Daylighting guidelines

By Scott Schuette, Energy Center of Wisconsin

Designing buildings with daylighting controls is a complicated process, requiring analysis and communication across multiple disciplines. Because of this complexity, daylighting often appears inaccessible to building owners and first time designers. Following is a set of general architectural, lighting and interior design guidelines. These guidelines may be used as a starting point for daylighting design and could be included in design documents. Please note though, that these are general guidelines that should be customized through more extensive analysis for specific climates and building types. Consult an experienced designer before using these guidelines on an actual project.

Warehouse
Provide skylights or tubular daylighting devices with automatic daylight harvesting controls in areas with frequent occupancy. The daylit zone shall be defined as the space that is equal to the height to the bottom of trusses extended equally in each direction below the skylight as shown in the following figure.

![Diagram of skylight and daylit zone]
Architectural

<table>
<thead>
<tr>
<th></th>
<th>Skylights</th>
<th>TDDs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Skylight/TDD to Roof</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. Visible Transmissivity</td>
<td>&gt;70%</td>
<td>&gt;50%</td>
</tr>
<tr>
<td>Min. Solar Heat Gain</td>
<td>0.40</td>
<td>0.30</td>
</tr>
<tr>
<td>Coefficient</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Assembly U-Value</td>
<td>0.60</td>
<td>0.50</td>
</tr>
</tbody>
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**Lighting**

- Maximum lighting power density of 0.6 W/ft² through use of fluorescent T8 or HID light fixtures.
- Install photosensors and controls connected to the lighting system serving the daylit zone to turn off or dim the lights when the footcandle level is equal to or greater than 30 footcandles. Provide lower footcandle targets for areas with ‘bulk’ items, than for areas with ‘fine’ items.
- In areas of infrequent occupancy, photosensor controls are less effective. Instead, install occupancy sensors and controls connected to the lighting system to reduce electric lighting levels during unoccupied periods.
- Allow daylight controls to reduce electric lighting to 0 – 10% illumination through a stepped dimming control system with a minimum of 2 steps and off.
- Utilize independent, third party commissioning of the daylighting control system. Ensure that the daylighting control system is installed correctly and is operational.
- Conduct introductory training for building facility staff.

**Interior Design**

- Use light, reflective colors and finishes in daylit areas
  - Ceiling Reflectance = 80%
  - Wall and Rack Reflectance = 60%
  - Floor Reflectance = 30%
- Position storage racks in between skylights and not directly under them.

**Office**

Provide windows and curtain walls with automatic daylight harvesting controls in daylit areas. The daylit zone shall be defined as the space that is equal to 1.5× the height of the window extended perpendicularly into the space as shown in the following figure.
Architectural

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Max. Window to Wall Ratio</td>
<td>30%</td>
</tr>
<tr>
<td>Min. Visible Transmissivity</td>
<td>&gt;50%</td>
</tr>
<tr>
<td>Min. Solar Heat Gain</td>
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</tr>
<tr>
<td>Coefficient</td>
<td></td>
</tr>
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<td>0.35</td>
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Utilize external shades on the south-facing façade and vertical fins on the east- and west-facing facades to block direct sunlight from entering the space.

Lighting

- Maximum lighting power density of 0.9 W/ft² through use of direct/indirect T5 or high performance T8 fluorescent light fixtures and LED recessed downlight fixtures.
- Use task lighting in all offices and where needed for occupant reading.
- Install photosensors and controls connected to the lighting system serving the daylit zone to turn off or dim the lights when the footcandle level is equal to or greater than 40 footcandles.
- Position directional photosensors such that they view parallel to the windows and are shielded from direct view of adjacent windows.
- Install continuous dimming daylight controls to reduce electric lighting to 0 – 10% illumination. If continuous dimming controls are cost prohibitive, install stepped dimming controls with a minimum of 3 steps.
- Utilize independent, third party commissioning of the daylighting control system. Ensure that the daylighting control system is installed correctly and is operational.
- Conduct introductory training for building facility staff.

Interior Design

- Use light, reflective colors and finishes in daylit areas.
  - Ceiling Reflectance = 80%
  - Wall and Partition Reflectance = 60%
  - Floor Reflectance = 30%
- Select cubicles with low partition heights (3.5’-4.0’) parallel to the daylighting windows.

Classroom

Provide windows and curtain walls with automatic daylight harvesting controls in daylit areas. The daylit zone shall be defined as the space that is equal to 1.5× the height of the window extended perpendicularly into the space as shown in the following figure.
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</tr>
</tbody>
</table>

Utilize external shades on the south-facing façade and vertical fins on the east- and west-facing facades to block direct sunlight from entering the space.

Lighting
- Maximum lighting power density of 1.0 W/ft² through use of direct/indirect T5 or high performance T8 fluorescent light fixtures and LED recessed downlight fixtures.
- Provide multiple lighting zones and/or shade control to allow varied lighting scenes for A/V presentations, note taking, and test taking. Ensure that the primary teaching surface and A/V surface can be shielded from direct sun at all times.
- Install photosensors and controls connected to the lighting system serving the daylit zone to turn off or dim the lights when the footcandle level is equal to or greater than 75 footcandles.
- Position directional photosensors such that they view parallel to the windows and are shielded from direct view of adjacent windows.
- Allow daylight controls to reduce electric lighting to 0 – 10% illumination.
- Utilize independent, third party commissioning of the daylighting control system. Ensure that the daylighting control system is installed correctly and is operational.
- Conduct introductory training for building facility staff.

Interior Design
- Use light, reflective colors and finishes in daylit areas.
  - Ceiling Reflectance = 80%
  - Wall Reflectance = 60%
  - Floor Reflectance = 30%
Two panel system in response to stricter energy codes

By Moshe Konstantin, CPI Daylighting

With today’s strict energy codes, architects are looking for more ways to incorporate daylighting into their projects. A daylighting system versatile enough to comply with numerous building codes and standards can be configured by assembling two independent glazing panels into one system. The two panels are connected with concealed connectors, creating a protective cavity for various modular inserts. The daylighting system can be configured for Department of Defense Antiterrorism Standard for Buildings, Human Impact of 2000 ft-lb, 5 minute forced entry resistance, and Fire Rated “Class A” Roof Assembly, to name a few. Whether a building requires additional insulation, controlled daylighting, or enhanced sound reduction, this daylighting system can also be configured to resolve those daylighting issues.

Since the two panels are independent of one another, the interior panel is shielded from damaging hazards, such as outside weather conditions, ultraviolet radiation, or impact. Thus, the interior panel can remain intact indefinitely. If the exterior panel ever needs to be removed, the building envelope is protected and never exposed. This feature significantly reduces the time and costs associated with repairs or system modifications.

A two panel system is not only versatile; it also delivers more light per insulation level than traditional composite panels. The flexible system is NFRC tested and certified for U value and SHGC. It can achieve a U-value of 0.23 and maintain a light transmission of 52%. It passes the test requirements for wind load, cycling and missile impact level D per ASTM E-1886 &1996, as well as those for water and air infiltration per NFRC 400.

Daylighting is complex and will never have a one-size-fits-all protocol, but a two panel daylighting system provides the industry with many daylighting solutions in one neat package.