

# Daylight Design: Metrics and Methods for the B3 Guidelines

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April 27, 2022 – 11am – 12pm

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>
  - Tuesday, May 24<sup>th</sup>, 2pm-3pm, Zoom
- Whole Building Life Cycle Assessment for the B3 Guidelines
  - Registration link coming soon
  - 2 sessions:
    - June 7<sup>th</sup>, 1pm-3pm, Zoom
      - Introduction and Overview
    - June 9<sup>th</sup>, 1pm-3pm, Zoom
      - Workshop

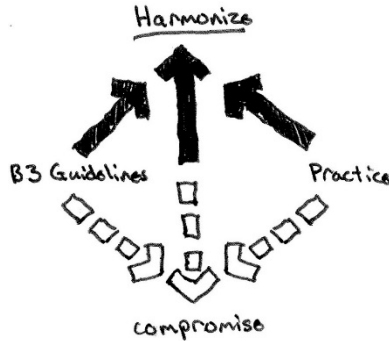
## B3 News

### 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.



## I.5A: Light Levels (no changes)

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.

## I.5B: Lamp Specifications (no changes)

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:

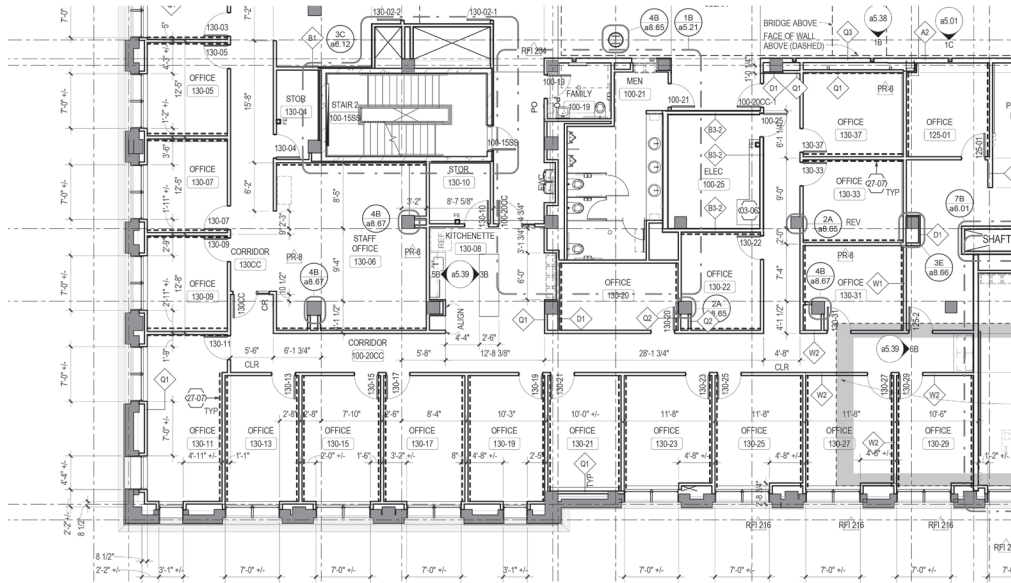
- Spaces with uses that only require minimal lighting and in which the primary activity intended for the space would be harmed by daylight (this exclusion does not apply to spaces with ultraviolet light concerns) – note that this only applies to the calculation of regularly occupied spaces with respect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

