Light In Architecture and Psychology of Light

Designing with Light

The majority of the information that we receive about the world around us comes through our eyes.

Light is not only an essential prerequisite, it is the medium by which we are able to see.

Through its intensity, the way it is distributed and through its properties, light creates specific conditions which can influence our perception. Lighting design is, in fact, the planning of our visual environment.

Good lighting design aims to create perceptual conditions which allow us to work effectively and orient ourselves safely while promoting a feeling of well-being in a particular environment.

Designing with Light

- Light plays a central role in the design of a visual environment.
- The architecture, people and objects are all made visible by the lighting.
- Light influences our well-being, the aesthetic effect and the mood of a room or area.

- It is light that first enables “what you see”.

Our perception of architecture will be influenced by light:
- Light defines zones and boundaries,
- Light expands and accentuates rooms,
- Light creates links and delineates one area from another.

Planning and Process

- The basis for every lighting concept is an analysis of the project…
  - the tasks the lighting is expected to fulfill,
  - the conditions and special features of a space or work surface.
- When it comes to qualitative planning, it is necessary to gain as much information as possible about the environment to be illuminated, how it is used, who will use it and the style of the architecture.
- A quantitative design concept can to a large extent follow the standards laid down for a specific task.
  - standards will dictate how much light is needed,
  - the degree of glare limitation,
  - the source color and color rendering.

Planning and Process: Schematic

- Preliminary lighting concepts list the properties that lighting should possess. They may give no exact information about the choice of lamps or fixtures or their arrangement.
- Further analysis provides illumination guidelines giving information about the individual forms of lighting… i.e. high light levels will need high performance fixtures and lamps, etc.
- The challenge of a qualitative lighting design is to develop a design concept that combines the technical and aesthetic requirements of complex guidelines.
- A concept that delivers the required performance with a equal level of technical expertise and the highest level of artistic clarity will produce the most convincing solution.
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Planning and Process: Design Development

• As the design phase progresses, decisions are made regarding:
  – the lamps and fixtures to be used
  – the arrangement and installation of the fixtures
  – any required electrical and control devices
• The decision regarding lamp type can be made at the beginning of a project or left until an advanced planning stage
• Lighting layouts (the plan) can be determined by the choice of a light fixture or could be the criteria for fixture selection.
• Lighting design process should be seen as a "back and forth" check in which developed solutions are repeatedly compared to the predetermined goals and requirements.

Summary
• Utilization of Space
• Psychological Requirements
• Architecture and Ambience

Vision: We See Brightness

The perception of brightness of the grey field depends on the environment - in bright surroundings, an identical grey appears darker than in dark surroundings.

Lighting Effects: Shadows and Gradient

The continuous luminance gradient across the surface of the wall is interpreted as a property of the lighting. The wall reflectance factor is assumed to be constant. The grey of the sharply framed picture is interpreted as a material property, although the luminance is identical to the luminance in the corner of the room.

Changing luminance levels may arise from the spatial form of the illuminated object; examples of this are the formation of typical shadows on objects such as cubes, cylinders or spheres.

Lighting Effects: Shadows and Gradient

A non-continuous luminance gradient across a surface may create confusion, miss-information, or the perception of darkness / gloom – or is this drama?
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Lighting Effects: Illumination of 3D Objects

Irrespective of size, a three-dimensional artifact must be illuminated from several different directions.

- Light from multiple directions:
  - models a sculpture
  - expresses depth by highlighting some areas while allowing others to fall into shadow
  - different angles render material variations with lesser or greater emphasis

Light and Perception

Fixed objects produce retinal images of varying shapes, sizes and brightness. Due to changes in lighting, distance or perspective, this indicates that mechanisms must exist to identify these objects and their properties and to perceive them as being constant.

Psychological Impressions Of Color

Using warm and cool sources for Key and Fill light not only increases sense of shape and depth of an object, but assist with defining direction of light.

