



**Cooledge**

404190206

**Luminous Surfaces in Architecture**

Cool 300

Presented by [Your Name Here](#)

Date: July 25, 2019



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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.



## Course Description

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Learn how luminous surfaces will change the way lighting is incorporated into architecture. Topics include the history and role of luminous surfaces in creating spaces that are more synchronized with the human experience of our environment, standards driving the incorporation of human well-being in design, the applications and design approaches for successfully specifying luminous surfaces into architecture, as well as a look at how luminous ceilings can contribute to acoustic performance.



# Learning Objectives

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At the end of this course, participants will be able to:

1. Understand the role of luminous surfaces for providing illumination in architectural spaces and the implications for human well-being
2. Understand the design requirements for luminous surfaces as a source of general illumination
3. Understand three (3) applications for luminous surfaces in architecture
4. Understand how luminous ceilings can contribute to acoustic performance





**Speaker Notes:**

- What do we mean when we say “luminous surface”? A luminous surface is one that emits light. The focus of this presentation will be on those luminous surfaces that are built for the purpose of providing illumination as opposed to decoration. Inherently, large surfaces that emit enough light to illuminate a space may also be used to attract attention – particularly in retail environments.

- The Shop at Japan House (London, UK)

## Nature Is Filled With Luminous Surfaces



### Speaker Notes:

- Our starting point should be the space where people first lived and which has influenced how we experience light. Nature has not only shaped how we see the world but also human physiology and our emotional responses to the environment. Recent understanding of this second point has led to a new way think about the role of illumination in our lives and how that illumination is delivered.

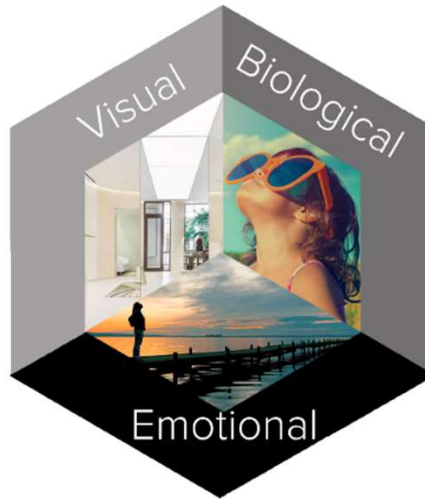
## A New Way Of Thinking About Light

Lighting must still deliver the performance required to successfully complete visual tasks

### Visual Impact of light

- Task performance
- Object identification and enhancement
- Color rendition

The impact of light on the human experience is a driving force for a fundamental change in the approach to lighting for architectural spaces



### Biological Impact of light

- Increased productivity
- Increased memory function
- Faster reactions
- Better sleep patterns (circadian rhythms)

### Emotional Impact of light

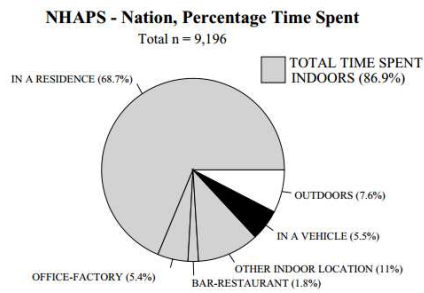
- Improvements in mood
- Decreased depression scores
- Positive judgement of performance
- Preference for “natural” illuminance

### Speaker Notes:

- Research that started in the early 2000's has led to a more detailed understanding of the impact that light has on the human experience. In addition, to being the critical factor in allowing us to see, there is a growing body of evidence that demonstrates that light is important for physiological and emotional well-being.
- “Human centric”, “biophilic”, or “integrative” lighting is rapidly becoming more understood and its role in design becoming increasingly important.
- The impact of light on the human experience is a driving force for a fundamental change in the approach to lighting for architectural spaces - one that applies a more holistic approach to designing with light by factoring in Visual, Biological and Emotional needs of a space and its occupants.

## Why Is This Important?

A widely quoted study by the Environmental Protection Agency (EPA) published in 2001 found that people spend 87% of their time indoors.



### Speaker Notes:

- Most of our waking hours are spent in offices, schools, hospitals, and public spaces that have been designed by a team of creative professionals
- And yet lighting is often treated as an engineering exercise in ensuring certain basic technical criteria is met instead of a fundamental component of the how people will experience the space
- By their nature, luminous surfaces embody both the technical and human experience aspects of design



## Lighting Must Still Deliver Performance



Visual

Quality illumination encompasses many performance characteristics

- Quantity
- Consistency
- Color Rendering
- Visual Comfort (eg. glare control, flicker-free)

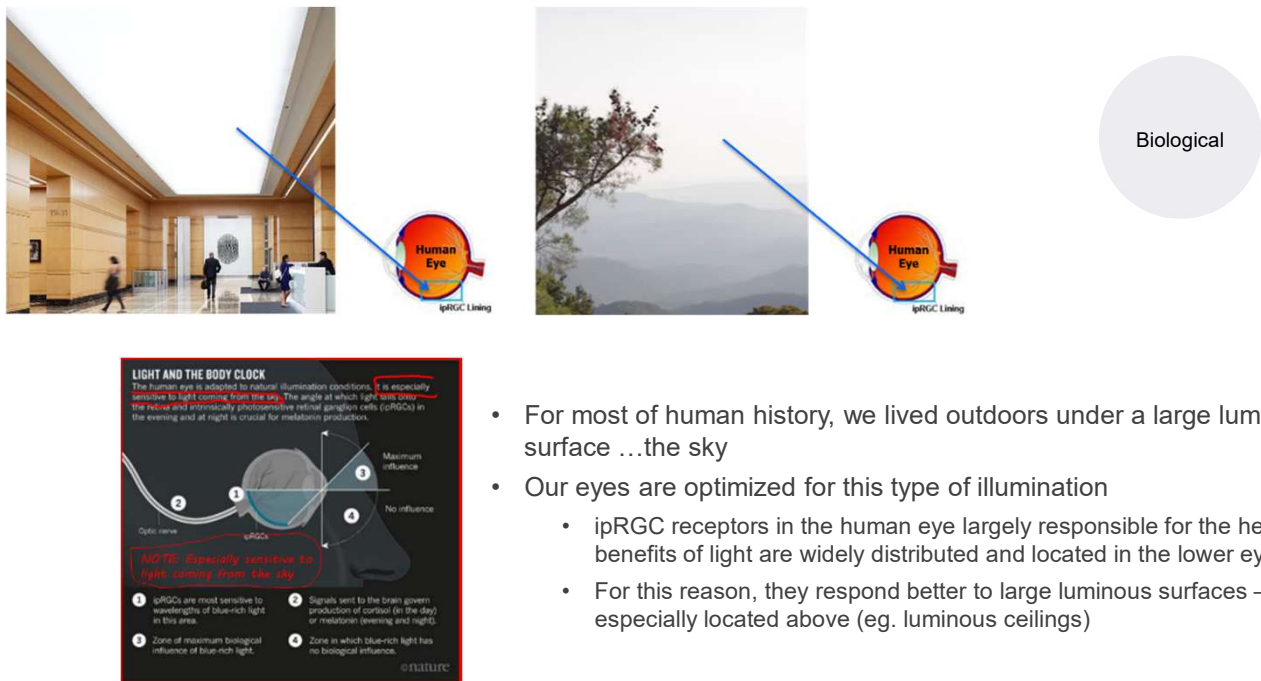
Luminous surfaces create a comfortable environment free of visual clutter

### Speaker Notes:

- The most obvious requirement of light is for visual performance. The attributes of quality illumination are well known and apply equally when luminous surfaces are used for illumination.
- Visual comfort is one of the key attributes and luminous surfaces inherently offer this feature when applied correctly.
- Large luminous surfaces can deliver the right quantity of illumination without the glare that may be present with more concentrated sources or the visual clutter created by suspending indirect luminaires

- Cooledge Project: McGuire Woods – Richmond, VA

## What's Different About a Luminous Surface?



- For most of human history, we lived outdoors under a large luminous surface ...the sky
- Our eyes are optimized for this type of illumination
  - ipRGC receptors in the human eye largely responsible for the health benefits of light are widely distributed and located in the lower eye
  - For this reason, they respond better to large luminous surfaces – especially located above (eg. luminous ceilings)

### Speaker Notes:

- By now, most of us have heard about circadian rhythms and their importance to human well-being. There have been a number of studies that show improvements in sleep patterns and alertness by ensuring proper lighting
- Other studies have indicated that improvements in productivity and memory can also be attributed to improvements in illumination.
- In the early 2000's a new receptor within the eye was discovered and found to be responsible for non-visual responses to light – those that are related to the physiological effects that impact human well-being.
- Unlike the rods & cones that are narrowly distributed at a focal point within the eye to optimize visual tasks, these “ipRGC” receptors are distributed over a wider area and in the lower part of the lining of the eye, indicating that they are designed for receiving light from large areas. This makes sense when you consider that one very large area, the sky, was the primary source of illumination for most of human history.
- Although more study is needed to quantify the impact, the conclusion is most likely to be that large luminous surfaces are the best way to supply people with the biological benefits needed for their well-being.

## How You Feel Can Depend on the Illumination You Experience



### CONTROL

Controlling the environment by adjusting the lighting is the most important aspect of delivering emotional benefits

- Dimming – control over the intensity of illumination
- Tunable White – control over the color temperature of the light

Emotional

### Speaker Notes:

- With the advent of new technologies in both lighting – with LEDs – and control systems, the ability to control one's environment has become much simpler and more effective.
- Flicker free dimming and the ability to tune the color temperature are key attributes for creating environments that evoke positive emotions.

