

## DAYLIGHT MODELING

Daylight Modeling takes the mystery and surprise out of predicting the impact of daylight on any building space.

How much daylight does it take to provide the desired results?

What about glare?

How will the time of day and season of the year impact the daylighted space?

What about the building's position on the lot?

How will surrounding terrain and other buildings impact the daylighting?

**Daylight Modeling** answers these and other questions.



*Public Library Auditorium*

The multiple benefits of daylighting are well documented. Here are three recommended sites, each containing excellent daylighting reference materials:

[thedaylightsite.com](http://thedaylightsite.com), [edfacilities.org](http://edfacilities.org), and [cie/news/](http://cie/news/)

Traditionally, the end results of daylighting design have been somewhat misunderstood with often unpredictable results. Now, alternate design solutions can be studied and planned. **Daylight Modeling** shows you the way to better daylighting any space.

Unmitigated sunlight often ruins an effective daylighting design. Controlling quality and quantity of daylight is imperative to managing related heat loss/gain.



*Health and*



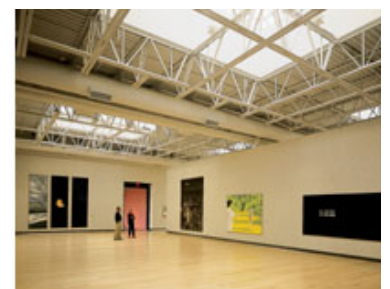
*High School Technology Classroom*

**Daylight Modeling** allows architects and designers to see the impact of variations in their daylighting strategies long before the space is constructed.

1. Avoid daylighting disasters and disappointments
2. Better understand capturing LEED® points through well-planned daylighting
3. Develop optional daylighting design alternatives
4. Improve the environments for all living things
5. Enhance the well-being, peace of mind and productivity of occupants

Achieving desirable aesthetics requires more than a "hunch". Searching for solutions and correcting daylighting errors and miscalculations post construction usually ends with an unsatisfactory result for all.

Following are just a few examples of various building applications that demonstrate what can be achieved by pre-planned, daylight modeling ... including analysis to determine Daylight Factor and/or Daylight Autonomy.



*Museum of Art*



Health and Fitness Club



Classroom



Judo Club



Credit Union

The objectives of our **Daylight Modeling** Service are to:

1. assist in verifying that your design achieves adequate ambient light levels
2. assist in qualifying for LEED® or other sustainable rating agenda
3. promote passive daylighting as the most effective and expedient way to meet "Carbon Zero" objectives
4. educate designers, builders, specifiers and owners about the benefits of [Kalwall®](#) ... the most highly insulating, diffuse-light-transmitting system in the world.



Gymnasium

College Ice Rink



University Library

**How does Kalwall do Daylight Modeling?**

Our **Daylight Modeling** service can handle clear (glass) fenestration in combination with Kalwall; we are not offering this service to verify glass only systems unless you know you are in trouble and need help!

According to *Energy Focus*, "Daylight isn't sunlight, but instead is sunlight reflected or diffused to a very low level." In designing any space, one of the first steps must be to control direct beams of sunlight. Through the use of building orientation, transmittance levels, plans, CAD files or takeoffs and target illuminance levels, **Daylight Modeling** is an often overlooked design analysis tool to aid in predicting daylighting results.

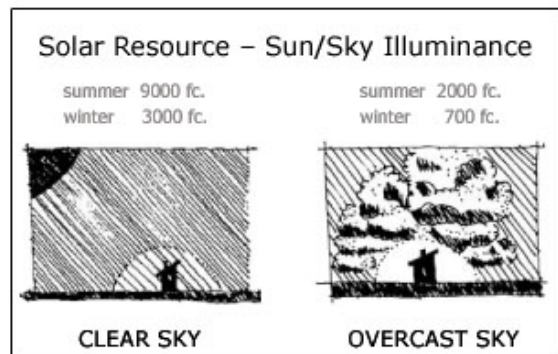
you are in trouble and need help!

**What are the Metrics?**

Ambient outside sunlight is often excessive for inside lighting requirements.