- Cool Light And Warm Shade:
  - Color also can provide information about an object's dimensions and depth.
  - Our visual system assumes the light comes from above, we rely on our visual experience with nature to explain direction of light.
  - "visual experience tells us warm light comes from the interior illumination, a cooler light source comes from nature – daylight at day, moonlight at night"
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Types of Lighting

- Direct
- Indirect

Forming Functional Zones

- Large areas that on the whole are evenly illuminated can appear rather monotone if they are not divided up.

room illuminated evenly

unlit room
Forming Functional Zones

- Light can be used to emphasize individual functional zones in an area, e.g. traffic areas, waiting areas, and exhibition areas.

room with left wall illuminated (simulate daylight)

room with rear walls only illuminated

room with objects only illuminated

room with stairs only illuminated
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Forming Functional Zones

• Zonal lighting with delineated beams of light visually separates one area from another.

room with objects and stair illuminated

Forming Functional Zones

• Different illuminance levels establish a perceptual hierarchy and direct the viewer’s gaze.

room with left wall and stair illuminated equally

Forming Functional Zones

• Differentiated lighting of functional zones divide up an area and improve orientation.

room with rear wall and stair illuminated

Forming Functional Zones

• The differentiation of light colors creates contrasts and emphasizes individual zones.

room with left and rear walls illuminated
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Forming Functional Zones

Forming Functional Zones - Exterior

Defining Spatial Borders - Horizontal

• Floor illumination emphasizes objects and pedestrian surfaces.

floor lit with downlight fixtures
Defining Spatial Borders - Horizontal

- Indirect lighting of a ceiling creates diffuse light in the room with the lighting effect being influenced by the reflectance and color of its surface.

Defining Spatial Borders – Horizontal

Defining Spatial Borders – Horizontal

Defining Spatial Borders – Horizontal
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Defining Spatial Borders - Vertical

- Vertical spatial borders are emphasized by illuminating wall surfaces.
- Uniform light distribution emphasizes the wall as a whole.
- Bright walls create a high level of diffuse light in the room.
- Vertical illumination is used to shape the visual environment.
- Room surfaces can be differentiated using different levels of illuminance to indicate their importance.
- Uniform illumination of the surfaces emphasizes them as an architectural feature.

Defining Spatial Borders - Vertical

- Grazing light gives the wall structure by adding patterns of light.
- A decreasing level of brightness across a wall is not as effective as uniform wall washing at defining room surfaces.
- Lighting effects using grazing light emphasis the surface textures and become the dominant feature.
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Defining Spatial Borders - *Vertical*

- Columns appear as silhouettes in front of an illuminated wall.
- Walls lit with grazing fixtures.

Emphasizing Architectural Features

- The illumination of architectural details draws attention away from the room as a whole towards individual components.
- Columns appear as silhouettes in front of an illuminated wall.
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### Emphasizing Architectural Features

- Rooms can be given a visual structure by illuminating the architectural features.
- Narrow-beam downlights emphasizing the form of the columns.

- Grazing light accentuates individual elements or areas and brings out their form and surface texture.
- Grazing light can cause highly three-dimensional features to cast strong shadows.
- By using different levels of illuminance, different parts of a room can be placed in a visual hierarchy.

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### Emphasizing Architectural Features

- Columns lit with grazing fixtures

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### Emphasizing Architectural Features

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### Visual Clarity

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Because the sense of sight is contrast sensitive, the brightness contrast of a space determines its emotional impact.

**Emotional Impact**: individual impressions of a space are a function of brightness contrast

- the relationship of surfaces that are lighted to those left in the dark
- the focus or foreground to the surround or background