## Luminous Surfaces Light the Way

### QUALITY ILLUMINATION

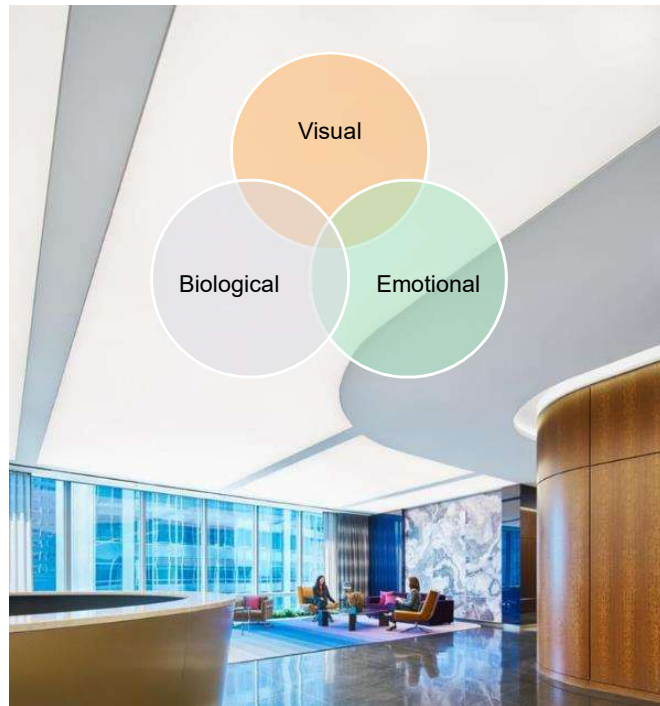
- Luminous surfaces may improve visual comfort, as long as all of the requirements for quality illumination are present

### SURFACE AREA

- Luminous surfaces offer the optimal way to deliver the physiological benefits of light, if other attributes are present

### CONTROL

- Flicker free dimming and color temperature control means light is adaptable to user needs, enhancing well being



### Speaker Notes:

- To summarize: illumination that is designed for human well-being must consider not only the visual performance but also the biological and emotional aspects.
- Luminous surfaces offer an alternative way to provide the high quality light needed – especially visual comfort – but perhaps of equal importance the use of large surface areas have the potential to enhance the biological benefits and when combined with controls form the most compelling way to provide general illumination in architecture.

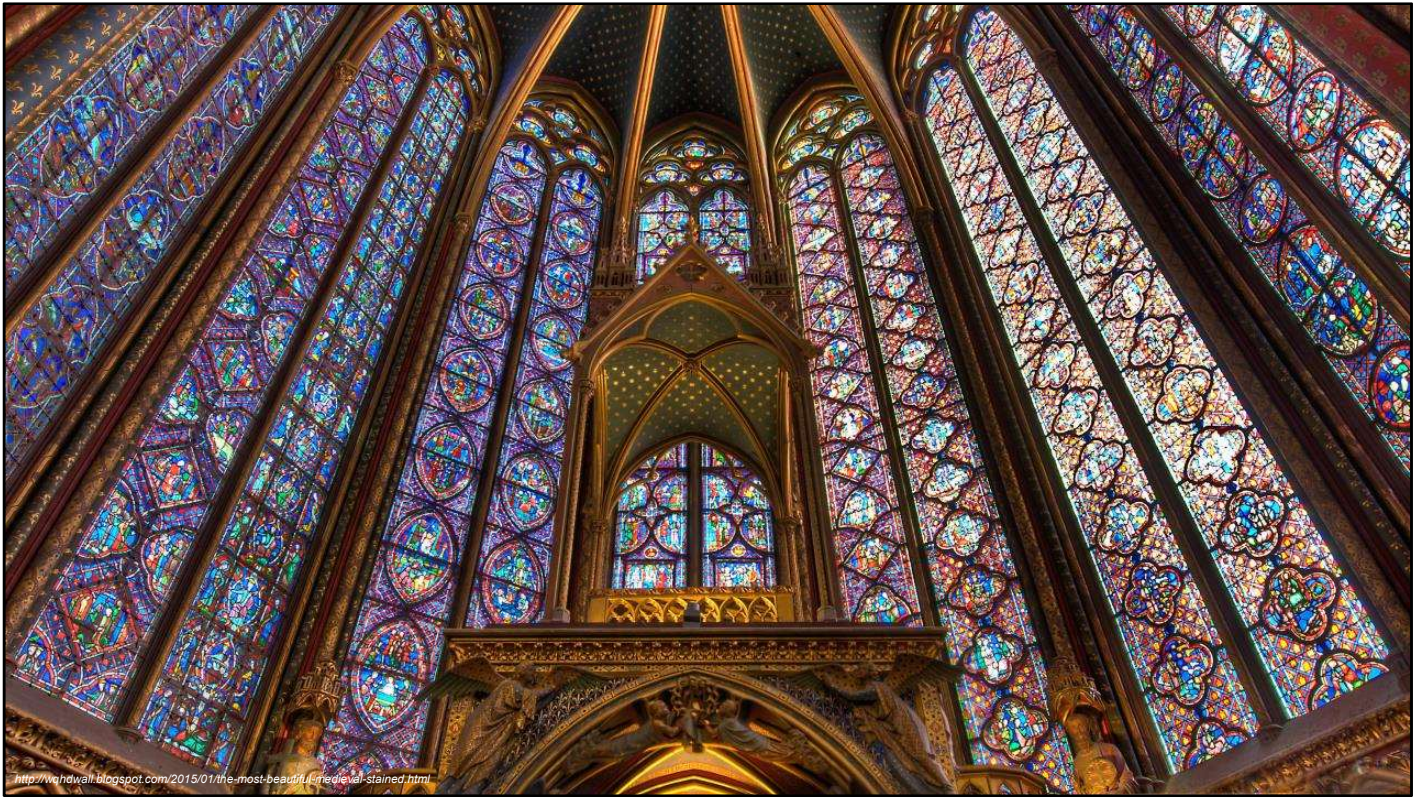
Cooledge Project: Mayer Brown Law – Chicago, IL



**Speaker Notes:**

- The scientific understanding of the benefits of using luminous surfaces in architecture may be a more recent occurrence, however the idea has been with us for a long time.





### **Speaker Notes: Bringing Natural Light Inside**

- While not used strictly for illumination, stained glass in houses of worship brought natural light indoors.
- When used on a large scale the impact was stunning.

## Luminous Surfaces In Architecture Circa 1937

### Luminous Surfaces for Architectural Lighting

By JOHN A. M. LYON

732

TRANSACTIONS I. E. S., JULY, 1937

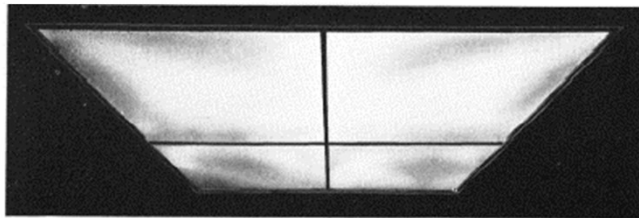


FIG. 8—The appearance of the laylight under the conditions of Run No. 27 is indeed pleasing. The luminous efficiency of the laylight as pictured is 62 per cent, while there is a brightness variation over the surface of 2.92 (ratio maximum to minimum brightness).

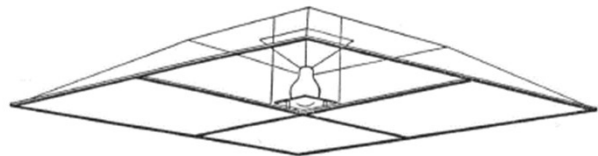


FIG. 7—This sketch shows the important design features of the laylight.

### Speaker Notes:

- With the widespread adoption of electric lighting, the idea of bringing outdoor lighting indoors by creating luminous surfaces moved on to how it might be done with artificial sources as shown in this study from 1937.
- By this time artificial skylights were already being deployed but mostly as a decorative element within the space. In the introduction to the paper this Mr. Lyon states how he is attempting to solve the problems of heat, minimum plenum intrusion, uniformity, efficacy and delivered lumens in a 6 foot square luminous surface with a single 300 watt incandescent lamp. Amazing how the problems of 1937 are not that different from today.

## Ambient Luminescence



Richard Kelly

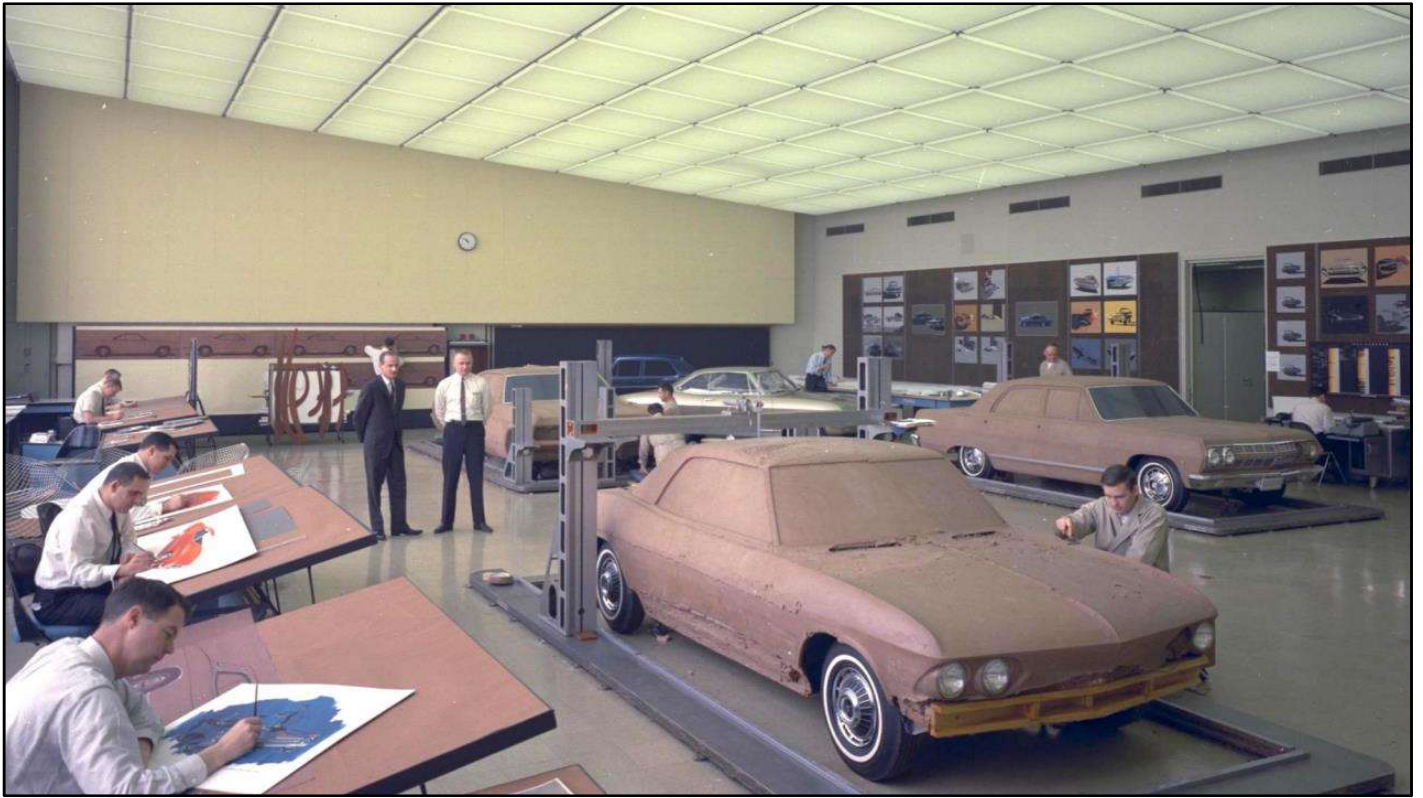
" Ambient luminescence produces shadowless illumination. It minimizes form and bulk. It minimizes the importance of all things and people. It suggests the freedom of space and can suggest infinity. It is usually reassuring. It quiets the nerves and is restful"



### Speaker Notes:

- In 1952, Richard Kelly considered by many to be the founder of modern lighting design defined his "three elemental kinds of light effect" or layers of light including the concept of ambient luminescence. In its ideal form ambient luminescence produces shadowless illumination and a sense of space in the same way nature's luminous surface provides, in his words, "the uninterrupted light of a snowy morning in the open country."





