LEED Daylighting Credits:

Understanding the Application of Glazing Factor Calculations versus Daylight Factor Modeling

"For current LEED documentation, illumination levels can be predicted or measured using methods widely accepted in practice; Daylight Factor calculations, physical modeling, computer simulations, and field measurements.... The LEED calculator radically over-predicts daylight illumination levels."

- (Carrier, Karen THE ROLE OF DAYLIGHTING IN LEED CERTIFICATION: A COMPARATIVE EVALUATION OF DOCUMENTATION METHODS)

The single number value arrived at by performing the LEED calculation can give a skewed perception that daylight will be evenly distributed in the room at the level calculated. In actuality, daylight is often localized and changes dynamcally under different outdoor conditions. LEED establishes a simple calculation that can be a initial predictive tool, particularly as applied to small spaces at building perimeters. However, this calculation does not communicate the character of a daylit space and can not predict complex distributions of light.

Modeling (physical or computer)can communicate both levels of daylight and their distributions. A predictive model is especially useful in designing electric lighting to interact effectively with available daylight. Based on distribution and use needs, fixtures and the sensors that control them can be placed logically and effidciently to deliver light where it is needed.

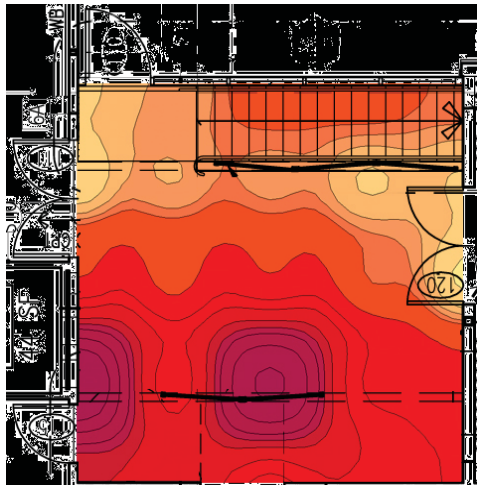


Figure A: A complex distribution of daylight.

LEED Daylighting Credits:

The 'Daylight' Glazing Factor (LEED) Calculation

The Calculation: GF * Window Area /Floor Area * T(vis)/T(min) * HF

GF = A geometry factor which increases calculated contribution of daylight when top lighting (skylighting) is used. Toplighting glazing area is multiplied by a factor of up to 5 times greater than the factor applied to sidelighting area.

T(vis) = The (manufacturer's) transmittance of the window glazing used.

T(min) = The recommended T(vis) for the window type being evaluated.

HF = A height factor which weights daylighting contribution of glazing above a certain floor height and disallows the contribution below another floor height.

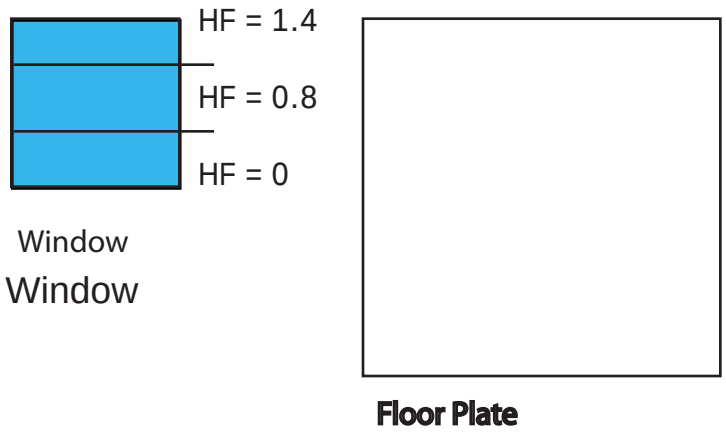


Figure B: LEED Glazing factor is a simple ratio of aperture area to floor area.

LEED Daylighting Credits:

'Daylight' Glazing Factor (LEED) Calculation Step by Step

1. Determine the manufacturer's assigned T(vis) for the window glazing used. Manufacturers often use the terms VT or VLT to express T(vis), if the T(vis) is given as a percentage, convert it to a decimal: 53% = 0.53. Tvis values generally range from ~0.7 (clear glass) down to values around 0.1 (kalwall).

2. Determine the **floor area** and each **window surface area** in the space being evaluated.

3. Determine which Height Factors apply to each window.
   For Toplighting, the HF is always 1.0.

   For Sidelighting, any window area below 2'6" is not included in calculations.

   Sidelighting between 2'6" and 7'6" is the vision glazing and has an HF of 0.8.

   Sidelighting above 7'6" is the daylight glazing and has an HF of 1.4

Figure C: Tvis expressed as VT on a window manufacturer's label.

