

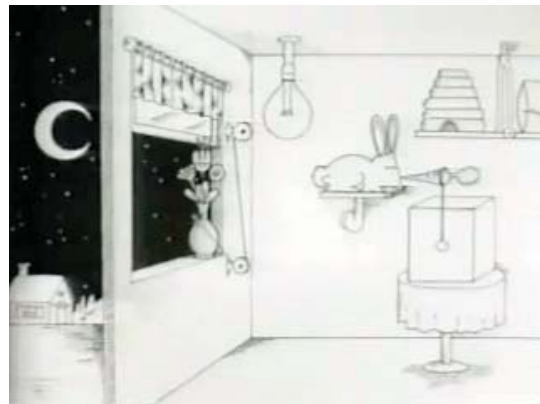
# DIVA and Design

Jeff Niemasz & Jon Sargent  
DIVA Day  
October 19th, 2012

Thursday, November 8, 12

## Multi-Platform Workflows

- Can stifle design, collaboration, and integration.
- Prone to Errors.
- More software to learn.



Sesame Street Rube Goldberg Alphabet Contraption

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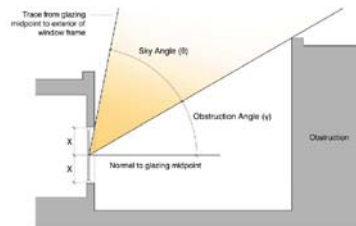
# Generative Form



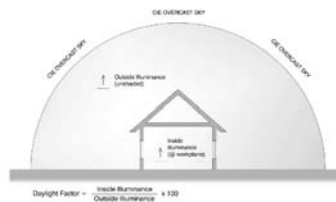
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# Environmental Relationships

Step 1: Site Conditions



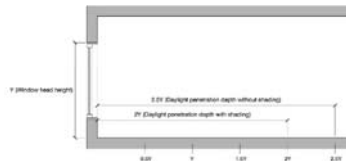
Step 2: Program needs



Step 3: Window to Wall Ratio

$$WWR > \frac{0.088 \cdot DF}{\tau_{vis}} \cdot \frac{90^\circ}{\theta}$$

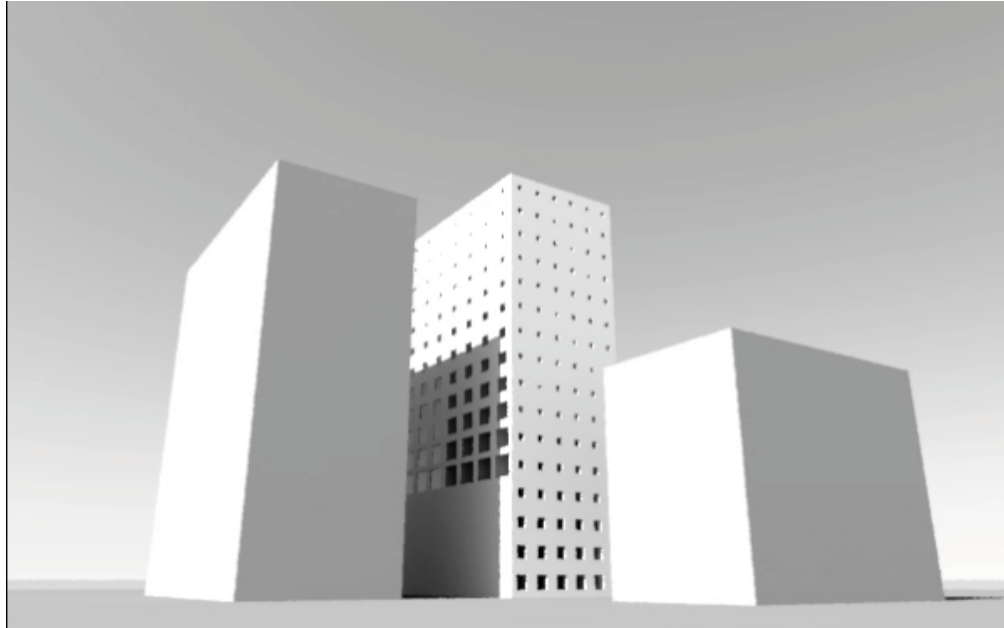
Step 4: Daylight Depth



CF Reinhart and VRM LoVerso, "A design sequence for diffuse daylight", Lighting Res. Technol, 2010; 42: 7-31