**Speaker Notes:**

- A little later the idea of creating a luminous surface that replicates the ambient luminescence of the sky was adopted by General Motors for their design studios where the use of glare-free ambient lighting would ensure that the details of automobiles designed in the studio would be authentic when seen in their intended environment: daylight.



**Speaker Notes:**

- This idea extended to the end of the design process in the Design Dome. Here the new models were displayed for the press in an environment designed to showcase vehicles as they would appear in the even, non-glare illumination of the sky.



**Speaker Notes:**

- Automobiles are still viewed in the context of large luminous surfaces that replicate the natural environment. Unfortunately, up until now, the lighting and technology options available to do this have remained essentially unchanged.

## Luminous Surfaces: The Old Way

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### Speaker Notes:

- The use of fluorescent tubes strung together was for a very long time the only practical way to achieve the scale and intensity required to emulate the sky.
- The constraints placed on design – particularly the need for deep setbacks to achieve uniformity - limited the use of luminous surfaces as the source of general illumination to specialty applications such as designing automobiles





**Speaker Notes:**

- LED Technology Enables a New Approach for Luminous Surfaces
- The limitations of fluorescent lighting technology are no longer relevant to this discussion. LEDs will be the primary source of light for the foreseeable future.
- And their incorporation into architecture in the form of luminous surfaces will overcome the restraints encountered by earlier technologies.

Cooledge Project = Ferrari Maserati of Alberta (Calgary)

## LED Lighting Today

LEDs have changed the technology of lighting but not the way spaces are illuminated.

### LAMPS



### LUMINAIRES



We are still stuck in a world of bulbs and boxes

### Speaker Notes:

- LEDs have delivered on their promise of energy savings and long life – and more recently have caught up to or surpassed traditional sources for quality in most applications.
- However, LEDs also arrived with the promise of creating new ways to deliver light to the environment. As of today, the technology inside has changed but the approach to lighting has not.

Architecture is being driven by the need to create spaces that are...

- MORE NATURAL
- MORE OPEN
- MORE SYNCHRONIZED TO HUMAN WELL-BEING



### Speaker Notes:

- As architects you are being asked to create environments that are more natural, feel more open, and provide an experience that better matches human needs for well-being.

## Architecture is Adopting New Standards for Human Well Being



### WELL SUBJECT LIVING BUILDING CHALLENGE

You can create buildings that generate more energy than they use, capture and treat all water on site, and are made using healthy materials. The Living Building Challenge framework will help you to create spaces that reconnect occupants with nature.

[TAKE ON THE CHALLENGE](#)

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Faster lease up rates

Higher resale value

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Better for building occupants, the community and the environment

Enhances your brand and establishes you as a leader in green building



Fitwel is the World's  
Leading Certification System  
Committed to Building Health for All

### Speaker Notes:

- New standards are rapidly evolving that go beyond energy efficiency by defining requirements to improve human well being.



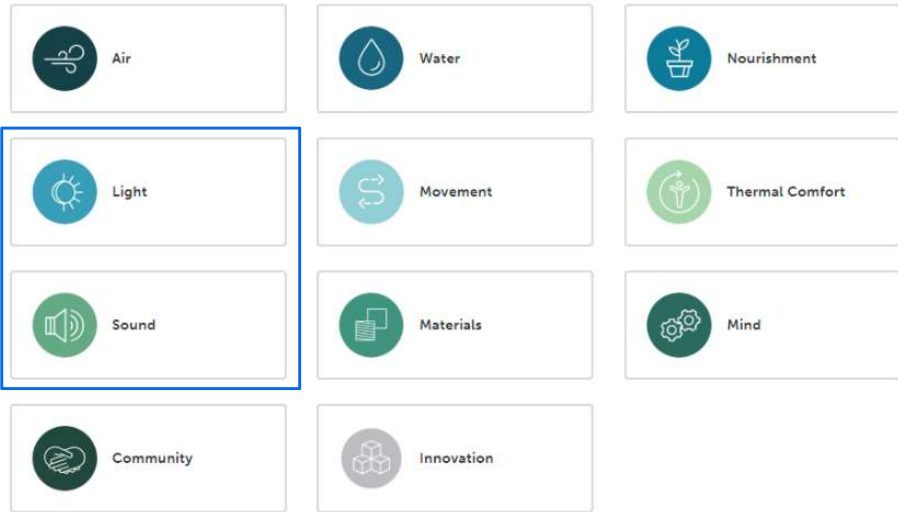
## WELL v2 Building Standard



"The International WELL Building Institute™ (IWBI™) is leading the global movement to transform our buildings and communities in ways that [help people thrive](#)."

"IWBI delivers the cutting-edge WELL Building Standard™, the leading global rating system and the first to be focused exclusively on the ways that buildings, and everything in them, can improve our comfort, drive better choices, and [generally enhance, not compromise, our health and wellness](#)."

"WELL is a standard for buildings, interior spaces and communities seeking to implement, validate and measure interventions that [support and advance human health and wellness](#)."



### Speaker Notes:

- Awareness of the impact of illumination on human well-being is a significant part of those emerging standards for creating environments that promote health and well-being
- Most of you have probably heard of the WELL standard. Version 2 was released in 2018 and includes lighting as one of its 11 primary "concepts"
- Sound is also a concept and we'll talk later on about how lighting and acoustics are becoming integrated

## WELL v2 Building Standard: Lighting

LIGHT FEATURES	
<b>Feature L01</b> <b>Light Exposure and Education</b> Provide access to indoor light exposure and light education.	PRECONDITION
<b>Feature L02</b> <b>Visual Lighting Design</b> Provide visual comfort and enhance acuity for all users through electric lighting.	PRECONDITION
<b>Feature L03</b> <b>Circadian Lighting Design</b> Support circadian health through interventions using electric lighting.	OPTIMIZATION
<b>Feature L04</b> <b>Glare Control</b> Minimize visual discomfort caused by glare from daylight and electric light.	OPTIMIZATION
<b>Feature L05</b> <b>Enhanced Daylight Access</b> Support circadian and psychological health through indoor daylight exposure and outdoor views.	OPTIMIZATION
<b>Feature L06</b> <b>Visual Balance</b> Create lighting environments that enhance visual comfort.	OPTIMIZATION
<b>Feature L07</b> <b>Electric Light Quality</b> Enhance visual comfort and minimize flicker using electric lighting.	OPTIMIZATION
<b>Feature L08</b> <b>Occupant Control of Lighting Environments</b> Provide individuals with access to lighting environments that can be customized to their requirements.	OPTIMIZATION

The standard defines requirements for the quality and composition of illumination in a variety of categories and combines those with the biological and emotional aspects of lighting design

### Speaker Notes:

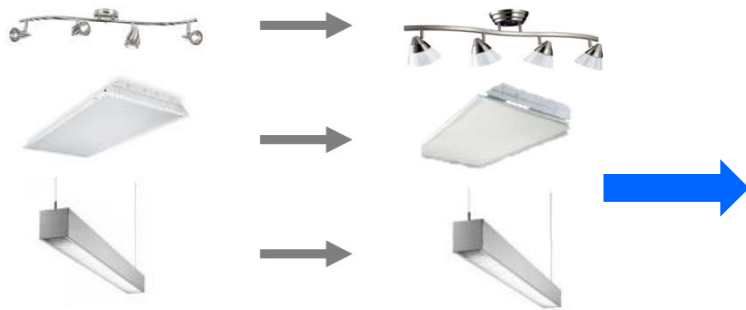
- Within the lighting concept, the standard defines requirements for 8 characteristics of illumination, including the use of circadian lighting to replicate elements of the natural daylight cycle
- In addition to addressing physiological aspects of illumination, the standard also defines minimum requirements for the quality of the light



**Speaker Notes:**

- In order to keep up with architectural trends and building standards, the approach to lighting design and hence lighting products must change and do so rapidly.

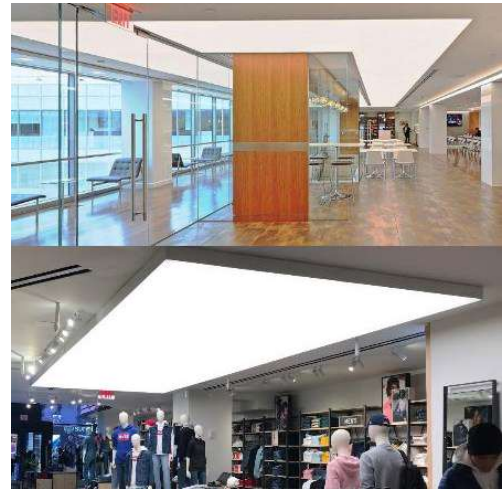
## LED Lighting: Evolution vs Revolution



Old Technology >> Old Luminaires

New (LED) Technology >> Old Luminaires

**Evolution:** Points and Lines



New Technologies >> New Luminaires

**Revolution:** Luminous Surfaces

### Speaker Notes:

- The lighting industry has embarked on an evolutionary path to incorporating new technology that ignores the inherent advantage LEDs bring to applications that make new form factors possible.
- A revolution in thinking about design is required

The next fundamental change in lighting will *not* be based on technology



The next fundamental change in lighting will be based on its integration into design

### Speaker Notes:

- Fortunately, the tools required to create the luminous surfaces that enable this change are available and the new revolution in lighting is underway.
- The luminous ceiling on the left is supplied by nature, the one on the right by the integration of LEDs with architectural materials into a single full illumination solution.