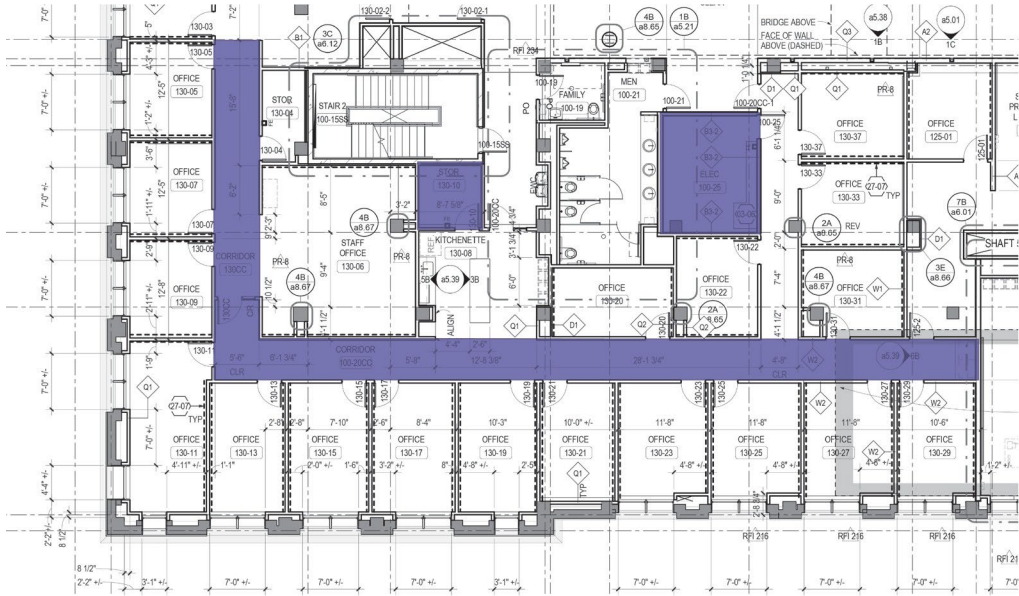
## Regularly Occupied Spaces Example

- Can be based on plans, program space lists, depending on project phase and process



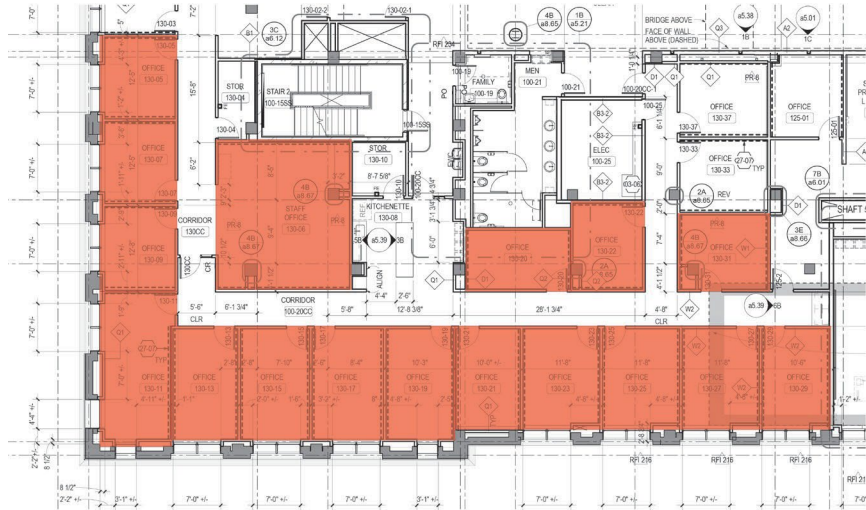
## Regularly Occupied Spaces Example

- Exclude clearly not 'regularly occupied' spaces – corridors, storage, mechanical rooms, etc.