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# Visualizing Relationships



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## Rules of Thumb and Simulations



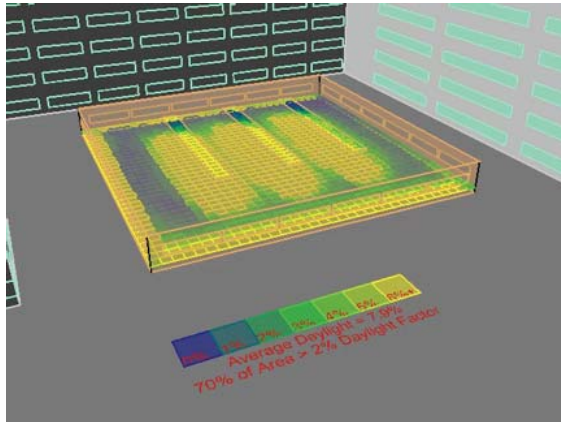
Diffuse Daylight Sequence **Rule of Thumb**



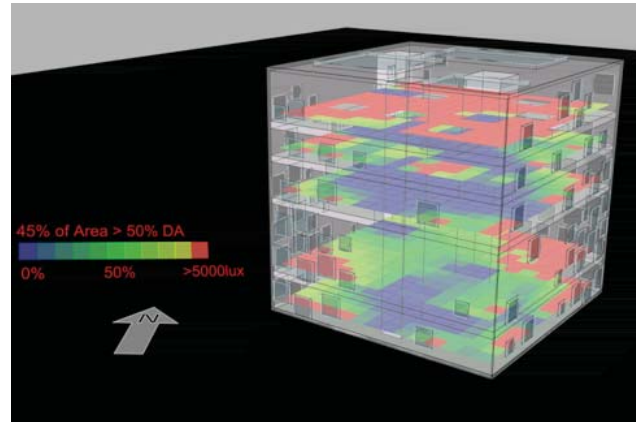
Daylight Factor **Simulation**

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# Proof of Concept Rhino/Grasshopper & Radiance and Daysim



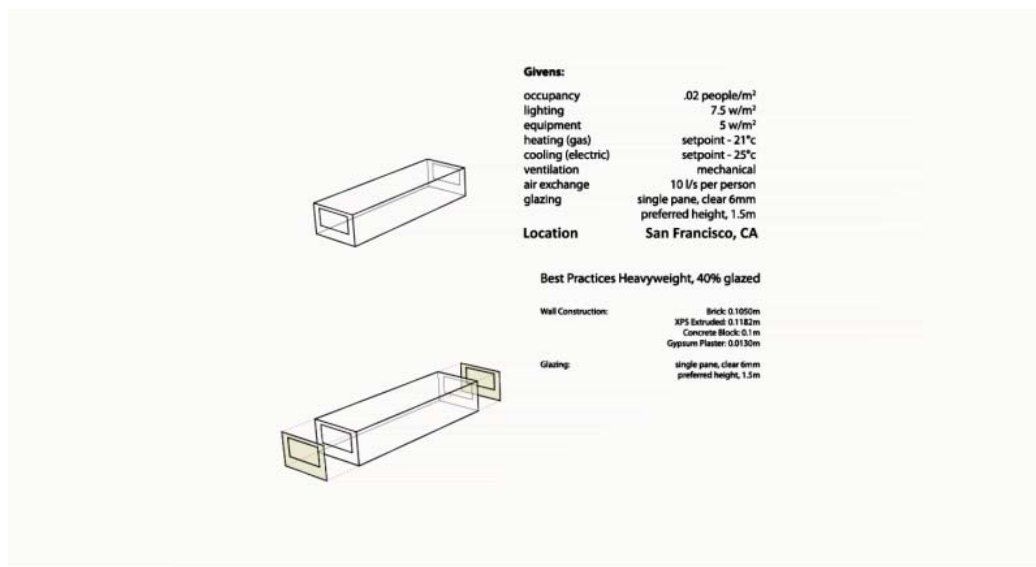
Skylight and Daylight Factor  
2009 International Radiance Conference