Projects: Left> Atrium with skylight by Velux in London designed by Foster & Partners; Right > Cooledge Project – 500 W. Monroe, Chicago

## Application & Design Approaches for Luminous Surfaces

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This section will cover:

1. Luminous Surfaces for Illuminated Features
2. Luminous Walls
3. Luminous Ceilings



## Applications for Luminous Surfaces



Luminous Ceilings



Luminous Walls



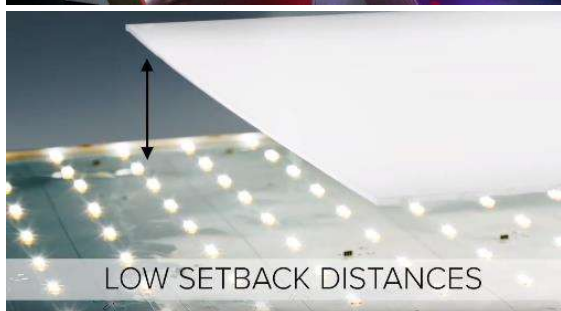
Illuminated Features

### Speaker Notes:

- There are three primary applications for luminous surfaces in architecture
  - Luminous Ceilings to provide general illumination
  - Luminous Walls that contribute to the illumination of a space but also act as a feature unto themselves
  - Illuminated Features that provide a focal point within a space to draw your attention



## Luminous Surfaces: Illuminated Features



### Design Approach

- Specifier takes the lead to coordinate the selection of diffusion materials, millwork (if required) and light source

### Key Design Considerations:

- Setback Distance
  - The distance between the light source and the diffusion material
  - A low profile is desirable but requires an understanding of the interaction between the light source and material
- Optical Properties of the Diffusion Material
- Choice of Light Source

### Mockups

- Are highly desirable to confirm that the setback distance works for the material/light combination

### Speaker Notes:

- Because illuminated features incorporate a huge variety of diffusion materials, it is almost always the case that the specifier will be required to take the lead to ensure a successful outcome.
- This entails choosing the material that meets the design intent along with the light source that will provide the best illumination.
- There are 3 key design considerations involved in this process
  1. The setback is the distance between the light source and the diffusion material. It is usually desirable for the setback to be as small as possible to enable a low profile, however, there is a limit to how thin the profile can be that requires an understanding of the interaction between the light source and the material being illuminated
  2. The optical properties of the material will dictate both the minimum setback and the amount of light needed to properly illuminate the feature
  3. And of course, the type and quality of the light source itself are critical
- For best results a mockup, if possible, will confirm the design

- Cooledge Project = SK-II COSMETICS “FUTURE X” SMART STORE (SHANGHAI, CHINA).



## Luminous Surfaces: Illuminated Features - Diffusion Materials



**Jade**  
(Vancouver, Canada)



**Resin**  
(Portland, USA)



**Perforated Metal**  
(Chicago, USA)



**Onyx**  
(Washington, USA)



**Polymer**  
(Doha, Qatar)



**Large Format Graphics**  
(London, UK)

### Key Properties:

- **Transmission:** impacts how bright the feature will be
- **Masking:** impacts how uniform the illumination will appear and/or the setback distance between the light source and luminous surface

### Speaker Notes:

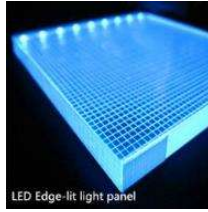
- The two important characteristics of diffusion materials for illuminated features are...
  1. Transmission is a measurement of how much light will pass through a material
  2. Masking is the degree to which the material diffuses the bright spots from LEDs used as the light source

## Luminous Surfaces: Illuminated Features – Light Source Options (LED)

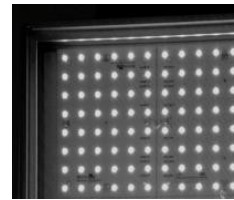
LED Rope



Typical Use		Signage
Uniformity (Large Area)	Yellow	Requires Close Spacing
Illumination Quality	Red	Not designed for architectural lighting
Ease of Install (Large Area)	Yellow	Simple method but requires a large number of modules
Field Adaptable	Green	Yes.



LED Edge-lit light panel



LED Tape



Typical Use		Coves, Linear Accent
Uniformity (Large Area)	Yellow	Requires Close Spacing
Illumination Quality	Red	Not designed for architectural lighting
Ease of Install (Large Area)	Yellow	Spacing correctly requires a lot of time
Field Adaptable	Green	Yes.

Edge Lit Panel

Typical Use		Direct View, Low Profile Backlighting
Uniformity (Large Area)	Yellow	Size limitations
Illumination Quality	Green	Spec grade has good quality
Ease of Install (Large Area)	Yellow	Multiple panels cannot be connected and require more complex wiring
Field Adaptable	Red	No

Rigid LED Panel

Typical Use		Large-Scale Signage
Uniformity (Large Area)	Green	Array pattern results in good uniformity
Illumination Quality	Green	Spec grade has good quality
Ease of Install (Large Area)	Yellow	Most panels use connectors designed for factory installation
Field Adaptable	Red	No

Flexible LED Panel

Typical Use		Architectural Features, Large Area Illumination
Uniformity (Large Area)	Green	Array pattern results in good uniformity
Illumination Quality	Green	Spec grade has good quality
Ease of Install (Large Area)	Green	When products with snap connectors are used
Field Adaptable	Green	Yes.

### Speaker Notes:

- There are a number types of LED-based sources used to illuminate diffusion materials.
- Rope and tape light are relatively inexpensive but require figuring out the spacing between the modules or rows to prevent bright spots. To achieve a low profile the spacing has to be tight, meaning a lot of tape or rope is required. And when used for large area luminous surfaces the labor to install becomes impractical.
- Edge lit panels are also relatively inexpensive and good for small scale applications where a very low profile is required. However at a large scale, they become complex to install and wire up. Edge lit panels are also heavy compared to other options and not field adjustable .
- Rigid LED panels deliver the quality of light needed for architectural features and are uniform at a reasonable setback but are typically not designed for field installation.
- On the other hand, spec grade flexible LED panels provide both the quality of light and features designed to allow easy installation

## Light Source Options: Flexible LED Panels



**Snap Connectors:** mechanical and electrical connection – makes installation simple and fast



**Cuttable:** allows for field adjustability



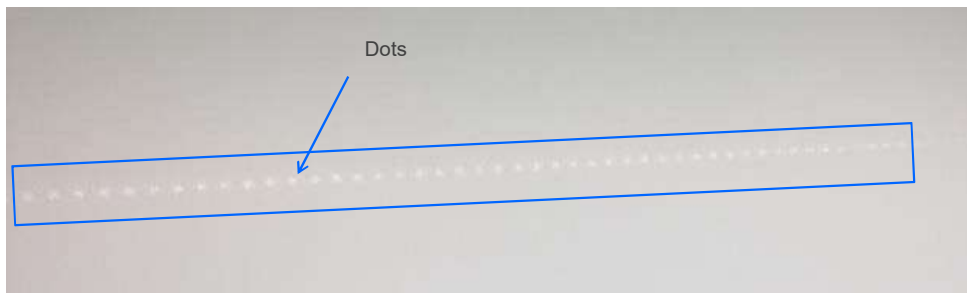
**Flexible & Light Weight:** easier to handle and accommodates curves when required



### Speaker Notes:

- Properly designed panels incorporate contractor friendly connections as opposed to the type that are used in factory assembly environments like a sign shop
- Since field conditions often don't match the plans, panels should be field cuttable without impacting uniformity or light output
- Flexible panels are inherently light weight and therefore easy handle and install. They can also accommodate curves or round columns that are common in architectural features.

## When Things Go Wrong...



**DOTS:** Light source was not chosen to match the masking characteristic of the diffusion material



**STRIPES:** spacing between linear sources was not tight enough for the setback distance

### Speaker Notes:

- Here are some examples of where the design requirements of luminous surfaces were not met
- In the first example, the points of LEDs show through the surface material because the light source was not properly matched to the masking performance of the material
- The bottom photos show what happens when a linear source is used without proper spacing for the required setback to achieve uniformity, resulting in massive striping



## Luminous Surfaces: Luminous Walls

### Design Approach

- Similar to Illuminated Features
- Is the wall just a feature or is the primary source of illumination?
- Structural coordination is an additional requirement



### Key Design Considerations:

- Setback Distance
- Contribution to Illuminance within the Space
- Large Areas dictate solutions that are simple to install

### Speaker Notes:

- Just as there is a wide variety of materials used for features, so to for luminous walls and therefore the same guidelines for choosing the materials and light source apply.
- In addition, luminous walls are often used to contribute to the illumination of the space and so an additional consideration for how much light is required becomes part of the design process
- Because of the sheer size of many luminous walls, light sources that may work on a feature scale are no longer feasible because they are not designed for integration into the building structure

- Cooledge Project = 550 Washington – Chicago, IL >> Frosted Acrylic + Patterned Aluminum Sheet

## When Things Go Wrong...



**STRIPES:** the cavity depth (setback distance) was not enough for the fluorescent fixtures used to provide uniform illumination resulting in ugly stripes

### Speaker Notes:

- To address the need for high light output and simple installation, fluorescent lighting has often been used for illuminating walls
- Here is an example of a luminous wall that used an inexpensive fluorescent lighting solution in a high end retail environment. The spacing of the fluorescent sources was not designed correctly for the available setback distance with an unfortunate aesthetic result.

## When The Right Illumination Source is Chosen...



*"I personally think it was a very easy transition from fluorescent bulb to [flexible LED panel]. It is a cleaner look and was fast and efficient to install. It makes the space look better as you see in the pictures of before and after."*

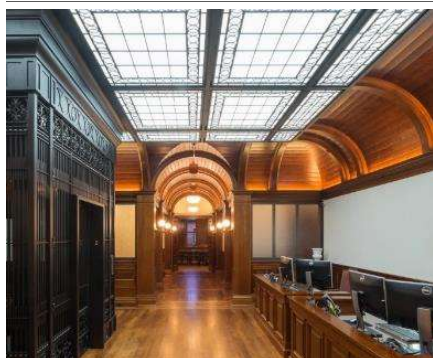
- Christian Plaza - Junior Designer, DDC

### Speaker Notes:

- The fluorescent sources were replaced with flexible LED panels resulting in a clean, uniform luminous wall that enhanced the high end furniture on display.

