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.

1

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.*

2

Planning and Process

Summary

- *An understanding quality versus quantity*
- *Art and Science*

- 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.

3

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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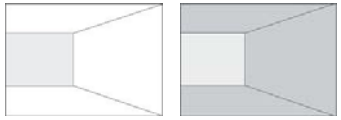
Planning and Process: Design Development

- 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.

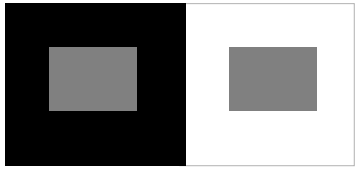
Summary
- *Utilization of Space*
- *Psychological Requirements*
- *Architecture and Ambience*

5

Vision: We See Brightness



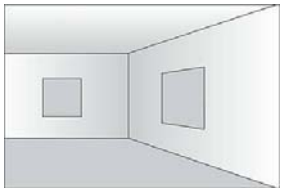
The perception of brightness of the grey field depends on the environment - in bright surroundings, an identical grey appears darker than in dark surroundings.



The fact that a medium grey area will appear light grey if it is bordered in black, or dark grey if it is bordered in white. This can be explained by the fact that the stimuli perceived are processed directly - brightness is perceived as a result of the lightness contrast between the grey area and the immediate surroundings. What we are considering here is a visual impression that is based exclusively on sensory input which is not influenced by any criteria of order linked with our intellectual processing of this information.

6

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.

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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.

Combination Key, Fill, and Back light

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

Key light only

Fill light only

Back light only

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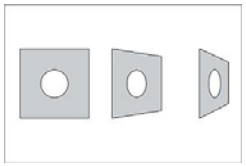
Light and Perception



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.

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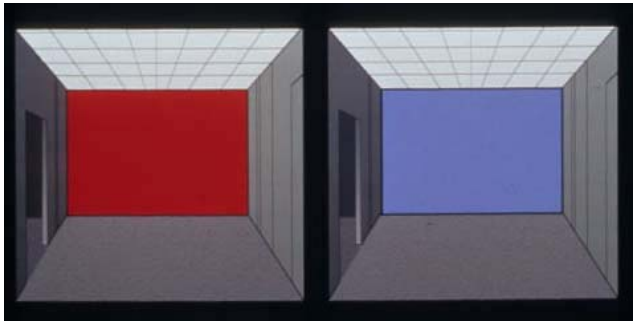
Psychological Impressions Of Color



Warm colors tend to advance

Cool colors tend to recede

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Psychological Impressions Of Color

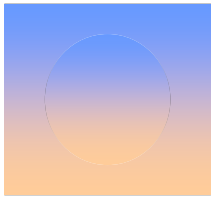
Using warm and cool sources for Key and Fill light not only increases sense of shape and depth of an object, but assist with defining direction of light

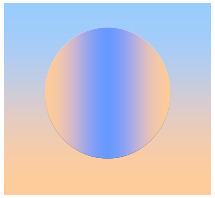
Cool Light And Warm Shade:

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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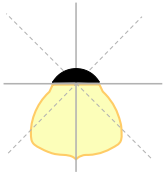
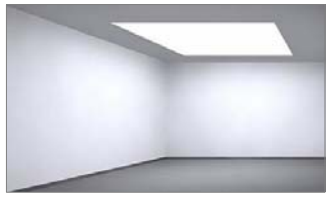
Types of Lighting



Direct



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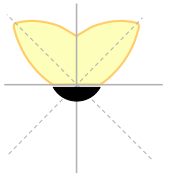
Types of Lighting



Indirect

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Forming Functional Zones

room illuminated evenly

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

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Forming Functional Zones

unlit room

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Forming Functional Zones

room with left wall illuminated (simulate daylight)

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Forming Functional Zones

room with rear walls only illuminated

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

18

Forming Functional Zones

room with objects only illuminated

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

19

Forming Functional Zones

room with stairs only illuminated

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

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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

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Forming Functional Zones

- Different illuminance levels establish a perceptual hierarchy and direct the viewer's gaze.

room with left wall and stair illuminated equally

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Forming Functional Zones

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

room with rear wall and stair illuminated

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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

