IEA ACTIVITIES TOWARDS STANDARDIZATIONS FOR DAYLIGHT SYSTEM CHARACTERIZATIONS AND HOURLY RATING METHODS

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Founded 1976 (Prof. Dr. h.c. Ing. Christian Bartenbach)

Independent from manufacturers

90 employees, ca. 40 in lighting design

Locations: Aldrans, Austria

more than 10,000 projects worldwide
OUR RANGE OF SERVICES
Tailored to suit your needs
ARTIFICIAL LIGHTING DESIGN
COMPLETE LIGHTING SOLUTIONS

ARTIFICIAL LIGHTING DESIGN
DAYLIGHTING DESIGN
MODEL BUILDING & VISUALISATION

OUR RANGE OF SERVICES
Tailored to suit your needs
IEA SHC Task 61 / EBC Annex 77
Integrated Solutions for Daylight and Electric Lighting

From component to user centered system efficiency
IEA SHC Task 61 / EBC Annex 77

Integrated solutions for daylight and electric lighting

*From component to user centered system efficiency*

Operating Agent: J. de Boer, Germany

**Subtask A**
B. Matusiak, Norway
User Perspective, Requirements

**Subtask B**
M. Fontoynont, Denmark
Integration and optimization of daylight and electric lighting

**Subtask C**
D. Geisler-Moroder, Austria
Design support for practitioners
(Tools, Standards, Guidelines)

**Subtask D**
N. Gentile, Sweden
W. Osterhaus, Denmark
Lab and field study performance tracking

**Joint Working Group**
Evaluation method for integrated lighting solutions
Virtual reality (VR) based Decision Guide
IEA SHC Task 61 / Annex 77

Subtask C: Design Support for Practitioners

Objective

Focus on the application of technical innovations in the field of integrated lighting solutions in practitioners’ workflows. Bring findings onto the desktops of designers by integration into widely used software tools, standards and codes, and design guidelines.

C.1 Review of state of the art design workflows

C.2 Standardization of BSDF daylight system characterization

C.3 Spectral sky models for advanced daylight simulations

C.4 Hourly rating method for integrated solutions
Hourly Rating Method

Overall model

Input
- Location, climate (TRY)
- User requirements (Profiles)
- Space

Components
- Electric Lighting
- Facade (Light and radiation)
- Light-management
- Network (Light, Light with other trades)

Sub models
- A: Facade model: Daylight and solar radiation
- B: Electric Lighting
- C: Light Management
- D: Network Model
- E: User- and Usage Models
- F: Calculation Control

Output
- Lighting
  - Energy
  - Demand profiles
  - Illuminances
  - Daylight Autonomy
  - Light quantities
  - Match with solar model
- Solar gains
  - Energy
  - Demand profiles
  - effective g-Values
  - Match with lighting model
- Effect on humans
  - Glare indication
  - Lighting quantity ($v(\lambda)$)
  - Radiation at other sensitivities (e.g. $s_{\text{rad}}(\lambda)$)
Relation to BACS

Translation into ISO 16484 logic

- “Emulation” / Modeling of inputs & outputs
- BMS: BACS logic
  - Sensors & Actors
  - Functions
Integrated Daylight and Electric Lighting
Formal „Room Control Schematic“ according to ISO 16484
"Daylight Emulation": Three-Phase-Method

\[ I \text{ result} = V \text{ view matrix} \times T \text{ BSDF} \times D \text{ daylight matrix} \times S \text{ sky distribution} \]
BSDF?
BSDF – Standardization

COC

IES/LDT

BSDF

!?
BSDF – Standardization
Sensitivity Analysis

Blinds, 00deg tilt
CIE Sunny Sky
21 March, 10am
Innsbruck, Austria (47.3N / 11.4E)

Geometry
Ev 1490 lx
DGP 0.26

Klems aBSDF
Ev 3340 lx
DGP 0.59

Klems BSDF
Ev 2650 lx
DGP 0.35

tt46 aBSDF
Ev 1530 lx
DGP 0.26

tt46 BSDF
Ev 1530 lx
DGP 0.26
# BSDF – Discretization and data format

## Established data formats

<table>
<thead>
<tr>
<th>Name</th>
<th>Input resolution</th>
<th>Output resolution</th>
<th>Currently used by software</th>
</tr>
</thead>
<tbody>
<tr>
<td>WINDOW 6 standard basis</td>
<td>Klems (145)</td>
<td>Klems (145)</td>
<td>WINDOW7, Relux, Radiance</td>
</tr>
<tr>
<td>IEA 21</td>
<td>Tregenza (145)</td>
<td>5deg full, i.e. 5°x5° (1297)</td>
<td>Relux, Radiance, Dialux</td>
</tr>
<tr>
<td>Shirley-Chiu</td>
<td>variable (limitation through data size)</td>
<td>variable (limitation through data size)</td>
<td>Radiance</td>
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## XML file format

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      <PhiL>95</PhiL>
      <Theta>146</Theta>
      <Phi>95</Phi>
    </GridPoints>
  </Header>
</Material>
```
### Task | Simulation method | System characterization / BSDF
---|---|---
Daylight Factor | Raytracing possibly mkllum continuous sky model | (a) Geometry (b) Low-res BSDF
Point-in-time illuminance for overcast / sunny sky | Raytracing continuous sky model | (a) Geometry (b) Low-res BSDF
Point-in-time glare metric for overcast / sunny sky | Raytracing peak extraction continuous sky model | (a) High-res BSDF (b) Low-res BSDF (with peak extraction)
Point-in-time rendering for overcast / sunny sky | Raytracing peak extraction continuous sky model | (a) High-res BSDF (b) Low-res BSDF if peak extraction
Annual illuminance metric | DC-method or 3-PM | Low-res BSDF
Annual glare metric | 5-PM peak extraction | Low-res BSDF and (a) Geometry or (b) High-res BSDF or (c) Low-res BSDF (only if PE)
Aim

The „right“ system data for

- Transparent systems¹
- Woven shades
- Venetian blinds
- Specular blinds / grids
- Micro-/Nano-structured systems
- Prisms, LCPs

¹ Clear / electrochromic glazing, films
Task Force „Revision of ISO 10916“

Proposed new scope

- extend ISO 10916 to an hourly based (annual) estimation of the daylight supply in buildings
- based on location and local climate data
- include facades with and without shading systems
- allow to model different daylighting control strategies including linkage with electric lighting systems (e.g. indoor occupation sensing)
- appropriate interface with BACS formalism
Acknowledgments

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