LEED Daylighting Credits:

'Daylight' Glazing Factor (LEED) Calculation Step by Step

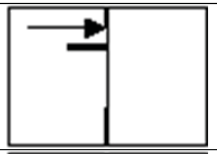
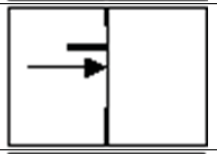
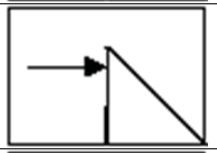
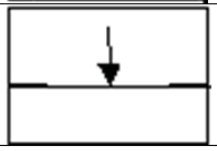
Window Type		Geometry Factor	Minimum T_{vis}	Height Factor
Sidelight, daylight glazing		0.1	0.7	1.4
Sidelight, vision glazing		0.1	0.4	0.8
Top lighting, vertical monitor		0.2	0.4	1.0
Top lighting, saw tooth monitor		0.33	0.4	1.0
Top lighting, horizontal skylights		0.5	0.4	1.0

Figure D: Determining the GF, Tmin and HF for your window glazing.

LEED Daylighting Credits:

'Daylight' Glazing Factor (LEED) Calculation Step by Step

5. The Daylight factor for each room can be determined by calculating the LEED Daylight factor value for each glazing condition in the room and totaling them, using the equation:

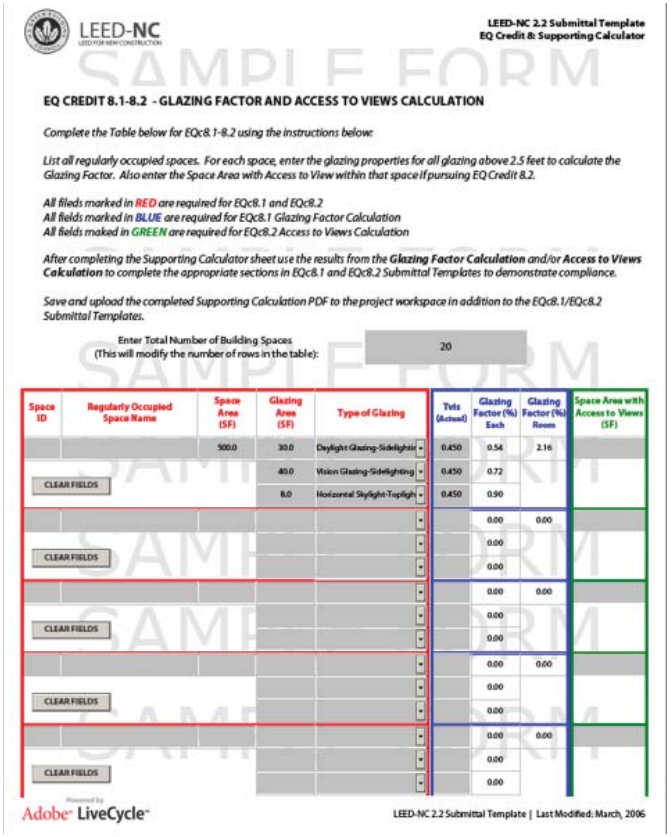
LEED DF =

S GF * Window Area /Floor Area * T(vis)/T(min) * HF

6. The USGBC has created a pdf Form that helps speed the calculations, to download it, navigate to:

http://www.usgbc.org/ShowFileaspx?DocumentID=1500

Open the PDF entitled:
Daylighting EQc8, Supporting Calculator.pdf


LEED-NC

LEED-NC 2.2 Submittal Template
EQ Credit 8: Supporting Calculator

SAMPLE FORM

EQ CREDIT 8.1-8.2 - GLAZING FACTOR AND ACCESS TO VIEWS CALCULATION

Complete the Table below for EQc8.1-8.2 using the instructions below:

List all regularly occupied spaces. For each space, enter the glazing properties for all glazing above 2.5 feet to calculate the Glazing Factor. Also enter the Space Area with Access to View within that space if pursuing EQ Credit 8.2.

All fileds marked in RED are required for EQc8.1 and EQc8.2
All fields marked in BLUE are required for EQc8.1 Glazing Factor Calculation
All fields maked in GREEN are required for EQc8.2 Access to Views Calculation

*After completing the Supporting Calculator sheet use the results from the **Glazing Factor Calculation** and/or **Access to Views Calculation** to complete the appropriate sections in EQc8.1 and EQc8.2 Submittal Templates to demonstrate compliance.*

Save and upload the completed Supporting Calculation PDF to the project workspace in addition to the EQc8.1/EQc8.2 Submittal Templates.