Cooledge Project: Minotti New York by DDC – New York

## Luminous Surfaces: Luminous Ceilings



Glass Ceiling

### Non-Stretch Ceilings (Glass, Acrylic, Resin)

#### Design Approach:

- Same as with Illuminated Features and Luminous Walls

#### Additional Key Design Considerations:

- Illuminance Levels
- Lighting Power Density (LPD) for energy code compliance
- Quality of Illumination



Luminous Stretch Ceiling

### Luminous Stretch Ceilings

#### Design Approaches:

- (1) Specify stretch ceiling (Div 9) and lighting (Div 26) separately and try to coordinate the design

or

- (2) Specify a full solution that includes specialty installation

#### Key Design Consideration:

- Quality and quantity of illumination



Luminous Modular Ceiling

### Luminous Modular Ceilings

#### Design Approaches:

- Specify as a luminaire

## Speaker Notes:

There are 3 types of luminous ceilings:

1. Those that use similar materials to those we have already looked at. In this case, the lighting element becomes even more critical because the luminous ceiling is the primary source of illumination and must fit into the requirements for good lighting design
2. Luminous stretch ceilings require specialty installers and have the ability to cover very large ceiling areas. Similarly, as the primary source of illumination, the quantity and quality of illumination is the fundamental design feature that needs to be addressed. Stretch ceilings can be specified separately from the lighting, but this approach requires the specifier to manage two separate suppliers operating in two separate construction divisions. A better alternative is to specify a full luminous ceiling solution from a single supplier who will take on responsibility for all of the materials and installation, and ideally will be experts in lighting.
3. A third approach that delivers the benefits of luminous ceilings but follows more traditional construction processes is to specify large area luminaires that have similar properties to full stretch ceilings but are supplied in a similar way to traditional lighting products.

- Cooledge Projects: Left >> Glass = Audrain Auto Museum (Newport, RI); Middle >> Stretch Ceiling = 500 W. Monroe, (Chicago, IL); Modular = WeWork (Shanghai, China)



## Luminous Ceilings: Stretch Ceilings



### 2 Types of Stretch Ceiling

**PVC (Hot Stretch):** the PVC is heated and stretched into place and held with a profile, then tightens to taut when it cools

**Knitted/Woven Fabric - (Cold Stretch):** the fabric – usually coated polyester – is stretched taut and tucked into profile

### Key Design Considerations

**Quality of Illumination:** luminous ceilings are the primary source of illumination and must deliver the quality and quantity of light required to meet both the technical and human needs of the space

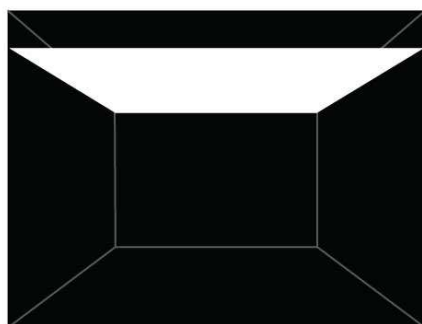
**Mounting Type:** depending on the type of ceiling and the design intent there are 3 mounting options available.

### Speaker Notes:

- There are two types of stretch ceiling that differ in texture and installation process: PVC or “hot stretch” and fabric or “cold stretch”. While they have some different characteristics, the same basic design considerations apply.
- As possibly the only source of illumination in the space, it is critical that when working with a stretch ceiling supplier they have the expertise and documentation to confirm the quantity and quality of the light. This includes specifications for all of the lighting qualities including flux, power, IES files, and color quality, etc.
- Suppliers of stretch ceilings include installation because it requires specific training and, in the case of PVC, specialty equipment. Installation is also dependent on the mounting type chosen.

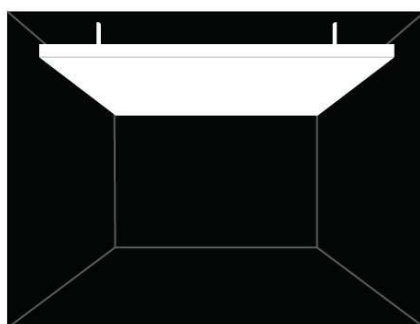
- Cooledge Project = 500 West Monroe St. Chicago, IL

## Luminous Ceilings: Stretch Ceiling Mounting Options



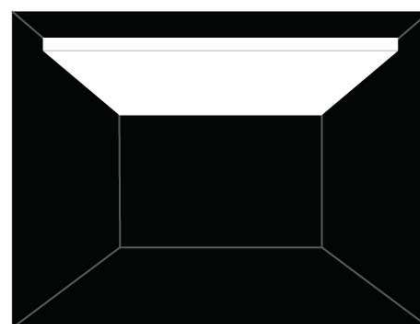
**Flush Mount**

Flush mount solutions are mounted from wall-to-wall across the ceiling or cavity to deliver continuous immersive illumination



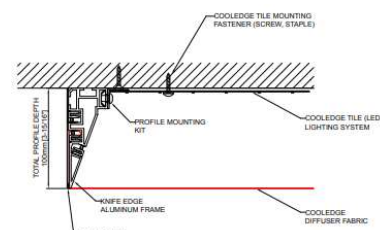
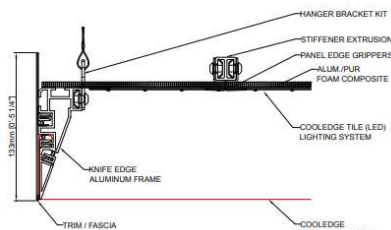
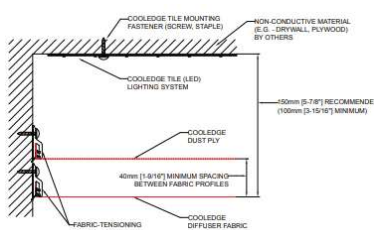
**Suspended**

Large area luminaires for spaces with higher ceilings or where exposed ceiling elements are part of the design aesthetic



**Surface Mount**

Used to maximize the feeling of openness and volume or to blend with the ceiling finish



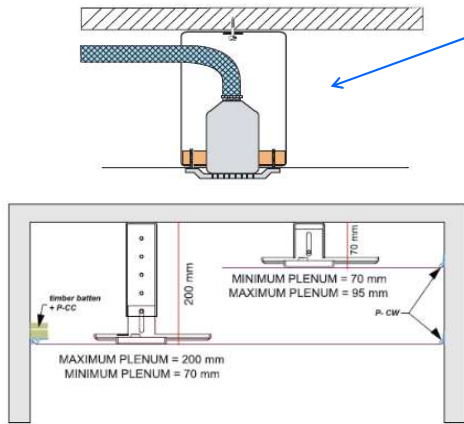
### Speaker Notes:

- Stretch ceilings can be mounted in 3 ways:
  1. Flush mount, as the name would indicate, results in a luminous surface that is flush with the ceiling and may stretch across the entire ceiling area or fill a cavity within the ceiling
  2. Suspended is similar to more traditional pendant mounted luminaires except that the size is generally considerably larger. These solutions are often referred to as clouds and can be as large as the equivalent T-bar ceiling clouds. These are often employed in open concept areas with exposed ceiling elements and can be even more effective if incorporated with acoustic capabilities
  3. Similarly surface mount luminaires are much larger than traditional luminaires and good for maximizing a feeling of openness in spaces with lower ceiling heights

## Luminous Ceilings: Penetrations

### Penetrations

- Additional task lighting (downlights)



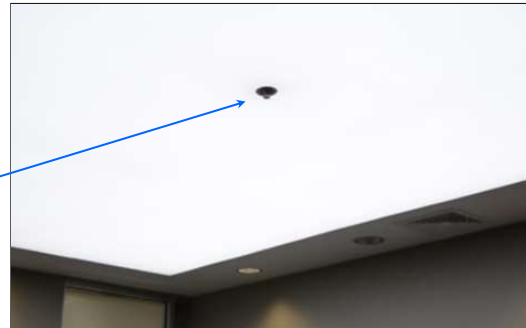
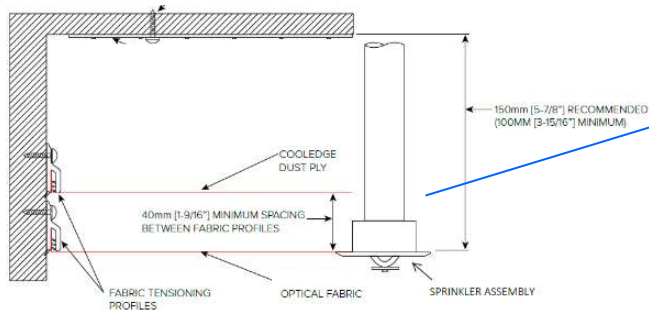
### Speaker Notes:

- An important feature of stretch ceilings is the ability to accommodate the various other elements found in ceilings including supplementary lighting.

## Luminous Ceilings: Penetrations

### Penetrations

- Fire Suppression



1. Cut holes in the dust ply and fabric diffuser



2. Press the escutcheon into place until secured



### Speaker Notes:

- Fire suppression equipment can also be integrated into flush mount ceilings.

## Luminous Ceilings: An Easier Way to Bring the Outdoors...Inside



### Luminous Ceilings in a Traditional Format

- Large scale luminaires that provide the benefits of luminous ceilings but in a format familiar to the market
- Sizes are typically up to the maximum that can fit through doors and into elevators
- Fabric diffusion materials provide the same look and feel as larger stretch ceilings
- Mounting methods are the same as traditional luminaires and suitable for most ceiling types
- Like traditional luminaires they should have specifications for light quantity and quality including IES files and spectral information
- Because specialty installation is not required, there should not be any confusion about which construction division these products will fall into
- Luminaires of this type will form the next generation of integrated ceilings



Suspended



Surface Mount



Recessed



Grid (T-Bar)

### Speaker Notes:

- A recent trend in the market has been to adopt the characteristics of large scale stretch ceilings that make them a superior way to deliver illumination that brings the feeling of the outdoor environment but deliver them in a form factor that is more suited for the traditional construction process
- Luminaires are constructed using fabric for diffusion but are sized small enough that they can be shipped complete from the factory and installed by electrical contractors using the same methods as traditional luminaires
- As with stretch ceilings, the modular versions enable environments that have the open, natural feel so important to creating a sense of well-being and capitalizing on the emotional and physiological responses that are a fundamental part of our experience

- Cooledge Projects = Top = Bank of America Center – Orlando; Bottom = WeWork - Shanghai



## Applications & Design: Summary



**Luminous Ceilings**

Used to create the feeling of being outdoors in interior spaces, particularly those lacking access to natural light

- Stretch ceilings can be specified separately from the lighting but more effective solutions including installation are available from single sources
- An easier way to obtain a similar result is to use large-scale fabric luminaires that follow traditional divisions of labor
- In either case, illumination should be supplied by lighting experts



**Luminous Walls**

Encompass all of the design considerations of illuminated features

- In addition to creating a focal point the additional intention is to contribute to or provide the illumination within the space
- Large Areas dictate solutions that are simple to install



**Illuminated Features**

Primary purpose is as a visual focal point that may also highlight the use of materials to enhance a specific design aesthetic

- Uniformity depends on setback and masking
- Brightness depends on light output and diffuser transmission
- Choice of the light source is critical to success

### Speaker Notes:

- To summarize:
- Luminous ceilings are best specified as holistic solutions supplied from a single manufacturer that understands both ceiling installation and more importantly the properties of light that result in high quality illumination
- Luminous walls and illuminated features are dependent on the properties of the diffusion materials in combination with the light source. Flexible LED array panels are the best suited light sources for large architectural features and walls.



