Daylight Design: Metrics and Methods for the B3 Guidelines

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Presented live via Zoom
Agenda

- Housekeeping
- General B3 Updates
- Updated Lighting and Daylighting Guideline
  - Spatial Daylight Autonomy
  - Daylight Factor
  - Small Buildings
- Daylighting Guideline Update Process
- Modeling and Documentation for Compliance
  - Software options
  - Spreadsheets
- Case Studies and Examples
Learning Objectives

- Understand the importance of daylight in design for energy use, occupant satisfaction, and productivity
- Understand how daylight design can be included in new construction and renovation projects
- Understand the different metrics that may be used to document compliance with B3, including for smaller buildings
- Understand how to document B3 compliance and track regularly occupied spaces
Webinar Logistics

• Recording and slides from this session will be posted on the B3 Training and Education page - https://www.b3mn.org/guidelines/training-and-education/

• Attendees will be muted throughout presentation

• Please use Q&A function for questions as they arise. Questions will be addressed at the end of each section and at the end of the presentation

• Closed captioning is available for this webinar via the menu in your Zoom window
B3 News

Upcoming training sessions:

• Site and Water Updates including Small and Constrained Sites
  • [https://z.umn.edu/2022B3SmallSites](https://z.umn.edu/2022B3SmallSites)
  • Tuesday, May 24th, 2pm-3pm, Zoom

• Whole Building Life Cycle Assessment for the B3 Guidelines
  • Registration link coming soon
  • 2 sessions:
    • June 7th, 1pm-3pm, Zoom
      • Introduction and Overview
    • June 9th, 1pm-3pm, Zoom
      • Workshop
Guideline Updates:

• Small Buildings Method now available

• Small Sites and Daylighting update coming soon
  • Site and Water updates draft available for comments until May 6th
Intent of Guideline Revisions

- Bring B3 up-to-date with the latest national standards and green rating systems
- Revise performance standards and requirements to reflect the current state of the building industry in Minnesota
- Reduce the administrative burden for project teams
- Improve the sustainable performance of projects in the future
Guideline I.5 Lighting and Daylighting

Intent

To promote occupant comfort by providing adequate levels of natural and artificial light to maintain sufficient light levels for tasks being performed. Quality lighting can also support cognitive function, mental health, and social interaction while being aesthetically pleasing and complementing the design of the space.
1. Provide adequate light levels according to Illuminating Engineering Society (IES) guidelines not including daylighting contributions for regularly occupied spaces. These light levels shall be:

i. Measured at task plane.

ii. Maintain contrast levels by demonstrating one of the following:

   (1) Average wall surface to average work surface illuminance level ratio: 1:3.

   (2) Average ceiling surface to average work surface illuminance level ratio: 1:10.
1. Use light sources with a color rendering index (CRI) of at least 80, unless necessary for special use.

2. All light sources should be Restriction of Hazardous Substances (RoHS) compliant following the most current European RoHS requirements.
I.5C: Daylighting

1. On facades facing within 45 degrees of east, south or west: provide glare control devices with manual operation (or automatic with manual override) for 90% of all regularly occupied spaces.

2. Demonstrate daylight utilization with one of the following:
   i. Spatial Daylight Autonomy (sDA30fc/50%) in at least 50% of Regularly Occupied Floor Area. I.e., at least 50% of the Regularly Occupied Floor Area must achieve a minimum of 30fc for at least 50% of operating hours per year. OR
   ii. Daylight Factor (DF) of at least 1.0% in 50% in Regularly Occupied Floor Area
I.5C: Daylighting

*Regularly Occupied Space:*

Any space that is occupied by one or more persons for more than one hour during days the building is in use. Note that this includes spaces which may be irregularly occupied but, when occupied, a typical occupant would spend more than one continual hour in the space. Excluded from calculation of continuously occupied spaces are:

- Spaces with uses that only require minimal lighting and in which the primary activity intended for the space would be harmed by daylight (this exclusion does not apply to spaces with ultraviolet light concerns) – note that this only applies to the calculation of regularly occupied spaces with respect to the daylighting requirements.

- Spaces that do not meet the minimum occupancy outlined above during daylight hours – note that this only applies to the calculation of regularly occupied spaces for the daylighting criteria with respect to the daylighting requirements.

- Spaces where no individual occupant spends at least one continual hour during days the building is in use.