Enter Total Number of Building Spaces
(This will modify the number of rows in the table): 20

Space ID	Regularly Occupied Space Name	Space Area (SF)	Glazing Area (SF)	Type of Glazing	Tvis (Actual)	Glazing Factor (%) Each	Glazing Factor (%) Room	Space Area with Access to Views (SF)
		500.0	30.0	Daylight Glazing-Sidelightin	0.450	0.54	2.16	
CLEAR FIELDS			40.0	Vision Glazing-Sidelighting	0.450	0.72		
			8.0	Horizontal Skylight-Topligh	0.450	0.90		
						0.00	0.00	
CLEAR FIELDS						0.00		
						0.00		
						0.00	0.00	
CLEAR FIELDS						0.00		
						0.00		
						0.00	0.00	
CLEAR FIELDS						0.00		
						0.00		
						0.00	0.00	
CLEAR FIELDS						0.00		
						0.00		

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LEED-NC 2.2 Submittal Template | Last Modified: March, 2006

Figure E: The LEED Calculator for Daylight Credits

LEED Daylighting Credits:

'Daylight' Glazing Factor (LEED) Calculation Step by Step

7. The sum of all window equations for a given room will yield a Glazing Factor number. If this number is above 2 for a given space, the space is considered daylit for LEED. Remember this has little to do with how much light is actually present, or where it is distributed.

8. If at first you do not succeed in reaching the LEED requirement of 75% of occupied space with a glazing factor of 2 or greater, it may be possible to employ the partial credit. Look to see if any large spaces are just barely below the 2 level. Then check that the percent of occupied areas without daylight access is below 25%. If so, it may be possible to allocate a small portion of the floor area in the almost daylit space to the total without daylight access, and in so doing bump the remainder of the space up to dayit levels. Conceptually one might picture it as below:

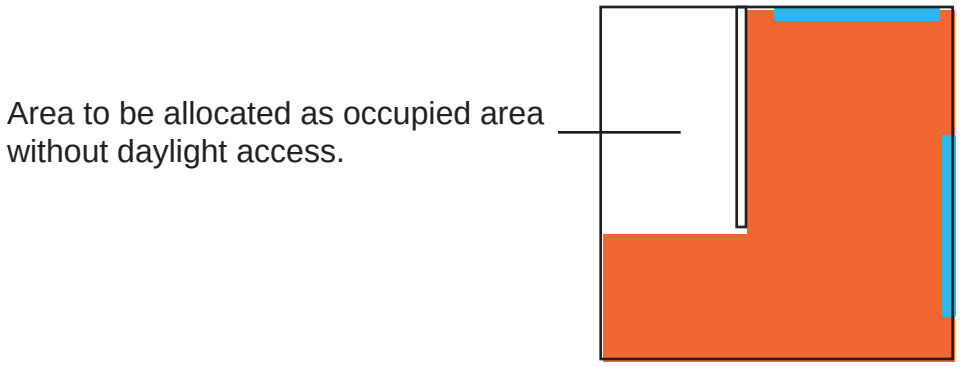

Figure F: Reallocating space to meet the partial credit.

Thinking Beyond LEED Daylighting:

A Visual Demonstration of How Glazing Geometry Changes Light Distribution.

The room in Figure G has 75% of the floor plate receiving at least 2% of outside daylight. In Figure H about 33% of the space receives this amount of available daylight.

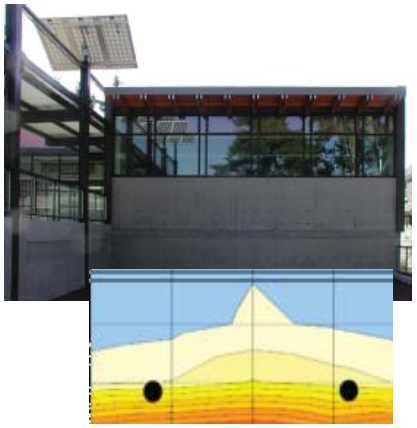

Figure G: Glazing is located high on the wall and distributed evenly across the space. Inner reflectance off the side walls is possible due to adjacency.

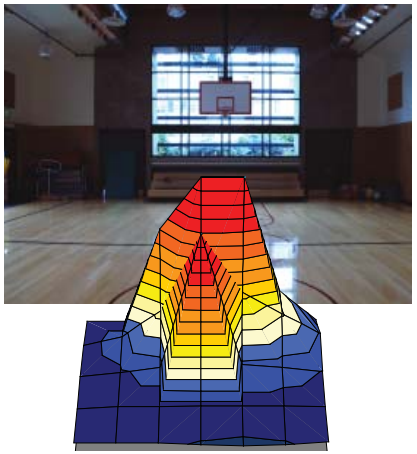

Figure H: Glazing is centered in the wall. Areas of high contrast are created at the corners of the space.