General illumination in a room will permit vision. The emotional impact of an interior through the manipulation of brightness contrast is a real challenge for the creative lighting designer.
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<table>
<thead>
<tr>
<th>Emotional Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Images](111x108 to 154x166) ![Images](111x171 to 154x237) ![Images](244x225 to 283x283) ![Images](157x123 to 201x182) ![Images](118x253 to 186x355) ![Images](188x264 to 238x362) ![Images](206x108 to 283x221) ![Images](244x288 to 282x339) ![Images](206x225 to 234x260) ![Images](157x186 to 200x251) ![Images](115x465 to 194x567) ![Images](115x573 to 195x676) ![Images](197x465 to 275x566) ![Images](197x573 to 275x674)</td>
</tr>
<tr>
<td>Degrees of Stimulation</td>
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</tbody>
</table>
| All activities benefit from some form of visual stimulation  
  – High levels encourage participation and increase enjoyment  
  – Low levels help a person feel contented, comfortable, focused, and relaxed  
  Although individuals react differently to the same environment, there is a high degree of similarity in people’s reactions to light. |
| Emotional Impact |
| ![Images](587x753) |
| Degrees of Stimulation |
| Environments that are complex, crowded, asymmetrical, novel, unfamiliar, surprising, random are High-load  
  Environments that are simple, uncrowded, symmetrical, conventional, familiar, unsurprising, or organized are Low-load. |
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## Degrees of Stimulation

Environmentalists use the terms **High-load** to **Low-load** to describe the degrees of stimulation of arousal. The more stimuli that must be processed by a person, the higher the load.

![Stimulation Examples](image1.png)

## Degrees of Brightness Contrast

The degree of brightness contrast evokes emotions in the same way as background music. It affects:

- the performance of tasks,
- influences the behavior of people at work or play, and
- affects the amount of containment and pleasure we experience.

The degree of brightness contrast establishes the emotional setting, which either enforces or undermines the intended activity.

Steps in the design process:
1. Define the activity that will occur in the space
2. Determine the degree of simulation that will enforce the activity
3. Establish the degree of brightness contrast that will yield the necessary level of simulation

**Brightness contrast is established by developing patterns of light and shade** – select which surfaces to receive light or leave other as darkness.

![Contrast Examples](image2.png)

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### Degrees of Brightness Contrast

**Low Contrast Environment** – everything is of equal emphasis

![Low Contrast](image3.png)
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### Degrees of Brightness Contrast

**Low Contrast Environment** — *everything is of equal emphasis*

![Image](image1)

**Mid Contrast Environment** — *combinations of emphasis*

![Image](image2)

**Mid Contrast Environment** — *combinations of emphasis*

![Image](image3)

**High Contrast Environment** — *high bright and dark areas*

![Image](image4)
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#### Degrees of Brightness Contrast

**High Contrast Environment – high bright and dark areas**

- **Very High Contrast Environment – extreme high bright and dark areas**

<table>
<thead>
<tr>
<th>Subjective Impressions</th>
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</thead>
<tbody>
<tr>
<td>• Professor John Flynn’s studies in the 1970’s established fundamental research about how the distribution of light and resulting patterns of light effect our subjective impressions.</td>
</tr>
<tr>
<td>• In particular patterns of light on vertical surfaces, because they are more noticeable, strongly influence our impressions of:</td>
</tr>
<tr>
<td>- Spaciousness / Confinement</td>
</tr>
<tr>
<td>- Visual Clarity / Haziness</td>
</tr>
<tr>
<td>- Relaxation / Activation</td>
</tr>
<tr>
<td>- Private/ Public</td>
</tr>
</tbody>
</table>
Subjective Impressions

1. Direct lighting on table: strong contrast, too harsh for lighting faces. 
Pleasantness: Neutral 
Clarity: Hazy, quiet impression 
Spaciousness: Strong impression of confinement

2. Lighting on all walls, low intensity, suitable for display. 
Pleasantness: Neutral, leaning towards a more pleasant impression 
Clarity: Neutral 
Spaciousness: Promotes impression of increased height

3. Lighting of cove above, low intensity, pleasant for near and distant faces. 
Pleasantness: Strong negative 
Clarity: Strong promoting hazy, quiet impression 
Spaciousness: Neutral

4. Direct lighting on table, lighting of small wall 
Pleasantness: Relatively strong positive 
Clarity: Neutral 
Spaciousness: Neutral with strength in impression of height

5. Direct lighting on table, lighting of cove above, somewhat intensity, pleasant for near faces. 
Pleasantness: Relatively strong negative 
Clarity: Strong 
Spaciousness: Somewhat

Pleasantness: Strong 
Clarity: Strong 
Spaciousness: Strong

Reinforced by:
- Uniform peripheral lighting, especially on walls
- Brightness is reinforcing, but not decisive

Luminance Patterns

Spaciousness: 
Relatively bright ceilings and wall are particular importance to reinforce a sense of spaciousness. Uniform illumination also helps make the room feel spacious.