*Regularly Occupied Floor Area:*

The total floor area within Regularly Occupied Spaces, as defined above.
Regularly Occupied Spaces Example

- Can be based on plans, program space lists, depending on project phase and process
Regularly Occupied Spaces Example

- Exclude clearly not ‘regularly occupied’ spaces – corridors, storage, mechanical rooms, etc.
Regularly Occupied Spaces Example

- Identify clearly regularly occupied spaces – offices, classrooms, etc.
  - Group similar size and location rooms – bank of private offices
  - Note different conditions related to daylight – fully interior rooms vs. perimeter rooms
Regularly Occupied Spaces Example

- Some spaces may be ambiguous – break rooms, reception areas. Clarify programming when possible to determine if space will qualify as ‘regularly occupied.’
Regularly Occupied Spaces Example

- Calculate approximate square footage for ‘regularly occupied’ spaces
I.5D: Use CRI of at least 90 (Recommended) (no changes)
Use light sources with a CRI of at least 90.

I.5E: Light Direction and Glare (Recommended) (no changes)
Use direct-only overhead lighting for 25% or less of total connected lighting load in all regularly occupied spaces.
I.5E: Interior Surface Reflectance (Recommended)

Specify interior surfaces (walls, floors, ceilings, permanently installed furniture) for all regularly occupied spaces that meet or exceed the following area-weighted average reflectance values to maximize lighting efficiency and to increase the perceived brightness of spaces:

3. Ceilings: at least 85% average surface reflectance.
4. Walls: at least 60% average surface reflectance.
5. Floors: at least 25% average surface reflectance.
6. Furniture:
   i. At least 45% average surface reflectance for work surfaces.
   ii. At least 50% average surface reflectance for movable partitions.
Spatial Daylight Autonomy (sDA)

Spatial Daylight Autonomy (sDA) - the percentage of floor area that receives at least 300 lux (30 footcandles) for at least 50% of the annual occupied hours.

Guideline Change – sDA is now always measured with illuminance goal of 300 lux / 30 fc.

B3 Requirement – 30 footcandles for half of occupied hours, in 50% of regularly occupied floor area
Daylight Factor (DF)

**Daylight Factor** – the ratio of the light level inside a structure to the light level outside the structure. DF is a representative metric based on the CIE overcast sky for September 21 at 12:00pm.

\[
DF = \frac{\text{Indoor Illuminance}}{\text{Outdoor Illuminance}} \times 100\%
\]

**Guideline Change** – Daylight Factor target reduced from 2% to 1%, and area required to achieve the DF reduced from 80% to 50%.

**B3 Requirement** – Daylight Factor of at least 1.0% in 50% of regularly occupied floor area
Point-in-time Illuminance

Illuminance level is the illuminance falling on the workplane, based on a simulation measured at 9am and 3pm on the equinox.

Guideline Change – No longer available as compliance metric.
Small Buildings Method

1. Projects that include less than 20,000 gsf of conditioned space may demonstrate adequate daylight utilization by either:

   i. Documenting a window-to-wall area ratio (WWR) of the portion of exterior walls bounding regularly occupied spaces of at least 35%, and a minimum visible transmittance (VT) of 0.65 for all exterior glazing in regularly occupied spaces

   ii. Documenting a window-to-floor area ratio (WFAR) of the portion of exterior walls bounding regularly occupied spaces of at least 20%, and a minimum visible transmittance (VT) of 0.65 for all exterior glazing in regularly occupied spaces.
Peer Standards

- **LEED v4.1 - EQ: Daylight**
  
  Provide manual or automatic with manual override glare-control devices in all regularly occupied spaces AND

  Pick one path:
  
  - Simulation - sDA 300/50% for regularly occupied spaces, areas with ASE over 10% need glare control – calculate average for all Regularly Occupied Floor Area
    - 40% of ROFA - 1 point
    - 55% - 2 points
    - 75% - 3 points
  
  - Simulation - Illuminance – 9a and 3p on clear sky day at equinox for each Regularly Occupied Space – illuminance between 30-300 fc at 9a and 3p
    - 55% of ROFA - 1 point
    - 75% - 2 points
    - 90% - 3 points
  
  - Measurement after construction – illuminance in each Regularly Occupied Space between 30-300fc
    - 55% of ROFA at one time of year - 1 point
    - 75% at two times of year – 2 points
    - 90% at two times of year – 3 points
Peer Standards