## Combining Light & Acoustics

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This section will cover:

1. Attributes of Luminous Surfaces
2. LED Light Source Options
3. Integration of Light Sources & Architectural Materials



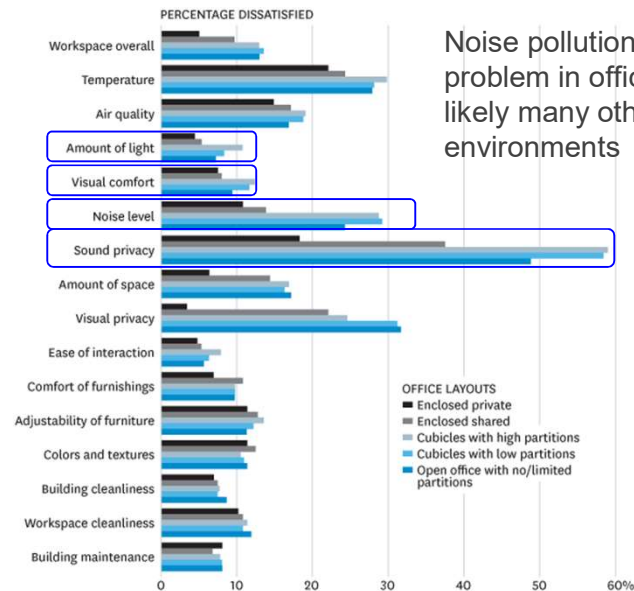
### Speaker Notes:

- We've talked about the impact of illumination on the human experience and how luminous surfaces, in particular luminous ceilings, are ideal for optimizing that experience. But they also can be used to address another aspect of well-being: acoustic design

# Luminous Ceilings: Integrating Light and Acoustics

## EVERYONE CAN HEAR YOU, NOW

Lack of sound privacy is the biggest frustration we have with our cubicles.



Noise pollution is a big problem in offices and likely many other public environments



"Studies indicate that approximately **80 percent of office workers** believe that their productivity would increase if their working environment was more acoustically private."

"A **300 percent increase in perceived 'worker satisfaction'** was reported as a result of the reduction in noise levels from conversational noise. In addition a measured **20% increase in sales productivity** was recorded at the end of the six months following the refurbishment."

American Society of Interior Designers; Armstrong World Industries, Inc.; DynaSound, Inc.; Milliken and Co.; Steelcase, Inc., 2005.

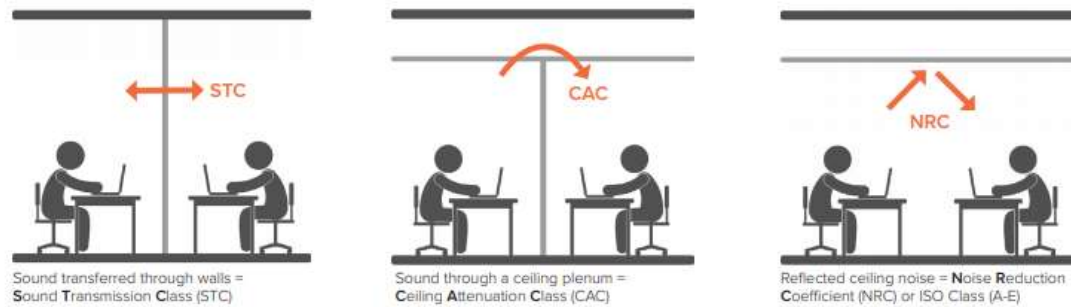
SOURCE ANALYSIS OF DATA FROM THE CENTER ON THE BUILT ENVIRONMENT  
BY JUNGSOO KIM AND RICHARD DE DEAR, UNIVERSITY OF SYDNEY

HBR.ORG

## Speaker Notes:

- Whether full stretch ceilings or large area fabric luminaires, luminous ceilings can solve an increasingly important and difficult design problem
- Multiple studies have concluded that ambient noise and sound privacy are the two biggest sources of frustration and reduced productivity for office workers.
- It is not a stretch to assume that this feeling applies many other public environments..

## Luminous Ceilings: Integrating Light and Acoustics



Ceilings are the only place where sound can be absorbed

No walls or glass walls to absorb sound

Stone or tile floors reflect sound



Combining lighting and acoustic performance can help this

### Speaker Notes:

- There are 3 type of noise problems in a given space with corresponding metrics to describe the effectiveness of materials to deal with them
- Lighting can help with the problem of reflected ceiling noise that in traditional designs has been addressed by installing acoustic ceiling tile (ACT) ceilings. The relevant material property for this problem is the Noise Reduction Coefficient (NRC) value – a measure of how well a given material absorbs sound
- As design moves increasingly toward to open concept spaces, addressing noise issues in other ways than ACT ceilings has become much more important
- In open spaces, the trend in design has been to use more durable materials for flooring, however, these materials reflect almost all of the noise back into the space. And by definition, there are very few walls to act as sound absorbers. That leaves the ceiling as the only place to introduce measures to reduce the amount of ambient noise

## Luminous Ceilings: Integrating Light and Acoustics

Combining lighting and acoustics can be unattractive...



Dozens of bright point sources are used to provide general illumination to make room for acoustic panels



Lighting and acoustic clouds battle for space, making for a lot of clutter in the ceiling



Funky interior design but the lighting...well....



Downlights are used for general illumination – where's the "ambient luminescence"?

Combining lighting and sound absorption usually results in compromising the quality of the lighting

### Speaker Notes:

- Acoustic panels, baffles, and clouds have typically been used to address this problem
- But those solutions occupy the same space needed for lighting
- The result is usually not pretty and it is often the quality of the illumination that gets sacrificed

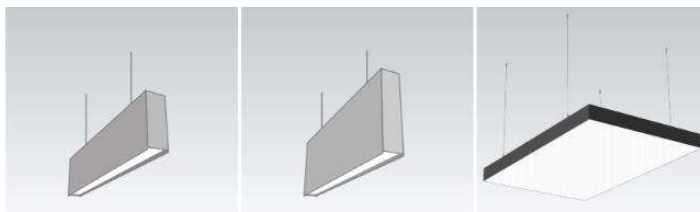


## Luminous Ceilings: Integrating Light and Acoustics



Traditional luminaires have an NRC value = 0 = no sound absorption capability

New acoustic luminaires are finding their way into the market but...



Length	8' (2.4m)	8' (2.4m)	8' (2.4m)
Absorbing Height/Width	h = 1' (0.3m)	h = 1.5' (0.45m)	w = 6' (1.8m)
Sound Absorbing Area	8 sqft (0.72m <sup>2</sup> )	12 sqft (1.08m <sup>2</sup> )	48 sqft (4.46m <sup>2</sup> )
NRC	1.0	0.9	0.75
Sabin	8 (0.7)	10.8 (0.97)	36 (3.35)

Acoustic Pendant Luminaire

Acoustic Pendant Luminaire

Modular Luminous Ceiling Luminaire

- The fundamental unit of sound absorption is a "sabin"
- A sabin is the product of absorption coefficient x area
- Larger size counts as much as NRC value

...just as the large scale of Luminous Ceilings provides better general illumination, it also provides better sound absorption capability

### Speaker Notes:

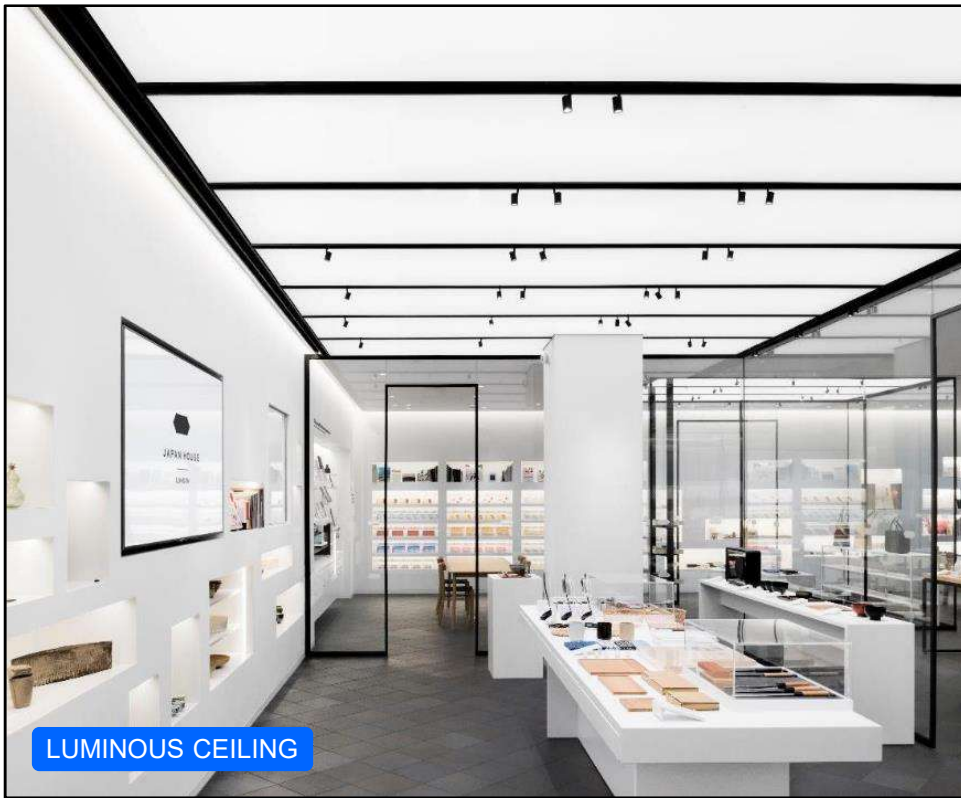
- Traditional troffer and pendant luminaires that provide the primary layer of illumination contribute nothing to improving noise > the Noise Reduction Coefficient (NRC) value is typically = 0, indicating no sound is absorbed by the luminaire.
- Both lighting and baffle manufacturers have recognized the need for combining acoustics and lighting but they suffer from the same fundamental problem we started with at the beginning of this presentation: the limitation of using traditional form factors.
- The absorption of sound depends on not just one characteristic – sound absorption of the material as measured by NRC – but a second equally important factor: size
- It is the combination of having both high sound absorption properties and large size that make luminous ceilings and large scale modular luminaires the ideal solution for combining light and acoustics to create environments that are good for your eyes... and your ears.



