Shortwave Studies with RADIANCE in the Historic Center of Bayonne

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Thermograms
Simulations
with FEM
Thermograms Simulations with FEM

Daylight Study in a LightWell
Thermograms Simulations with FEM

Photograph (left) and Thermogram (right) of Bayonne street at 13h
Thermograms Simulations with FEM

Conduction - Fourier’s law

Convection - Newton’s law

Radiation - Stefan-Boltzmann’s law

Longwave (greater than 4 μm)
Conduction - Fourier's law

Convection - Newton's law

Radiation

Longwave (greater than 4 μm) - Stefan-Boltzmann's law

Shortwave (less than 4 μm)

Radiant Power Absorbed as Input
(Absorbed$_i$ = (1-$r_i$) Irradiance$_i$)

from Radiosity or RADIANCE simulations
Views of the simplified model of the street
Photograph (left), thermogram (center), and simulated thermogram (right) of Bayonne street at 13h
Improve the level of detail in:

- Geometry
Photograph of Tonnelier street (left) and Irradiance map from rfluxmtx simulation (right) of Bayonne street at 13h.
Improve the level of detail in:

- **Geometry**
- **Materials characteristics**

  Reflectance heterogeneity
  Transmittance and
  Specular Reflection of windows
<table>
<thead>
<tr>
<th>Materials</th>
<th>Specular Transmission</th>
<th>Specular Reflection</th>
<th>Fresnel’s Law (angular dependence)</th>
</tr>
</thead>
<tbody>
<tr>
<td>glass</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>trans</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>mirror</td>
<td></td>
<td>X</td>
<td></td>
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<tr>
<td>BRTDfunc</td>
<td>X</td>
<td>X</td>
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<tr>
<td>BSDF</td>
<td>X</td>
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<tr>
<td>glass + mirror</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>glass + brightfunc</td>
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Irradiance maps of a North building facade during a April clear day at 13h

- Diffuse Reflections
- Specular Reflections
+ Diffuse Reflections
- Specular Reflections
+ Diffuse Reflections
+ Specular Reflections

Mean: 7 W/m²
Mean: 67 W/m²
Mean: 74 W/m²

Δ ≈ 10%
rfluxmtx -I -y ≈100000 -ab 7 -ad 100000
Model

Calcul
- UDI 100-2000 Lux
- Daylight Coefficients (2PM)
  rfluxmtx
Base Model

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<thead>
<tr>
<th>UDI</th>
<th>%Surf.</th>
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<td>100-2000</td>
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<tr>
<td>UDI &gt; 50</td>
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<td></td>
<td>0%</td>
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<td></td>
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White Walls

<table>
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<tr>
<th>UDI 100-2000</th>
<th>%Surf. UDI &gt; 50</th>
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<tr>
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<td>97%</td>
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<td>100%</td>
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</tr>
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<td></td>
<td>47%</td>
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<tr>
<td></td>
<td>10%</td>
</tr>
</tbody>
</table>
White Walls

UDI
100-2000

% Surf.
UDI > 50

-ab 13

-ab 5
3 Mirror-Walls

UDI
100-2000

%Surf.
UDI > 50

99%

95%

100%

95%

77%
Thermograms Simulations with FEM

Daylight Study in a LightWell
Thank you for your attention