Thinking Beyond LEED Daylighting:

Using Toplighting to Increase Interior Daylight.

Strategizing to add toplighting is a good way to bring light into the back of deeper spaces. In Seattle, overcast sky light can be up to three times as bright as light from a vertical window. On a sunny day, light from above may be five times as bright.

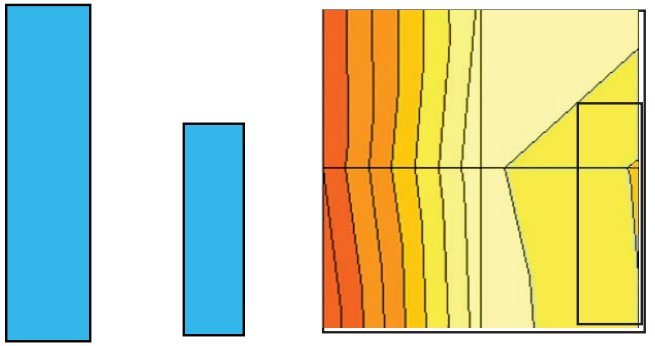

Figure I: A horizontal skylight brings light to the back of the space, creating a pleasant even distribution that works with the electric lights off.

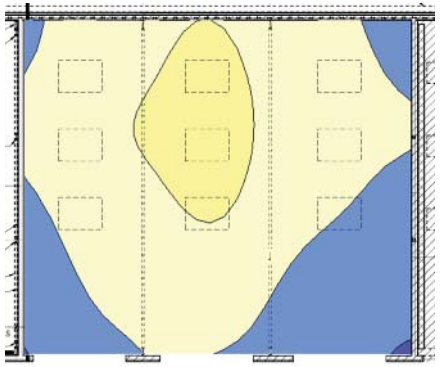

Figure J Multiple skylights are used to efficiently daylight a high bay space, designed to work in concert with dimming lights for energy savings.

Thinking Beyond LEED Daylighting:

The Limitations and Opportunities of Employing Daylight.

Daylight factor measures the percentage of daylight and its distribution in a space. When there is little exterior daylight, there will be reduced interior light.
To reach an IES standard (for instance 30 Foot Candles) at the work surface, it is important to identify the locations of work spaces, and place electric lighting control sensors and the fixtures so that they supplement daylight when necessary. In Figure K below, a workspace located in the lower right corner in plan will not receive sufficient daylight ondim overcast days. A light sensor here will insure that the entire space receives adequate light at all times, with electric light supplementing only when needed.

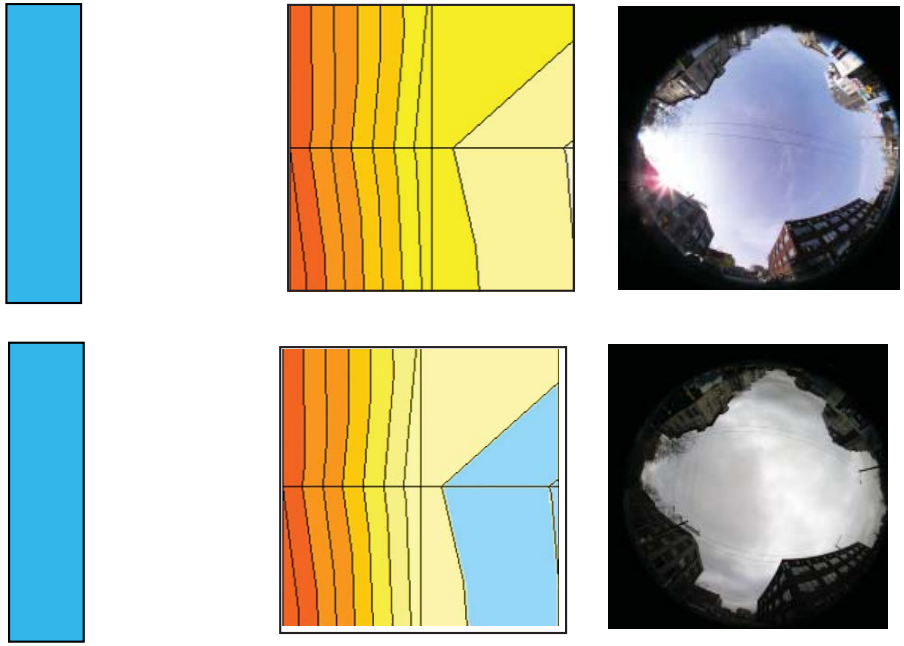

Figure K: Diagramatic light level distribution in a space with unchanged geometry on a bright sunny day (above) and a dim overcast day (below). On a dim day, the light at the back of the room may be well below 30FC.