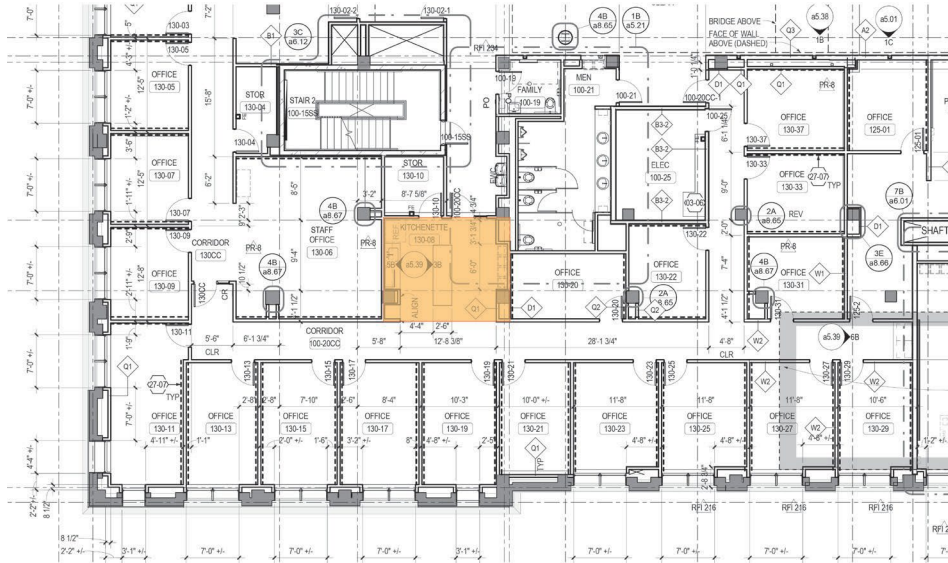
## Regularly Occupied Spaces Example

- 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

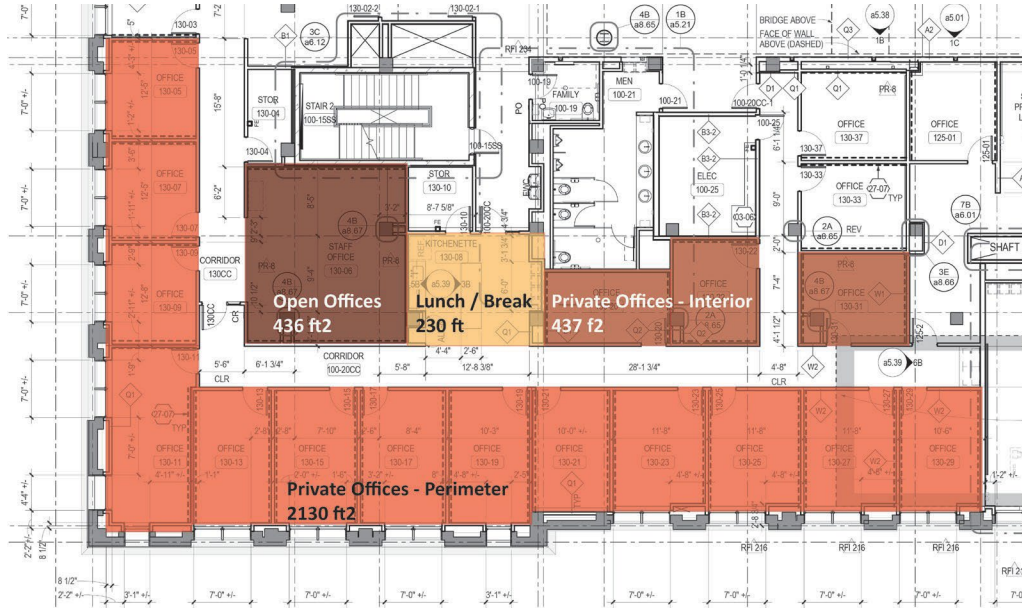
- Some spaces may be ambiguous – break rooms, reception areas. Clarify programming when possible to determine if space will qualify as ‘regularly occupied.’