Daylight Autonomy Demonstration  
2010

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# Proof of Concept Rhino/Grasshopper & EnergyPlus



Linking Grasshopper with Energy Plus  
Spring 2010 class "Thermal Performance of Buildings"  
J Niemasz, J Sargent, L Viklund

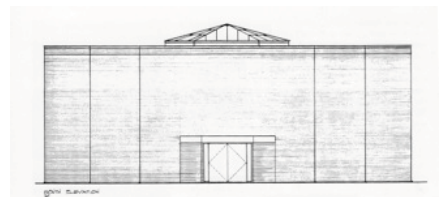
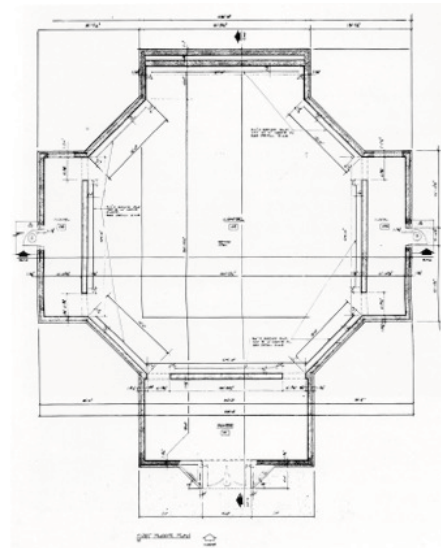
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## DIVA Thermal Analysis + Galapagos

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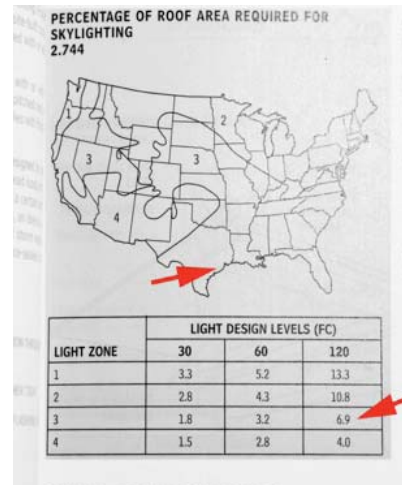
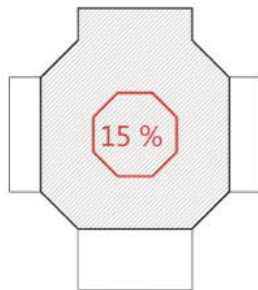
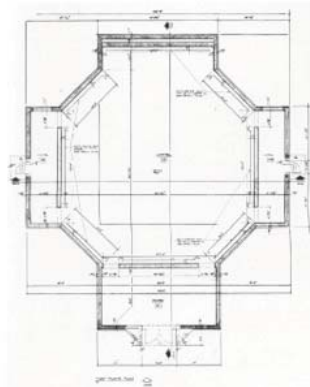
### Example: Size a Skylight

- Location: Houston, TX
- Program: Museum
- 1500 sf
- No windows



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# Skylight Rules of Thumb



DOE rule of thumb for windowless space recommends between 5 and 15% skylight to floor area percentage.