**Typical Light Levels**

Different kinds of spaces require different light levels. Following is a quick reference table of Illuminating Engineering Society of North America (IESNA) indoor recommended footcandle ratings:



Lighting Design Lab / SCL 1993

**Quick Reference Table for IESNA Indoor Recommended Footcandles**

**Offices**

- Corridors, stairways
- Reading, transcribing
- Regular office work
- Accounting, auditing, business machine operation
- Detailed designing & drafting

**Pools**

Recreational

Exhibitions

**1 footcandle (fc) ≈ 10 lux**

**Schools**

- 10 Reading, note-taking, art rooms, typing
- 30 Laboratories, shops
- 50 Gymnasium - general assembly
- 75 Gymnasium - general exercise & recreation
- 150 Gymnasium - exhibits & matches
- 30 Library - ordinary reading & stack
- 50 Library - study areas & check desk

**Stores**

- 30 Circulation areas
- 30 Stockrooms
- 100 Merchandising, serviced
- 200 Merchandising, self-service

**We Use Dynamic Daylight Simulation (DAYSIM)**

DAYSIM is a daylighting analysis software that calculates the annual daylight availability in arbitrary buildings as well as the lighting energy use of automated lighting controls (occupancy sensors, photocells) compared to standard on/off switches. Among the dynamic daylight performance metrics calculated by DAYSIM are Daylight Autonomy and Useful Daylight Index.

Daylight Autonomy (DA) is the amount of time that you can expect to reach a certain light level through the use of just daylight. The target illuminance and hours of operation

**DAYSIM and Ecotect**

DAYSIM has been linked to the popular Ecotect building design software. Ecotect models can be directly exported to DAYSIM for further analysis. Vice versa, DAYSIM results can be imported back into Ecotect for presentation.

View more information about [DAYSIM](#).

An example of Daylight Autonomy distribution calculated using DAYSIM and visualized through Ecotect is shown below.

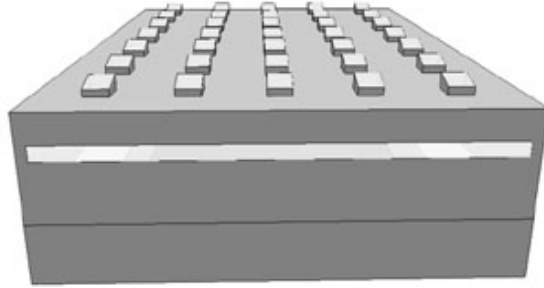


are flexible. The IESNA Lighting Handbook contains illuminance guidelines, but daylighting gurus think 40 to 60% DA is great!

### So What Are We Looking At?

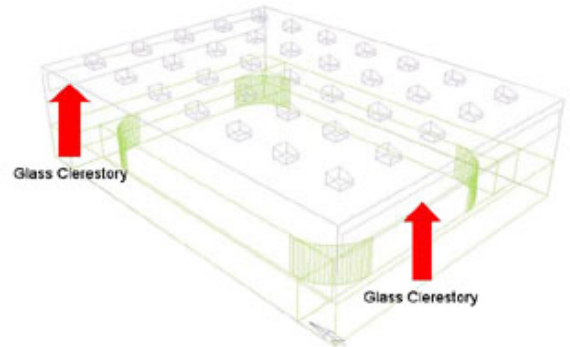
- Plan view of the building footprint
- Skylights and clerestory on south/north faces
- Light distribution in the space

Here's an example using a High School in Wasatch, Utah:



Glass clerestories on north and south elevations.

Diffuse top-lighting by translucent Kalwall.



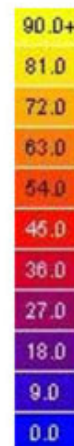
### What does the New Model Show?

- This is a gymnasium, designed for 50 footcandles ambient light, provided by daylighting.
- The design goal is to avoid the use of electric lights in the space for most of the day.
- Original concept used translucent unit skylights in combination with glass clerestories.

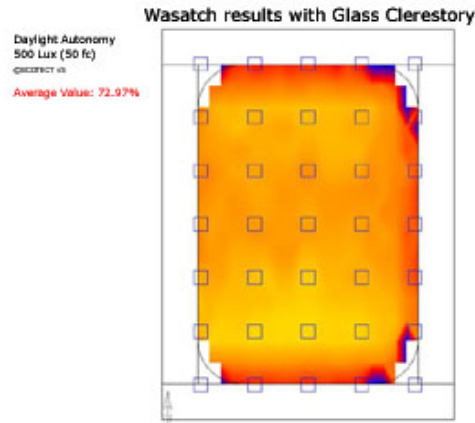
- Modeling showed glare problems with glass clerestory approach, and also revealed design solution when transparent clerestory material was switched to translucent ... because sunlight was then properly controlled.

### How to Read the DA Scale ...

- Blue means never reached the target illuminance (0%) ... does not mean "No daylight" in that area!
- As the colors move up to yellow that means a higher value.
- DA means the percent of time you'll reach a set light level with daylight alone ... (hence the "autonomy" part) for the year during operating hours.
- 40 - 60% considered excellent!