## 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)(no changes)

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



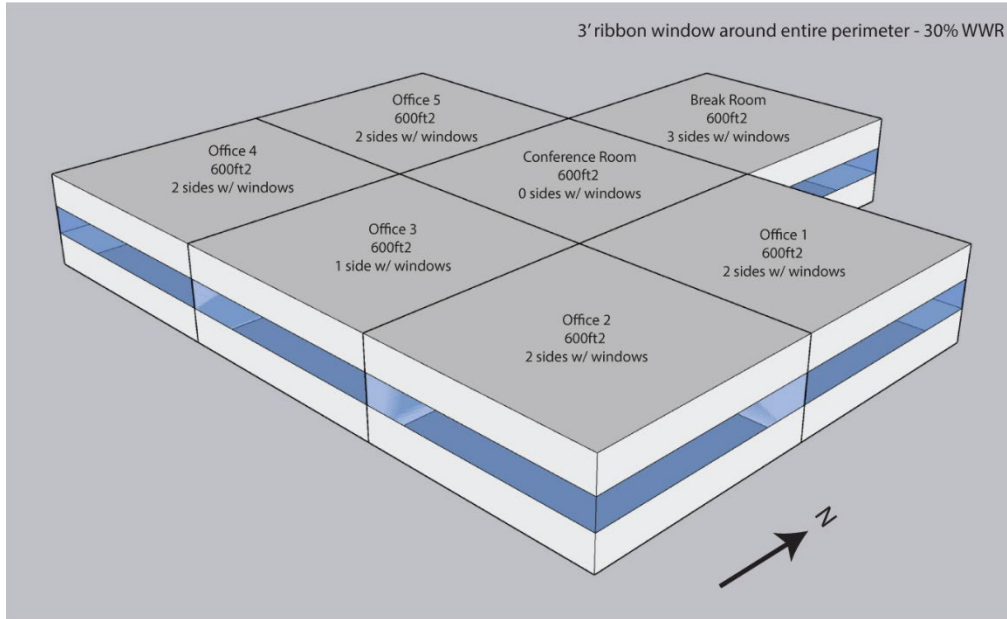
# Peer Standards

- **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

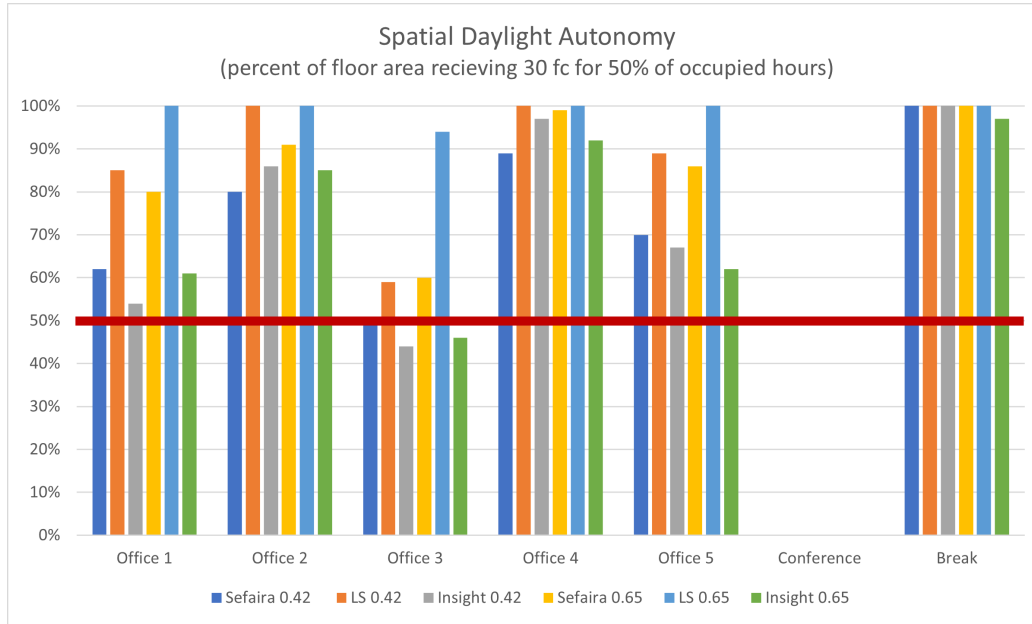
# Threshold Adjustment Process

- 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

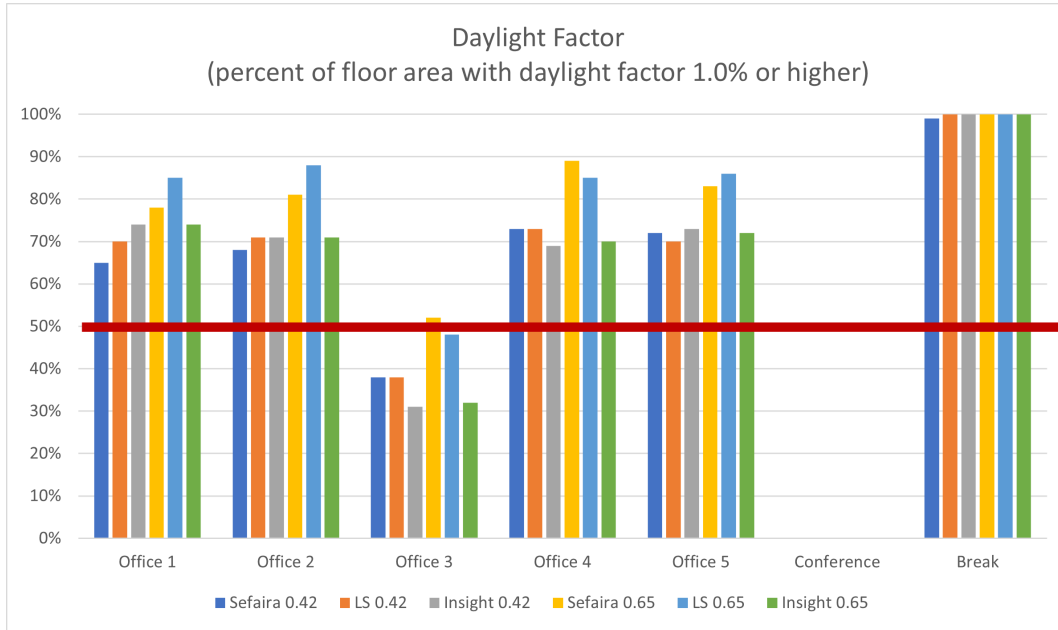
# Daylight Simulations – Documentation – Example Project