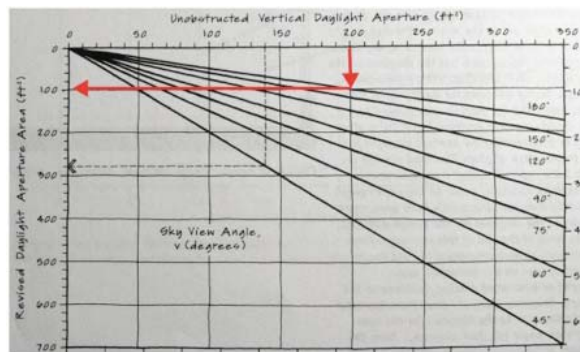
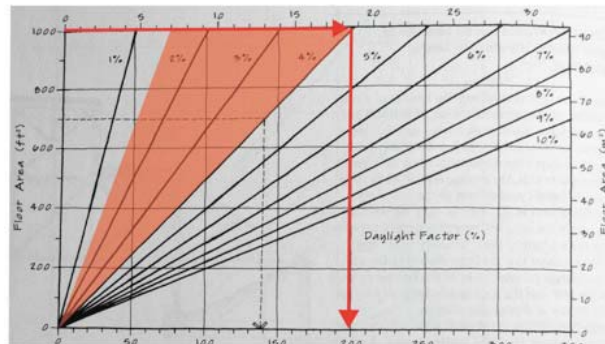
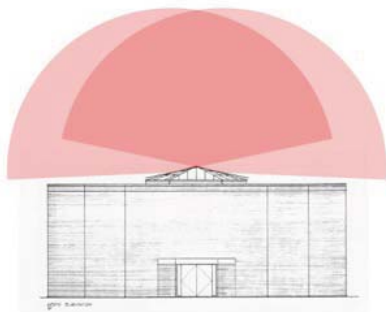
US Dept. of Energy website: <http://www.energysavers.gov>

AIA graphic standards uses a climate zone and recommends a 7% skylight.

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# Skylight Rules of Thumb cont.

