Modifiers for Side Lighting
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Outline

Modifiers

Single Side Lighting

Bi-lateral Lighting

Multi-lateral Lighting

Clerestory Lighting

Light Shelves

Internal Controls

External Controls

Summary
Modifiers

- Building geometry & spatial arrangement should promote, rather than preclude, distribution of daylight
Modifiers

- Buildings should be massed & configured so maximum # of spaces are near daylight.
- Fine-tune strategies based on linear, centric, or clustered forms.

FIGURE I.8
Articulated plans showing increased daylighting zones.
Modifiers

- Create low contrast between the window frame and adjacent walls to reduce glare and improve vision.
- Minimize mullions
- Splay window jambs.
Modifiers

• **Borrowed light**
  – With acceptable depths, light can be shared to hallways & other spaces
  – Interior partitions must have glass or open space to share lighting
  – Noise/security concerns
  – Usually uses clerestories or glass located high in the exterior wall for best distribution.
  – Ceiling is a secondary light source!
Modifiers

- Splayed surfaces are effective at increasing the apparent size of the aperture.
- Splayed surfaces can “temper” brightness variations near the opening.
Modifiers

- Bounce daylight off surrounding surfaces to diffuse light in more even brightness patterns
Modifiers

- Filter daylight to avoid harshness of direct sun & sky light
Modifiers

- External reflection from:
  - Ground
  - Adjacent buildings
  - Roof top
  - Walls

- Reflectance characteristics important
Single Side Lighting

- Performance based on the geometric relationships between:
  - The room
  - Size, shape, location of daylight apertures
- Three proportional relationships:
  - Spatial proportions
  - Aperture proportions
  - Spatial/aperture proportions
Single Side Lighting

- Aperture – rough opening of the window without regard to framing
- High E levels near window; low rear of room
- 1.5 to 2.5 x Ht. To 10%
- Strong directionality of light
- Effective for lighting 2-D horizontal surfaces
- High glass effective for lighting vertical surfaces
Single Side Lighting

• High openings - clerestories

High, narrow openings (e.g., ribbon windows) can project light deep into rooms and achieve uniform distribution of daylight, but view of outdoors will be restricted. Ceiling and upper walls should be high-reflectance, matte surfaces.

- Light directed toward ceiling will reduce glare from windows
- Primary light source (high location can spread and project light deep into room)
- High-reflectance wall surfaces (to decrease contrast between glazing and surround)
Single Side Lighting

- Windows with low sills

Openings with low sills project more light onto floor and permit better distribution of reflected ground light.

![Diagram](image)

- Wide opening (corresponds to normal horizontal "to-and-fro" eye movements of room occupants)
- Secondary light source (reflections from floor can balance reflected light from walls and ceiling)
Single Side Lighting

- Windows at end walls

End

Openings at end of walls can help users understand size and shape of rooms by defining intersections of major surfaces. End openings also can reduce brightness ratios by illuminating adjacent surfaces. However, views of outdoors for time orientation and weather information will be restricted.

Reference

Case Study: Herman Miller SQA Building

- Herman Miller SQA Building, Holland, MI, USA
- William McDonough + Partners, Charlottesville, VA
- 290,000 square feet housing manufacturing, offices & showrooms
- Good energy efficiency
- Indoor air quality
- Daylighting
- Restored wetlands & prairie landscape site.
- Daytime workers rated the building as better for people.
- Linear form
Case Study: Dormitory at M.I.T.

- Steven Holl, Architects, New York City
- 160,000 sq. ft. for 350 students.
- Received 2000 PA Award
- Façade is perforated, prefabricated, concrete panels with large scale openings into view corridors, main entrances & outdoor activity area.
- Linear form
Case Study: Dormitory at M.I.T.
Bi-lateral Lighting
Bi-lateral Lighting

- Better distribution balance
- 15/30 rule
- Less glare than single side lighting
- Glare can still be a problem without filtered or bounced light
- Used to create two or more primary lighting zones in a room
Bi-lateral Lighting

- Illuminance contours are more balanced.
- Horizontal distribution.
- Vertical distribution.
- Reviewing in plan & section useful.
Multi-lateral Lighting

Figure 4.4  Section of the Carmel Mountain Ranch Library.
(M. W. Steele)
Multi-lateral Lighting

• Light from multiple directions
• 15/30/15 proportions
• Better brightness balance
• Glare control still needed
• Less use of artificial lighting during daylight
• Controls by zone
• Can be used to vary the max. to min. illuminance
Clerestory Lighting

- Defined by Robbins (1986, p. 80) as an aperture above the aisle roof of a church nave, transept, or choir acting as a primary light source.
- Any window whose sill height is greater than eye height, usually 7’ or more above the floor.
- If top is above ceiling height, is considered a roof monitor.
Clerestory Lighting

- Usually not used as view glass.
- Open to bright part of sky dome close to zenith.
- Allow deeper daylight penetration.
- Provide excellent horizontal & vertical task illuminance.
- Ground reflections usually not critical; reduces ground-reflected glare.
Case Study: Temple Beth Shalom

- Hastings-on-Hudson, NY, USA
- Edward I. Mills & Associates and Perkins Eastman, Architects
- Congregation wanted “a peaceful, light-filled place.”
- Vertical windows & clerestories.
Case Study: Temple Beth Shalom
Case Study: Atlantic Center for the Arts

- Thompson & Rose Architects
- New Smyrna, Florida, USA
- Articulated, clustered site plan
- Boardwalk connects buildings
- Window forms vary among buildings
- Cluster form
- Responsive to microclimate
Case Study: Atlantic Center for the Arts
Case Study: Seabird Island School

- Salish Indian Reservation, Agassiz, British Columbia, Canada
- Patkau Architects, Vancouver
- Long, linear plan oriented on east-west axis
- Temperate climate with cool, overcast winters
- Large clerestory on south side.
- Low, irregularly shaped windows provide view.
- Complex linear form.
- Building “engages the site.”
Case Study: Seabird Island School

Figure 1.23 Site plan of Seabird Island School.
(Parada Architects)
2. **BOUNCE**

Daylight against surfaces to spread it out and get it deep into interior spaces.
Light Shelves

- Location of shelf affects its exposure to sky.
- Finish of shelf for redirecting light important.
- Diffuse finishes better than shiny due to maintenance & other issues.
- Depth of shelf important relative to sun angle.
- South orientation best.
- Glass below shelf – view glass.
- Glass above shelf – daylight glass.
- Ceiling reflectance impacts interior illuminance.
Light Shelves

- Separate view glass from daylight glass.
- Types:
  - Internal
  - External
  - Combination

6-59. The clerestory portion of a lightshelf should not allow direct penetration of sunlight at any time. The lower window may allow some sunlight penetration as long as it falls below eye level.

6-60. Project lightshelf from facade to capture high-angle sunlight and provide additional shading for low windows.

6-61. With flat facades, most of the lightshelf is in shade at high sun angles.
Light Shelves

- Deep daylighting
- External shelf
- Internal shelf
External Controls

- Louvers
- Eggcrates
- Overhangs
- Screens
Internal Controls

- Two critical issues:
  - Reliability
  - Ease of use

- Categories:
  - Shutters
  - Window shades
  - Drapery
  - Opaque sliding panels
  - Directional glazing & glass block
"Architectural study always involves a moment of art and instinct. Its purpose is still to bring the world of matter into harmony with human life." (Alvar Aalto)
References

- **Kimbell Art Museum**
  http://www.kimbellart.org/building/Architecture_facts.cfm?id=3