# Daylight Simulations – Documentation – Example Project



# Daylight Simulations – Documentation – Example Project



# Meeting The Guidelines

- Performing simulations
- Documenting results for submission

## Daylight Simulations - Software

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

Other applications: Elum Tools, Climate Studio

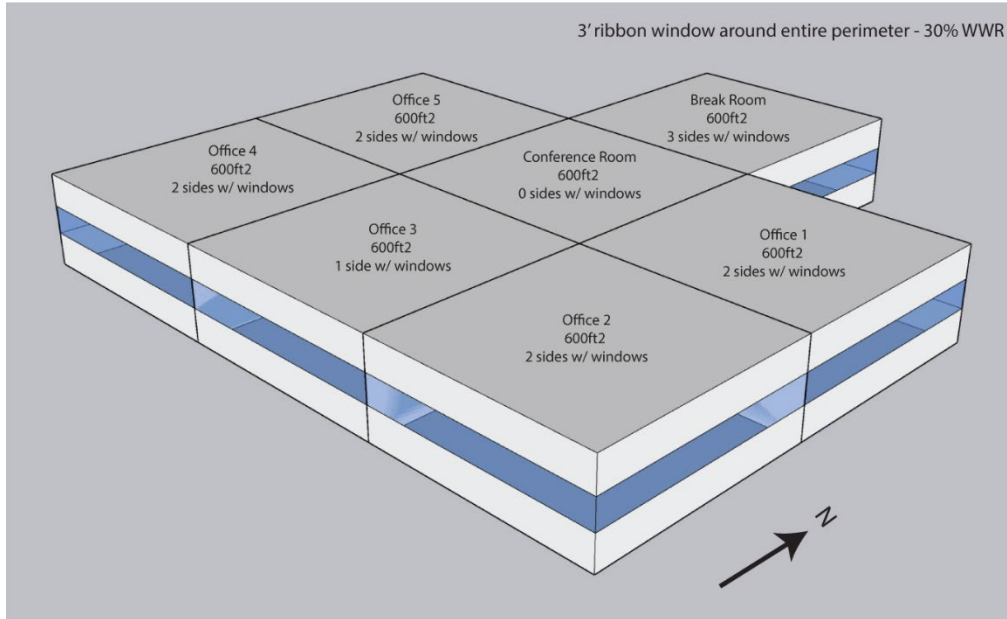
# Daylight Simulations - Documentation

## Spreadsheets:

- Regularly Occupied Spaces
- Electric Lighting
- Daylighting
- Surface Reflectance (recommended guideline)



# Daylight Simulations – Documentation – Example Project



# Documentation

## Step 1 – List Regularly Occupied Spaces with Program and Area in I5\_ROS spreadsheet

AutoSave • OFF 33App\_I5\_ROS\_demo - Group • Liz Kutschke UK

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**Appendix I-5: Regularly Occupied Spaces and Floor Area**  
B3 Guidelines - Version 3.2/03  
Last Updated: April 26 2022

**KEY:**  
Blue highlighted areas show constants or outputs calculated by the spreadsheet  
Yellow highlighted areas show required inputs

**Instructions:**  
1) List each individual or representative regularly occupied space<sup>1</sup> in Column B  
2) Select the most appropriate space type from the dropdown in Column C. If the intended program use is not listed, select the IES category (A-Y) that most closely matches the description of the activity in the space, as summarized on the "IES Reference Categories" tab<sup>3</sup>.  
3) List square footage of individual or summed spaces represented in Column D.  
4) If space listing is Representative of multiple spaces, use Column F to list specific rooms included.  
5) Save this document and copy + paste room information into Electric Lighting (33App\_I5a) and Daylighting (33App\_I5c) spreadsheets for submission to B3 Tracking Tool.

**Regularly Occupied Spaces<sup>1</sup>**

Space ID	Room Name	Space Type	Area (sf)	Percent of Regularly Occupied Area (sf)	Notes
1	Office 1	Office - Open	600	14%	
2	Office 2	Office - Open	600	14%	
3	Office 3	Office - Open	600	14%	
4	Office 4	Office - Private	600	14%	
5	Office 5	Office - Private	600	14%	
6	Conference Room	Pool (Recreational)	600	14%	
7	Break Room	Receiving / Shipping	600	14%	
8		Restroom	600	0%	
9		Patrol (General)		0%	
10		Stairs - Typical		0%	
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38				0%	
39				0%	
Total Regularly Occupied Floor Area <sup>2</sup>			4200		

**Drop Down Menu with Space Program Types**

1 "Regularly Occupied Space" - Any space that is occupied by one or more persons for more than one hour (during daylight hours) on days the building is in use. This primary activity intended for the space would be harmed by daylight (this exclusion does not apply to spaces with ultraviolet light concerns).  
2 "Regularly Occupied Floor Area" - The total floor area within Regularly Occupied Spaces, as defined above.  
3 This workbook includes IES recommendations for common space types for users between 25 and 65 years old. If needed, you may override the Target Horizontal Illuminance.