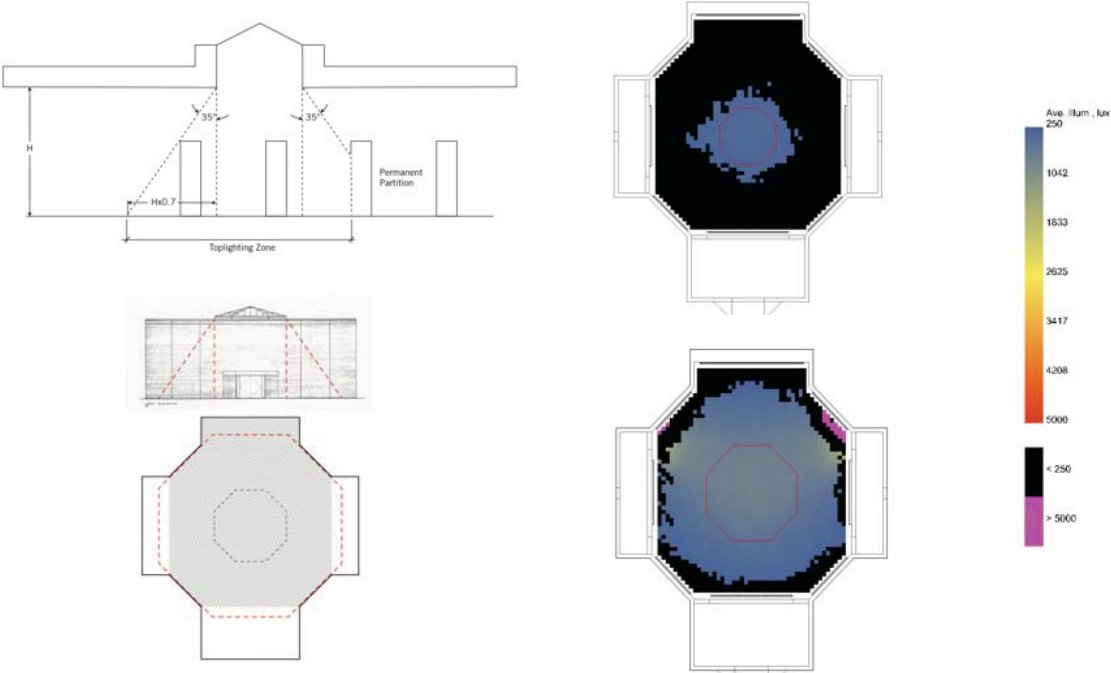
| TASK/USE                 | fc (Lux)          | Latitude |       |          |
|--------------------------|-------------------|----------|-------|----------|
|                          |                   | 10°-20°  | 30°   | 40°      |
| Assembly Tanks, simple   | 20-50 (215-536)   | 1.5-3    | 1.4   | 2.6      |
| moderately difficult     | 50-100 (536-1070) | 3-6.5    | 4     | 5.5-14.5 |
| Air Terminals            | 10-20 (108-215)   | 0.5-1    | 1.5   | 1-3.5    |
| Bank, lobby              | 10-20 (108-215)   | 0.5-1    | 1.5   | 1-2.5    |
| bar                      | 50-100 (536-1070) | 3-6.5    | 4     | 5.5-14.5 |
| Casuarium, general       | 20-50 (215-536)   | 1.5-3    | 1.4   | 2.6      |
| reading                  | 50-100 (536-1070) | 3-6.5    | 4     | 5.5-14.5 |
| Conference Room          | 20-50 (215-536)   | 1.5-3    | 1.4   | 2.6      |
| Corridor, stairs         | 5-10 (54-108)     | 0.5-1    | 0.5-1 | 0.5-1    |
| Dining Hall              | 5-10 (54-108)     | 0.5-1    | 0.5-1 | 0.5-1    |
| Drafting                 | 50-100 (536-1070) | 3-6.5    | 4     | 5.5-14.5 |
| Exhibition, general      | 10-20 (108-215)   | 0.5-1    | 1.3   | 1-2.5    |
| display                  | 20-50 (215-536)   | 1.5-3    | 1.4   | 2.6      |
| Hotel Rooms              | 20-50 (215-536)   | 1.5-3    | 1.4   | 2.6      |
| Lobby, lounge, reception | 10-20 (108-215)   | 0.5-1    | 1.3   | 1-2.5    |
| Library stacks, active   | 20-50 (215-536)   | 1.5-3    | 1.4   | 2.6      |
| inactive                 | 5-10 (54-108)     | 0.5-1    | 1.3   | 0.5-1    |
| Locker Rooms             | 10-20 (108-215)   | 0.5-1    | 1.3   | 1-2.5    |
| Museum Display           | 20-50 (215-536)   | 1.5-3    | 1.5-4 | 2.6      |
| Office, general          | 10-20 (108-215)   | 0.5-1    | 1-1.5 | 1-2.5    |
| Reading, normal          | 20-50 (215-536)   | 1.5-3    | 1.5-4 | 2.6      |



Sun, Wind & Light, Architectural Design Strategies second edition  
GZ Brown and Mark DeKay

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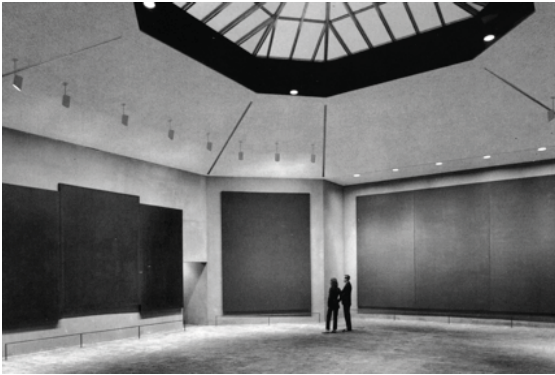
# LEED IEQ 8.1



Prescriptive and Performance Guidelines give daylighting credit for the 15% skylight but not for the 7%.