- **Green Globes New Construction 2021 - Credit 6.3.1.1**
  - Minimum – Daylight Factor at least 2 in 50% of ‘regularly occupied floor area’
    - Additional points for more floor area, higher DF
    - ‘Regularly occupied space’ – a room or enclosed space designed for human occupancy in which individuals perform activities for which the same has been specifically designed
Threshold Adjustment Process

- Initiated based on feedback from project teams:
  - Meeting different thresholds resulted in very different amounts and configuration of glazing
    - Goal: bring compliance thresholds in line with each other
  - Spreadsheet tool unclear and not helpful for compliance
    - Goal: simplify tool and streamline submissions

- Study and analysis to align thresholds:
  - Initial box models with various glazing sizes and configurations
  - Analyzed in multiple software
  - Results tracked and compared
  - Sample building tested for spreadsheet refinement and training
Daylight Simulations – Documentation – Example Project

3’ ribbon window around entire perimeter - 30% WWR
Daylight Simulations – Documentation – Example Project

Daylight Factor
(percent of floor area with daylight factor 1.0% or higher)

Office 1  Office 2  Office 3  Office 4  Office 5  Conference  Break

Sefaira 0.42  LS 0.42  Insight 0.42  Sefaira 0.65  LS 0.65  Insight 0.65

3 GUIDELINES
Meeting The Guidelines

• Performing simulations
• Documenting results for submission
### Daylight Simulations - Software

<table>
<thead>
<tr>
<th>Name</th>
<th>sDA</th>
<th>DF</th>
<th>Surface Reflectance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sefaira (Sketchup and Revit)</td>
<td>Yes</td>
<td>Yes</td>
<td>Ceiling – 80%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Walls – 50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Floor – 20%</td>
</tr>
<tr>
<td>Insight for Revit</td>
<td>Yes</td>
<td>Yes</td>
<td>Adjustable – set in model</td>
</tr>
<tr>
<td>LightStanza</td>
<td>Yes</td>
<td>Yes</td>
<td>Adjustable – set in web application</td>
</tr>
<tr>
<td>Andrew Marsh Tools – Dynamic Daylighting</td>
<td>Yes, with upload of weather file</td>
<td>Yes</td>
<td>Adjustable – set in web application</td>
</tr>
</tbody>
</table>

Other applications: Elum Tools, Climate Studio
Daylight Simulations - Documentation

Spreadsheets:
• Regularly Occupied Spaces
• Electric Lighting
• Daylighting
• Surface Reflectance (recommended guideline)
Step 1 – List Regularly Occupied Spaces with Program and Area in I5_ROS spreadsheet

Documentation

Drop Down Menu with Space Program Types
Step 2 – Copy ‘Regularly Occupied Space’ information into I5a – Electric Lighting Spreadsheet

Information copied and pasted from ROS spreadsheet

Populated automatically based on space program type

References for IES categories and light levels recommendations
Step 3 – Copy Regularly Occupied Space information into 15c – Daylighting Spreadsheet

Documentation

Step 4 – Complete simulations and document results

Select appropriate tab for chosen metric or small buildings method

Enter simulation results here

Compliance automatically indicated here as yes or no, calculated with daylight simulation results and associated floor areas
Case Study – Fergus Falls Public Library Renovation + Expansion

- Bentz / Thompson / Rietow, Inc. - Architects
- Gausman and Moore - Mechanical Engineers and Energy Modelers
- 25,600ft² on 1 story
- Occupied 2019
- Finalist for Best of B3 Design and Best of SB2030 awards in 2021
The B3 Case Studies Database provides design and performance information on projects using the B3 Guidelines and the SB 2030 Energy Standard. Each project case study includes a Scorecard with several performance metrics including energy, carbon, water, stormwater, and waste. The case study also includes an SB 2030 Label indicating the projects Energy Use Intensity (EUI) during design and actual performance.

About the Case Studies

The Case Studies Database currently includes all SB 2030 projects that have undergone at least one review of their energy data by the SB 2030 team. In practice, this means any project in or beyond the Design Development phase in the B3 Guidelines Tracking Tool.

Go To Case Studies

All of the information shown here is reported by the project team, and is drawn from the phase before the current phase in the Tracking Tool, which allows the projects guideline leader and agency contact and the RBTH 2030 team to review the information before it becomes public.

If you are part of a project that either should be included on the database or is showing outdated information, first ensure that the project is up-to-date in the B3 Guidelines Tracking Tool. If the project's status in the Tracking tool does not explain the disparity, please contact us at casestudies@b3mn.org.
Questions and Discussion