Reinforced by:
- Higher light levels on horizontal surfaces: workplane, ceiling plane
- Light in central area of room
- Some wall luminance
- Cooler, white light
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**Luminance Patterns**

**Visual Clarity:**
Visual clarity refers to the crispness and distinctness of the visual environment, rather than how well a task can be seen. Visual clarity is reinforced by shadows, by emphasis on horizontal surfaces such as the work plane and the ceiling, and by higher luminous in the center of the room.

**Subjective Impressions**

Reinforced by
- Non-uniform peripheral lighting, especially on walls
- Lower light levels
- Warmer-toned light sources

**Relaxation Patterns**

Relaxation also implies non-uniform lighting, with non-uniform wall lighting contributing to this impression. Warm color sources contribute to a relaxing feeling. Aspects of the patterns for relaxation can be effectively combined with those for visual clarity to create effective and comfortable work environments.

**Subjective Impressions**

Reinforced by
- Non-uniform
- Lower brightness in zone of user
- Higher brightness in zones surrounding user
- Wall lighting

**Privacy**
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Luminance Patterns

Privacy:
Privacy is light being in the shadows. Lighting patterns which are overall low, non-uniform, and darker zone of the occupant than in the surroundings will reinforce an impression of privacy. Vertical rather than horizontal surfaces should be lit.

Subjective Impressions

Impression of Spaciousness – the room appears larger or smaller

Impression of Perceptual Clarity – the room appears public or private

Impression of Pleasantness – the room appears friendly or sociable
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The Three Elements of Light

<table>
<thead>
<tr>
<th>General or Ambient lighting</th>
<th>Task Lighting or Lighting at the Work plane</th>
<th>Light or Highlighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>General lighting provides an area with overall illumination. Also known as ambient lighting, general lighting radiates a comfortable level of brightness, enabling one to see and walk about safely.</td>
<td>Helps you perform specific tasks such as reading, sewing, cooking, homework, hobbies, games, or balancing your checkbook.</td>
<td>Adds drama to a room by creating visual interest. As part of a decorating scheme, it’s used to spotlight paintings, houseplants, sculpture, and other prized possessions, or to highlight the texture of a wall, drapery or outdoor landscaping.</td>
</tr>
</tbody>
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Light Distribution Strategies

<table>
<thead>
<tr>
<th>General or Ambient Lighting:</th>
<th>Local or Task Lighting</th>
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<tbody>
<tr>
<td>General lighting provides uniform illumination over the entire area of a room, allowing flexibility in the placement of workstations. Localized general lighting also provides approximately uniform illumination, but luminaries are located in a pattern that responds to the specific arrangement of workstations.</td>
<td>Local Lighting provides high illumination on relative small areas. It can be too bright and uncomfortable unless surrounding surfaces are also illuminated, as shown. Local lighting used with general lighting is called supplementary lighting.</td>
</tr>
</tbody>
</table>

Richard Kelly

Focal Glow or Task light is…

“the campfire of all time, the glowing embers around which stories are told”
“the light burning at the window or welcoming gleam of the open door”
“directive, creates a brighter center: tells us what to look at, organizes, marks the important element”

Richard Kelly

General or Ambient light is…

“a snowy morning in open country”
“twilight haze in a mountain top or cloudy day on the ocean”
“the light in a white tent at noon”
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Richard Kelly

Sparkle or Glitter is…

“a play of brilliants”
“the sensation of a cache of diamonds in an opened cave”
“a ballroom of crystal chandeliers”

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