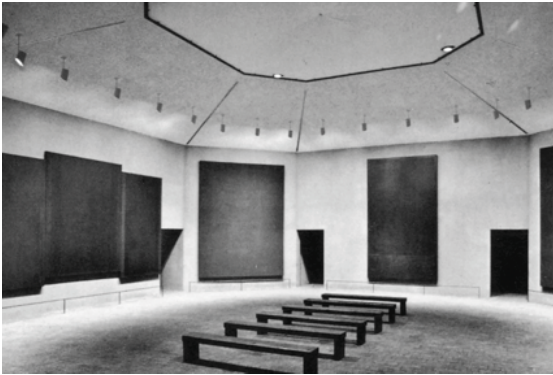
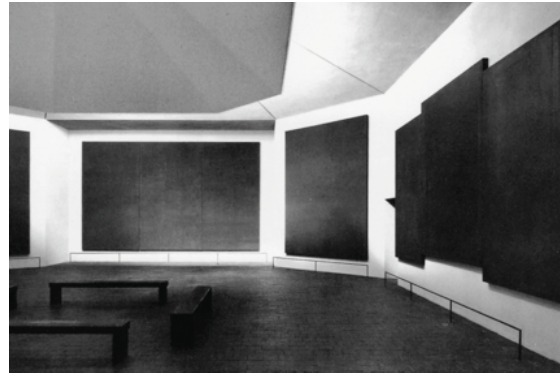
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Full scale prototype is the gold standard for daylight assessment.



Photos from "The Roktho Chapel", by Susan J. Barnes

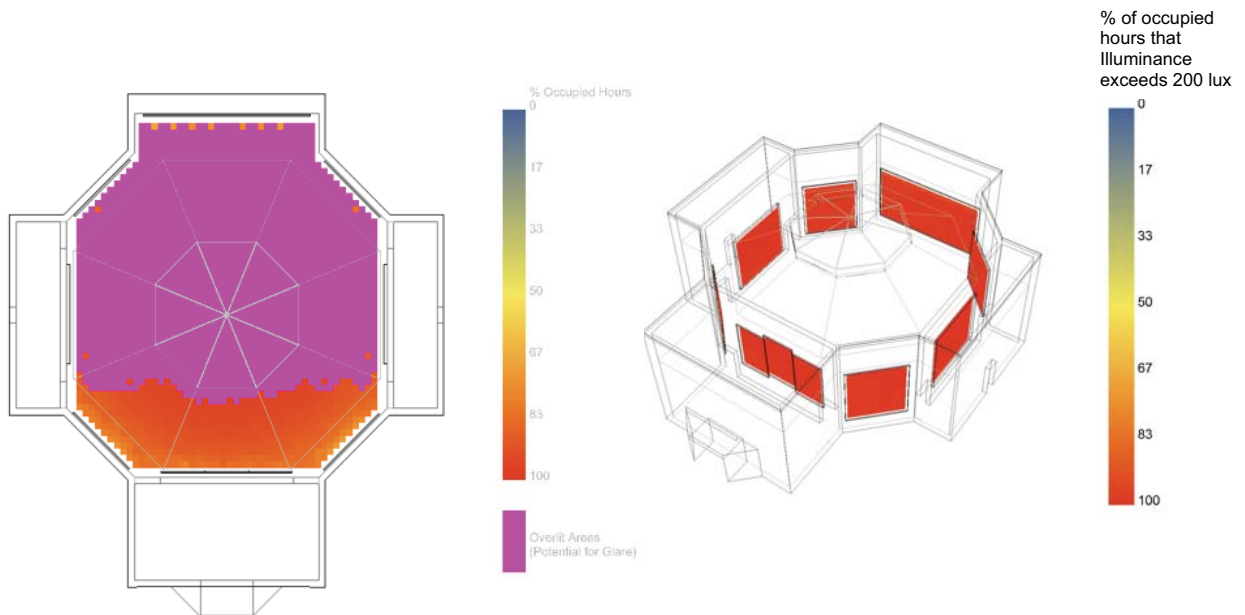
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Photos from "The Roktho Chapel", by Susan J. Barnes

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# Climate Based Metrics in DIVA



Daylight Availability (pink is over-lit)

Daylight Autonomy. Red means artwork exceeds 200 lx for 100% of the occupied hours

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"A Meditative Mecca- in Oil Country"  
Michael Hailey GQ Dec 2010