller
Gypsum cover
LED cables
20 mm hole cable path
Thermaly broken aluminum profile
Aluminum horizontal click profile
LED strip 12 mm
Polycarbonate panel 25 mm
Steel column H profile 100 x100 mm
Mock up

Minimum viewing distance needs to be higher than suggested by companies
Museum of energy Spain
25 mm pixel pitch from 30 m viewing distance-afternoon
Piccadilly Circus London
25 mm pixel pitch from 30 m viewing distance
Rollecate warehouse day
25 mm pixel pitch from 35 m viewing distance with direct sunlight
Rollecate warehouse night
25 mm pixel pitch from 35 m viewing distance
Evaluation

*Initial standards*

- **Light transmission** 72-50% but not 95% like glass

- **Good quality graphics** by easily adjusting pixel pitch variety >12 mm

- **Cost effective** solution (8 times cheaper than Philips and 35% less cost for a 25 mm than Brakel Atmos)-(10 and 8 times cheaper than GKD and Leurocom)

- **Maintenance** (LEDs are independent from PCSS, no lamination process or special enclosure)

- Use in **day** and **night** (above 50 mm pixel pitch sunlight affects the quality)
Evaluation

• **Limited life** of polycarbonate material and affected by the time (degradation and softening although the UV protection)

• Cannot be applicable in high rise buildings due to strong **wind loads** and pressures on the material

• Not applicable in **hot climates** in combination with the LEDs temperature emission

• **Sample** of 1:1 necessary and the distances increased
Further steps

• **Interactive** LED facade using motion or pressure sensors (passing train)

IR sensors (usually < 1m)

Ultrasonic sensors 6-10 m easily
XLamp® XP-e LED

Possible application for better performance with direct sunlight in a media facade

7 times light of sun (PCB)

27 times light of sun (PCB strip)
Future potential
Thank you