## Applications

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LUMINOUS CEILING



**THE SHOP AT JAPAN HOUSE (LONDON, UK)**

**ARCHITECT**  
Katayama Masamichi, Wonderwall

**LIGHTING DESIGN**  
Nulty (London)

**INTERIOR DESIGN**  
Marchini Curran Associates

**SIZE/AREA**  
768 sqft (70 m<sup>2</sup>)

## Speaker Notes:

- A stretch ceiling delivers a canopy of light to this retail area of the cultural center

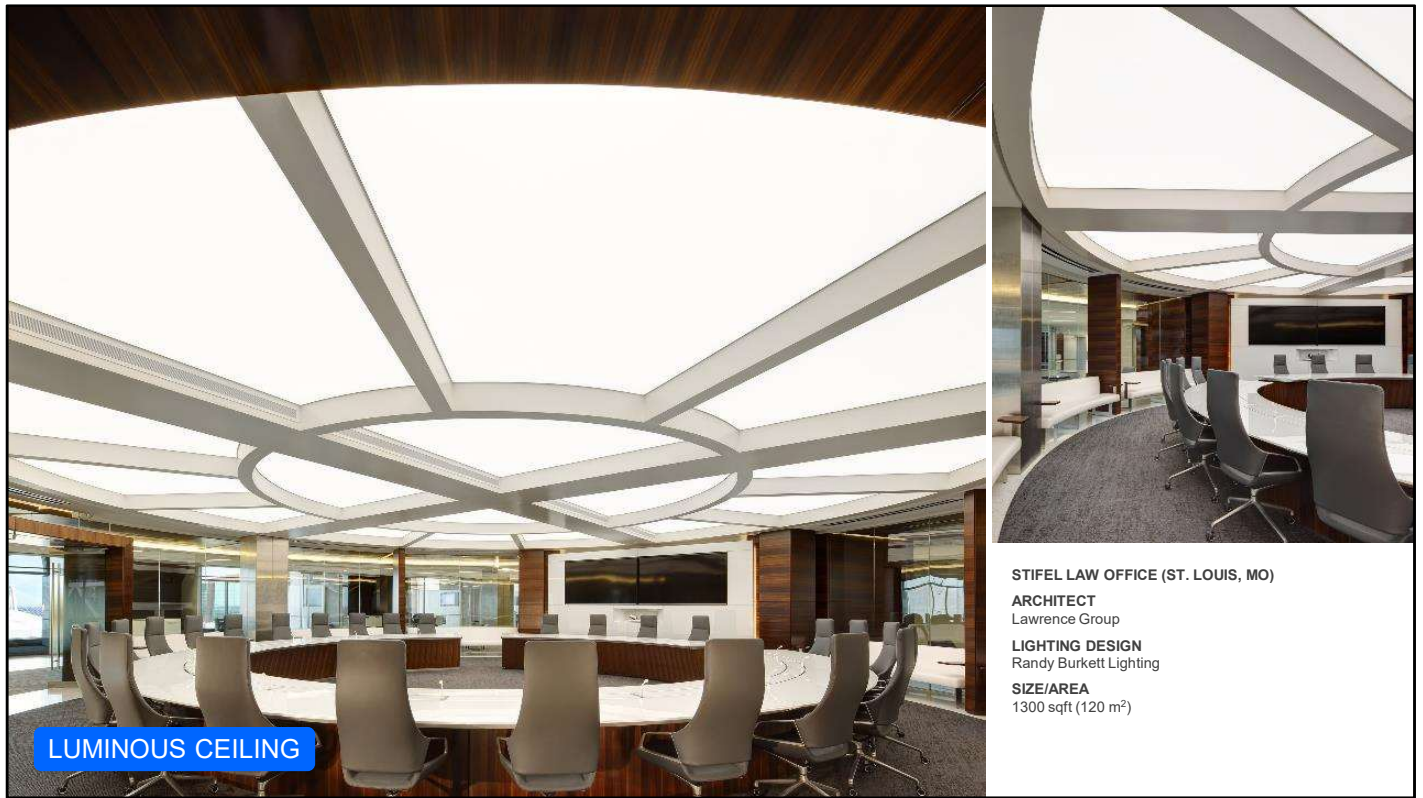


LUMINOUS CEILING

1 CONAGRA DRIVE (OMAHA, NE)  
**ARCHITECT**  
Alley Poyner Macchietto Architecture  
**LIGHTING DESIGN**  
Morrissey Engineering  
**SIZE/AREA**  
2100 sqft (195 m<sup>2</sup>)

## Speaker Notes:

- A continuous stretch ceiling continues the flow of natural light from windows at the edge of the atrium into the interior of the space



STIFEL LAW OFFICE (ST. LOUIS, MO)

**ARCHITECT**  
Lawrence Group

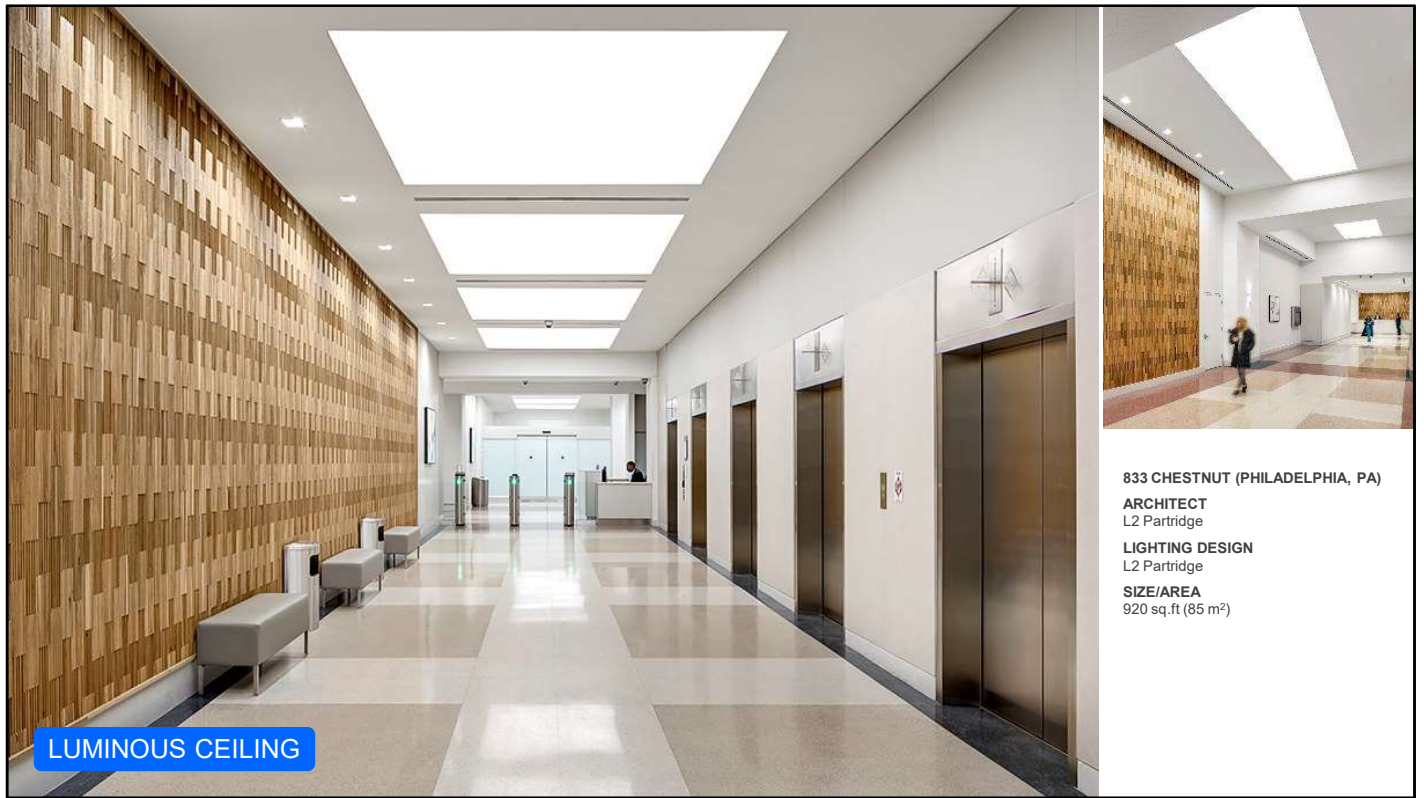
**LIGHTING DESIGN**  
Randy Burkett Lighting

**SIZE/AREA**  
1300 sqft (120 m<sup>2</sup>)

## Speaker Notes:

- A luminous ceiling acts as the centerpiece of this boardroom giving it the look of a futuristic command center.