Regularly Occupied Spaces IES Reference Categories Light Level Recommendations

Ready Accessibility: Investigate Display Settings 80%

# Documentation

## Step 2 – Copy 'Regularly Occupied Space' information into I5a – Electric Lighting Spreadsheet

Information  
copied and  
pasted from ROS  
spreadsheet

AutoSave 33App\_I5a\_demo

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Search (Alt+Q)

Comments Share

**Appendix I-5a: Electric Lighting Levels and Contrast Ratios**  
B3 Guidelines - Version 3.2r03  
Last Updated: April 26 2022

**KEY:**  
Blue highlighted areas show constants or outputs calculated by the spreadsheet  
Yellow highlighted areas show required inputs

**Instructions:**  
1) Copy + Paste room list with type and area from Regularly Occupied Spaces spreadsheet (33\_I5\_ROS\_App)  
2) Document the results from your photometric analysis of electric lighting plan that the illuminance on the horizontal task plane is within 10% of the targeted levels recommended in the IES Handbook.<sup>3</sup> If non-compliant, use 'Notes' column to record cause or justification for non-compliance.  
3) After documenting horizontal illuminance, document that the average illuminance of the walls and ceiling do not exceed B3 Guidelines maximum contrast ratios. If non-compliant, use 'Notes' column to record cause or justification for non-compliance.

Regularly Occupied Spaces <sup>1</sup>				
Space ID	Room Name	Space Type	Area (sf)	Percent of Regularly Occupied Area (sf)
1	Office 1	Office - Open	600	14%
2	Office 2	Office - Open	600	14%
3	Office 3	Office - Open	600	14%
4	Office 4	Office - Private	600	14%
5	Office 5	Office - Private	600	14%
6	Conference Room	Conference - AV	600	14%
7	Break Room	Lunch / Break Room	600	14%
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# Documentation

Step 3 – Copy Regularly Occupied Space information into I5c – Daylighting Spreadsheet

Step 4 – Complete simulations and document results

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**Appendix I-5c: Spatial Daylight Autonomy Simulation Results**  
 B3 Guidelines - Version 3.2x03  
 Last Updated: April 26 2022

**KEY:**  
 Blue highlighted areas show constants or outputs calculated by the spreadsheet  
 Yellow highlighted areas show required inputs  
 Grey highlighted areas will remain blank

**Instructions:**  
 1) Copy + Paste room list with type and area from Regularly Occupied Spaces spreadsheet (33\_I5\_ROS\_App)  
 2) Document results from simulations to record the spatial daylight autonomy (sDA<sub>ptc(50%)</sub>) of each individual representative space. Spreadsheet will calculate compliant space guideline as met.

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7	Break Room	Lunch / Break Room	600	14%
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# Case Study – Fergus Falls Public Library Renovation + Expansion

- Bentz / Thompson / Rietow, Inc. - Architects
- Gausman and Moore - Mechanical Engineers and Energy Modelers
- 25,600ft<sup>2</sup> on 1 story
- Occupied 2019
- Finalist for Best of B3 Design and Best of SB2030 awards in 2021

*All photos by Anthony Gilbert © Gaffer Photography*



## Case Study – Fergus Falls Public Library Renovation + Expansion



*Provided by Fergus Falls Public Library – Ryan Siemers Photography + Design*

# B3 Case Study Database – [casestudies.b3mn.org](http://casestudies.b3mn.org)

MINNESOTA

**B3**

CASE STUDIES DATABASE

Select/search for a project by name


Home Projects Contact

### Buildings, Benchmarks & Beyond Case Studies Database

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.

#### Bioscience and Health Careers Center

SB 2030 Energy Standard EUI: 183 kBtu/sf  
Design Model EUI: 71 kBtu/sf



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### 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 project's guideline leader and agency contact and the B3/SB 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](mailto:casestudies@b3mn.org).

**B3** Home

**B3** Guidelines

**B3** SB 2030 Energy Standard

**B3** Benchmarking

**B3** Energy Efficient Operations

**B3** Post Occupancy Evaluation

**B3** BUILDINGS, BENCHMARKS & BEYOND

Tools and Programs for Sustainable Buildings in Minnesota

Sponsors

Project Team

Admin Login

B3 Case Studies v6.0.2.4122

# Questions and Discussion

