THE INFLUENCE OF THERMOCHROMIC GLAZING PARAMETERS ON ENERGY SAVING AND COMFORT CRITERIA USING MOMENT-INDEPENDENT MEASURE

Arthur Ah-Nieme, Bruno Malet-Damour, Dimitri Bigot, Stéphane Guichard, Harry Boyer

To cite this version:

Arthur Ah-Nieme, Bruno Malet-Damour, Dimitri Bigot, Stéphane Guichard, Harry Boyer. THE INFLUENCE OF THERMOCHROMIC GLAZING PARAMETERS ON ENERGY SAVING AND COMFORT CRITERIA USING MOMENT-INDEPENDENT MEASURE . Assemblée Générale du laboratoire PIMENT 2017, Nov 2017, Petite-Île, Réunion. hal-01654443

HAL Id: hal-01654443
https://hal.univ-reunion.fr/hal-01654443
Submitted on 4 Dec 2017

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
THE INFLUENCE OF THERMOCHROMIC GLAZING PARAMETERS ON ENERGY SAVING AND COMFORT CRITERIA USING MOMENT-INDEPENDENT MEASURE

AIM OF THE STUDY
Identify the influence of thermochromic glazing parameters for office buildings in hot climates using dynamic building simulations and sensitivity analysis techniques.

BACKGROUND
Thermochromic glazing (TC): Has the capability to modulate its thermo-optical properties dynamically and reversibly when a change in its temperature occurs.

TC glazing for building application
• Has to be doped with other metals to improve its properties:
  • Transition temperature
  • Visible Transmittance
  • Solar modulation
• Has a potential to:
  • Reduces energy consumption (Hoffmann et al., 2014)
  • Improves thermal and visual comfort (Costanzo et al., 2016)
• Has a greater efficiency for hot climates (Saëli et al., 2010)

METHODOLOGY
• Thermal and daylighting simulations with EnergyPlus
• Sensitivity analysis method with a Python code with the SAlib library
• Analysis on several indexes and on 4 locations (hot tropical climates)

SENSITIVITY ANALYSIS
Moment-Independent Measure (Borgonovo, 2007):
The assessment of “the influence of the entire input distribution on the entire output distribution without reference to a particular moment of the output”

<table>
<thead>
<tr>
<th>INPUT VARIABLES</th>
<th>SYMBOL</th>
<th>RANGE</th>
<th>UNIT</th>
<th>PROBABILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Orientation</td>
<td>BO</td>
<td>0-360</td>
<td>°C</td>
<td>Continuous; Uniform</td>
</tr>
<tr>
<td>Window to Wall Ratio</td>
<td>WWR</td>
<td>0.5-99</td>
<td>%</td>
<td>Continuous; Uniform</td>
</tr>
<tr>
<td>Insulation Thickness</td>
<td>δtot</td>
<td>0.01-0.7</td>
<td>m</td>
<td>Continuous; Uniform</td>
</tr>
<tr>
<td>Weather File</td>
<td>wea</td>
<td>1-4</td>
<td>-</td>
<td>Discrete; Uniform</td>
</tr>
<tr>
<td>Switching Temperature</td>
<td>Tτ</td>
<td>5-70</td>
<td>°C</td>
<td>Continuous; Uniform</td>
</tr>
<tr>
<td>Switching Temperature range</td>
<td>ΔTτ</td>
<td>1-50</td>
<td>°C</td>
<td>Continuous; Uniform</td>
</tr>
<tr>
<td>Solar Transmittance Max</td>
<td>τmax,sol</td>
<td>0.3-0.9</td>
<td>-</td>
<td>Continuous; Uniform</td>
</tr>
<tr>
<td>Solar Transmittance range</td>
<td>Δτsol</td>
<td>0.01-0.5</td>
<td>-</td>
<td>Continuous; Uniform</td>
</tr>
<tr>
<td>Visible Transmittance Max</td>
<td>τmax,vis</td>
<td>0.3-0.9</td>
<td>-</td>
<td>Continuous; Uniform</td>
</tr>
<tr>
<td>Visible Transmittance range</td>
<td>Δτvis</td>
<td>0.01-0.5</td>
<td>-</td>
<td>Continuous; Uniform</td>
</tr>
<tr>
<td>Number of states</td>
<td>State</td>
<td>2-20</td>
<td>-</td>
<td>Discrete; Uniform</td>
</tr>
</tbody>
</table>

4096 simulations were performed

REFERENCES

ARThur J.P. Ah-Nieme
B. Malet-Damour, D. Bigot, S. Guichard, H. Boyer
artur.ah-nieme@univ-reunion.fr
Article accepted in the Australasian Building Simulation Conference
15 – 16 November 2017 – Melbourne