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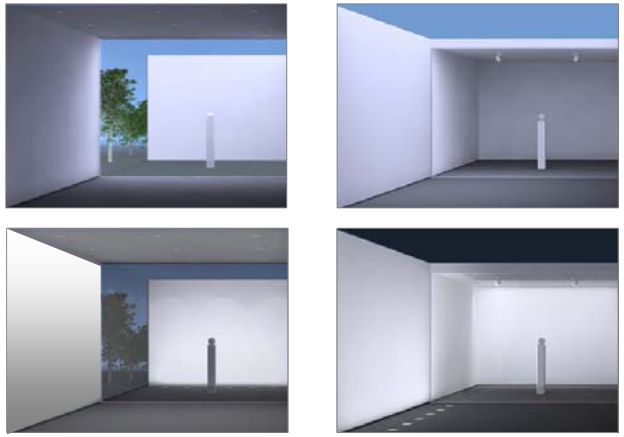
Forming Functional Zones - *Exterior*



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Forming Functional Zones - *Exterior*

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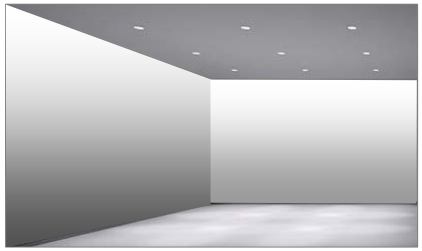
Defining Spatial Borders - *Horizontal*



floor lit with downlight fixtures

- Floor illumination emphasizes objects and pedestrian surfaces.

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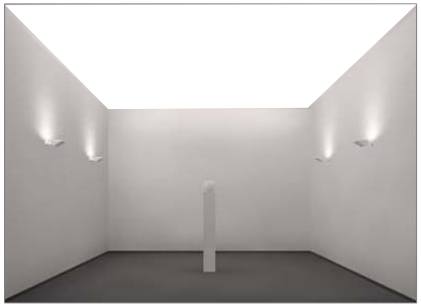
Defining Spatial Borders - *Horizontal*



ceiling uniformly lit with uplight wall fixtures

- 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.

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Defining Spatial Borders – *Horizontal*

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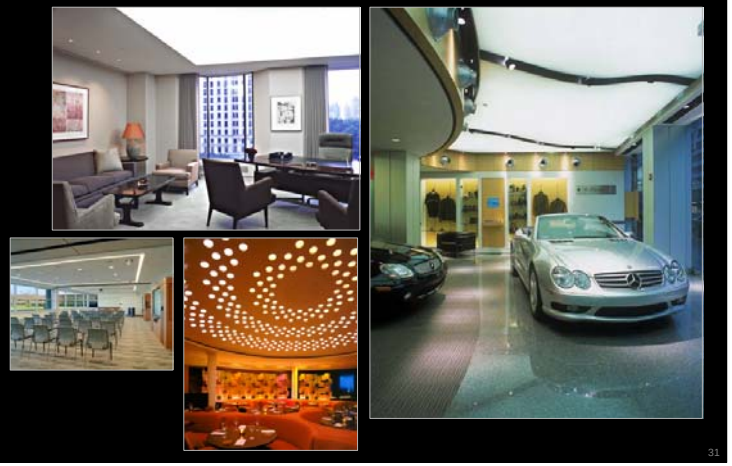
Defining Spatial Borders – *Horizontal*



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Defining Spatial Borders – *Horizontal*

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Defining Spatial Borders - *Vertical*

walls uniformly lit with wall fixtures

- 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.

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Defining Spatial Borders - *Vertical*

- Vertical spatial borders are emphasized by illuminating wall surfaces.
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- Uniform illumination of the surfaces emphasizes them as an architectural feature.