This diagram shows the Daylight Autonomy results with glass clerestories ... and at first glance may seem okay with an average of 73% ... But with another layer of analysis, glare is revealed ... [view larger graph](#)



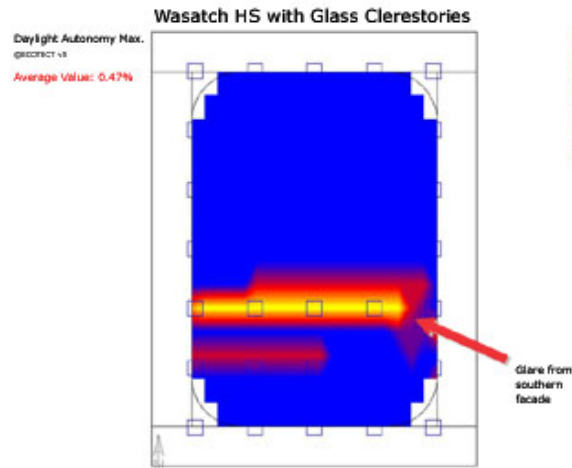
DA<sub>max</sub> (Daylight Autonomy Max) is a second level of analysis that looks for too much light. In some instances it can indicate glare.

Usually equates with direct beams from sun ... in any event, usually excessive, unbalanced interior light levels.

The yellow and red area below indicates solar glare coming through the southern glass clerestory, that must be dealt with to make this a usable space. [view larger graph](#)

DA<sub>max</sub> = 10 times the target light level ... so if 500 lux (50 footcandles) is "goal" for analysis, the DA<sub>max</sub> must find light over 5000 lux (500 fc)

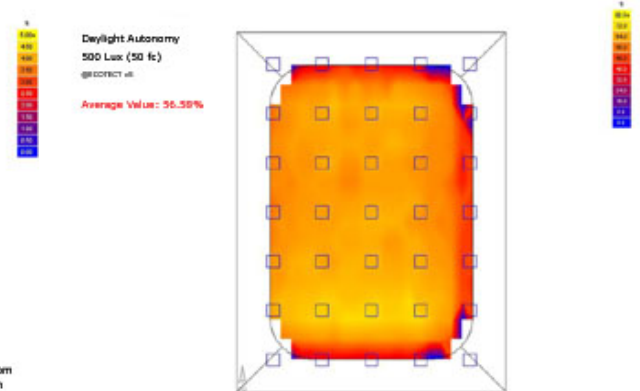
Changing the glass clerestories to U-value of 0.23 BTU/hr/ft<sup>2</sup>/°F (1.25 W/m<sup>2</sup>K) Kalwall – which gives a 20% light transmittance – drops the DA from 73% to 57% ... still excellent! [view larger graph](#)



**No glare with Kalwall Clerestories ...**

**Not too much light ...**

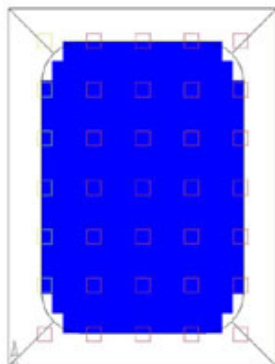
**Problem solved!**



**But Daylight Modeling doesn't end here. We can also show:**

- Daylight Factor
- Radiance Rendering (shows illuminance levels within the space at one point in time)
- Luminance (cd/m<sup>2</sup>)
- Lighting Contrast ratios within the space

Daylight Autonomy Max.  
@CORRECT v8  
Average Value: 72.97%



The major benefit of **Daylight modeling** is the visual representation of light distribution ... is this a good daylight design?

Our **Daylight Modeling** service can help you authenticate daylighting in your design.

[view larger graph](#)



*Middle School Library*



*Public Library*



*Science and Technology Center*

Kalwall Corporation is the world leader in providing unmatched daylighting options that deliver pure Museum-quality Daylighting™ — glare-free with super insulation — U-values as low as 0.05 BTU/hr/ft<sup>2</sup>/°F (0.30 W/m<sup>2</sup>K) and solar heat gain coefficient as low as 0.05.

Consider us your Daylighting Design Consultant. We want to want to be your 'partner', not just a 'peddler'. We're eager to learn more about your project and to assist you with the tools of **Daylight Modeling** to assure your designs achieve the most desirable results. Let us know what you're planning ... we can help.

Contact us at [info@daylightmodeling.com](mailto:info@daylightmodeling.com).