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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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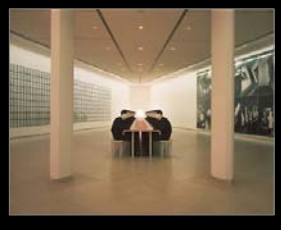
Defining Spatial Borders - *Vertical*



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Defining Spatial Borders - *Vertical*



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Defining Spatial Borders - *Vertical*




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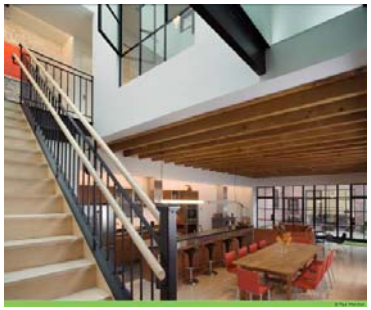


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Emphasizing Architectural Features

walls lit with grazing fixtures

- 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.

columns lit with grazing fixtures

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Emphasizing Architectural Features

- 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




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Visual Clarity




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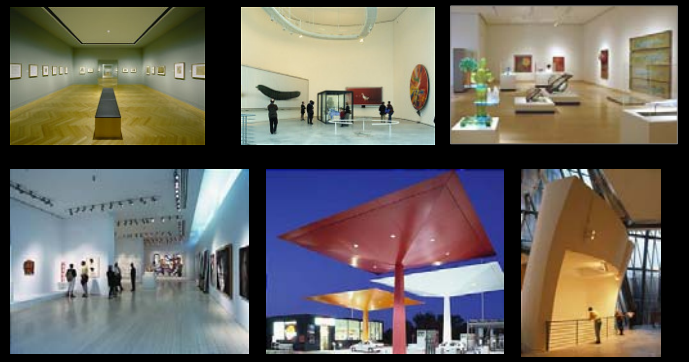
Visual Clarity



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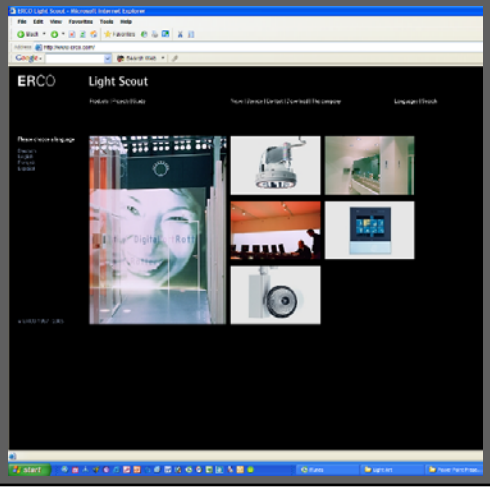

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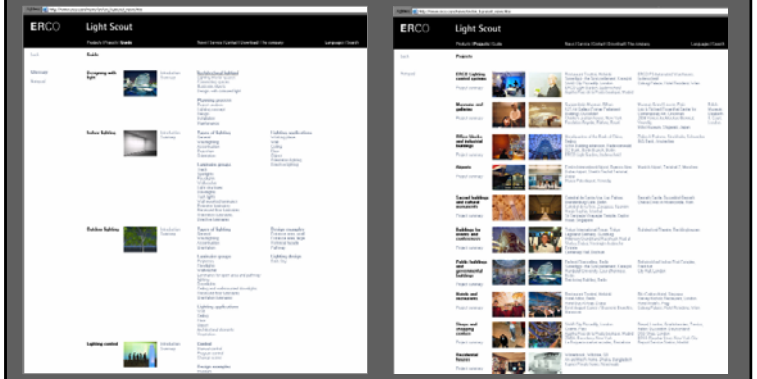

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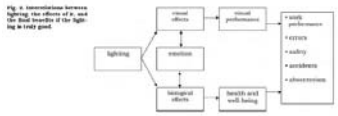
Psychology of Light

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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Emotional Impact

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Emotional Impact

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Degrees of Stimulation

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.

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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

Environmentalist 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.

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Degrees of Brightness Contrast

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

- the performance of task,
- influences the behavior of people at work or play, and
- Impact 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 is darkness

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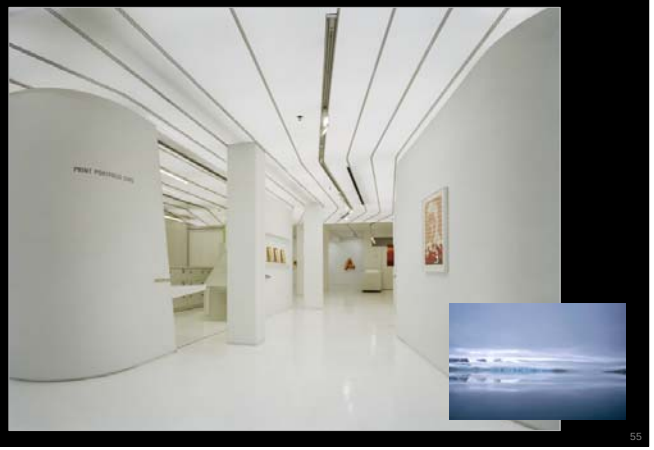
Degrees of Brightness Contrast

Low Contrast Environment – *everything is of equal emphasis*



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Degrees of Brightness Contrast

Low Contrast Environment – *everything is of equal emphasis*

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Degrees of Brightness Contrast

Low Contrast Environment – *everything is of equal emphasis*

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Degrees of Brightness Contrast

Mid Contrast Environment – *combinations of emphasis*

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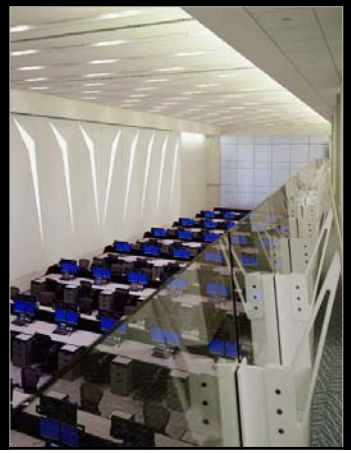
Degrees of Brightness Contrast

Mid Contrast Environment – *combinations of emphasis*



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Degrees of Brightness Contrast

High Contrast Environment – *high bright and dark areas*

60

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Degrees of Brightness Contrast

High Contrast Environment – *high bright and dark areas*

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Degrees of Brightness Contrast

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

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Degrees of Brightness Contrast

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

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Subjective Impressions

- 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**
- In particular patterns of light on vertical surfaces, because they are more noticeable, strongly influence our impressions of:
  - Spaciousness / Confinement
  - Visual Clarity / Haziness
  - Relaxation / Activation
  - Private/ Public

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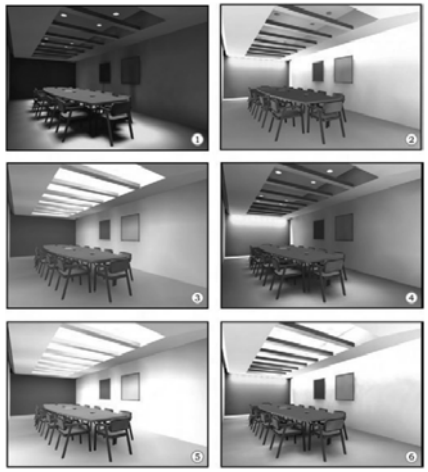
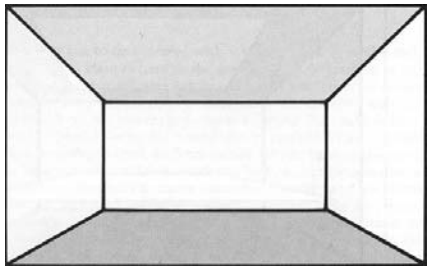
Light In Architecture and Psychology of Light

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, tending towards a more pleasant impression*
   Clarity: *Neutral*
   Spaciousness: *Promotes impression of spaciousness, 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 length*
5. **Direct lighting on table**, **Lighting of cove above** soft subdued effect, pleasant for near faces
   Pleasantness: *Relatively Strong negative*
   Clarity: *Strong*
   Spaciousness: *Somewhat*
6. **Lighting of cove above, Lighting of walls** flat shadow free
   Pleasantness: *Strong*
   Clarity: *Strong*
   Spaciousness: *Strong*



Subjective Impressions



SPACIOUSNESS

Reinforced by

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

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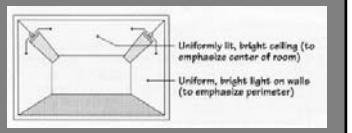
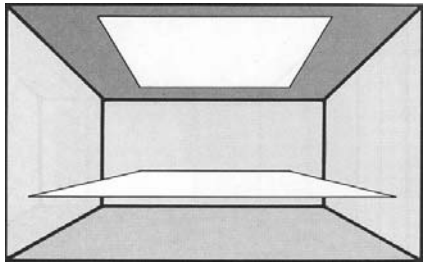
Luminance Patterns

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



Subjective Impressions



VISUAL CLARITY

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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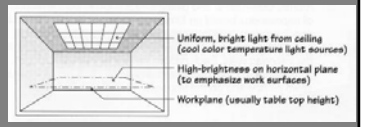
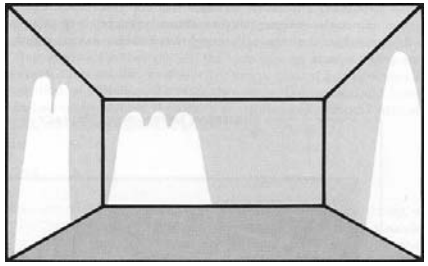
Light In Architecture and Psychology of Light

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



RELAXATION

Reinforced by

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

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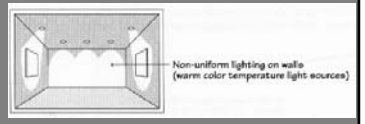
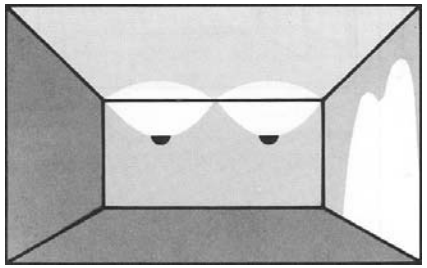
Luminance Patterns

Relaxation:
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



PRIVACY

Reinforced by

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

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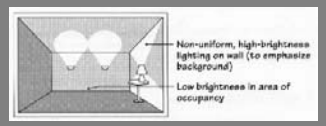
Light In Architecture and Psychology of Light

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*

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Subjective Impressions

Impression of Perceptual Clarity – *the room appears public or private*

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Subjective Impressions

Impression of Pleasantness – *the room appears friendly of sociable*

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Light In Architecture and Psychology of Light

The Three Elements of Light

General or Ambient 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.

Task Lighting or Lighting at the Work plane

helps you perform specific tasks such as reading, sewing, cooking, homework, hobbies, games, or balancing your checkbook

Light or Highlighting

adds drama to a room by creating visual interest. As part of a decorating scheme, it is used to spotlight paintings, houseplants, sculpture, and other prized possessions, or to highlight the texture of a wall, drapery or outdoor landscaping.

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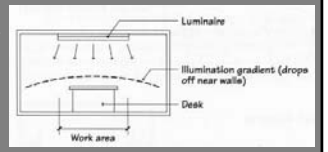
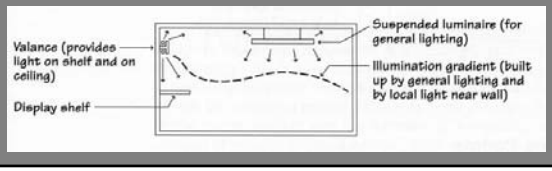
Light Distribution Strategies

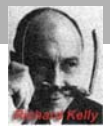
General or Ambient Lighting:
General lighting provides uniform illumination over the entire area of a room, allowing flexibility in the placement of workstations. Localized general lighting also provides approximately uniform illumination, but luminaries are located in a pattern that responds to the specific arrangement of workstations.



Local or Task Lighting
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.



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"

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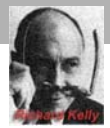
Richard Kelly



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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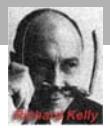
Light In Architecture and Psychology of Light

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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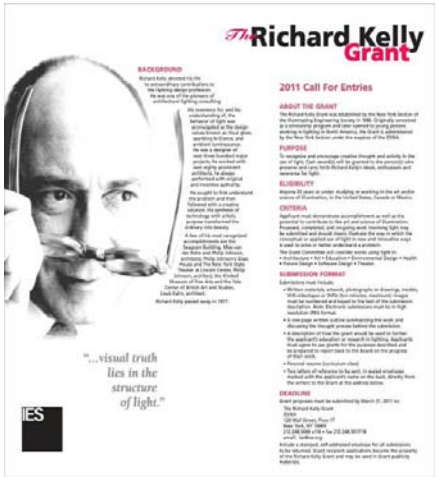

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