833 CHESTNUT (PHILADELPHIA, PA)

**ARCHITECT**  
L2 Partridge

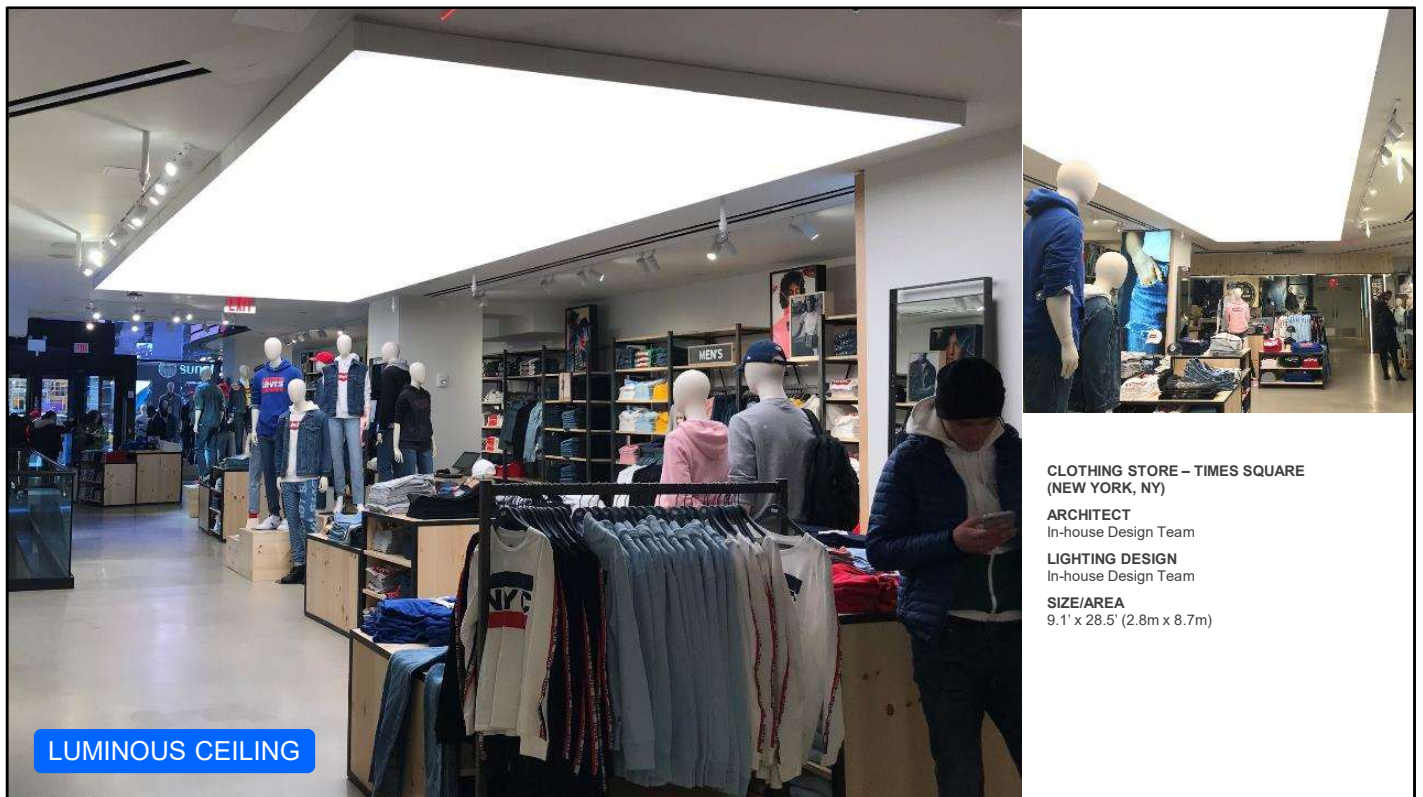
**LIGHTING DESIGN**  
L2 Partridge

**SIZE/AREA**  
920 sq.ft (85 m<sup>2</sup>)

## Speaker Notes:

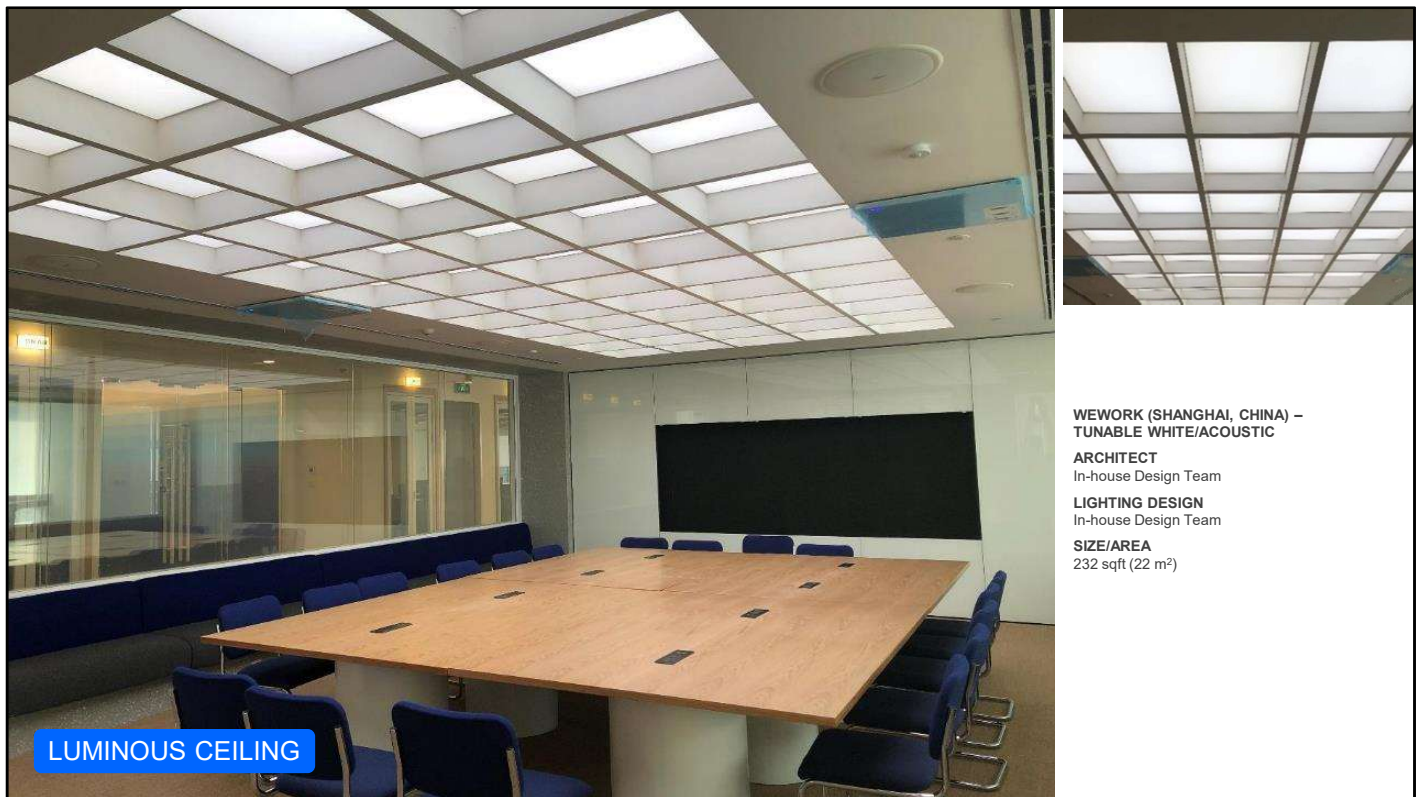
- A series of large flush mount luminous ceiling elements encompasses the corridors of this medical building with high levels of comfortable illumination





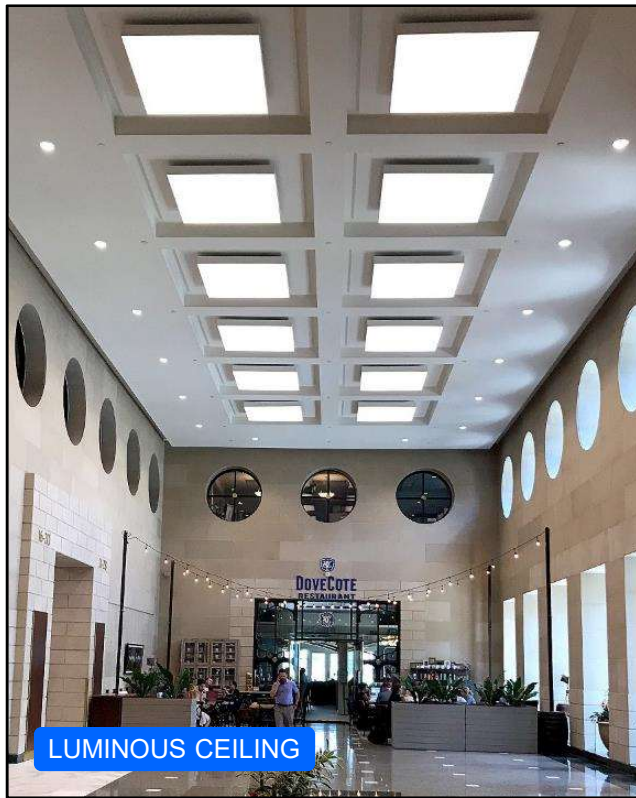
## Speaker Notes:

- A large surface mounted luminaire brings the feel of the outdoors to this retail space.



## Speaker Notes:

- This modular luminous ceiling incorporates acoustic performance and tunable white to change the mood of the space depending on its use



BANK OF AMERICA CENTER (ORLANDO, FL)  
ARCHITECT  
HKS  
SIZE/AREA  
30 Luminaires @ 5' x 5' (1.5m x 1.5m) each

## Speaker Notes:

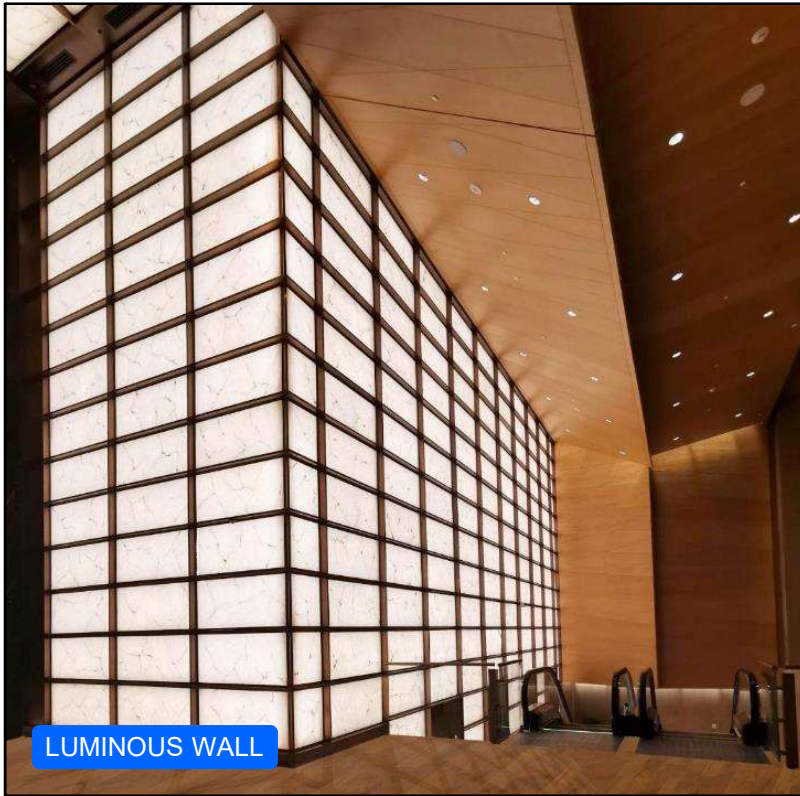
- Large scale luminaires are utilized throughout the lobby to provide a signature look for the entire space and to maintain the feeling of natural light in the transition from the outer lobby to the interior elevator and security areas.





## Speaker Notes:

- A luminous wall of white fluted glass creates a natural, open experience for people in the lobby of this recently refurbished 1930's art deco building



LUMINOUS WALL



BURJ ALSHAYA OFFICE TOWER – ALABASTER (WHITE ONYX)  
(KUWAIT CITY, KW)

**ARCHITECTS**

Gensler

KEO International

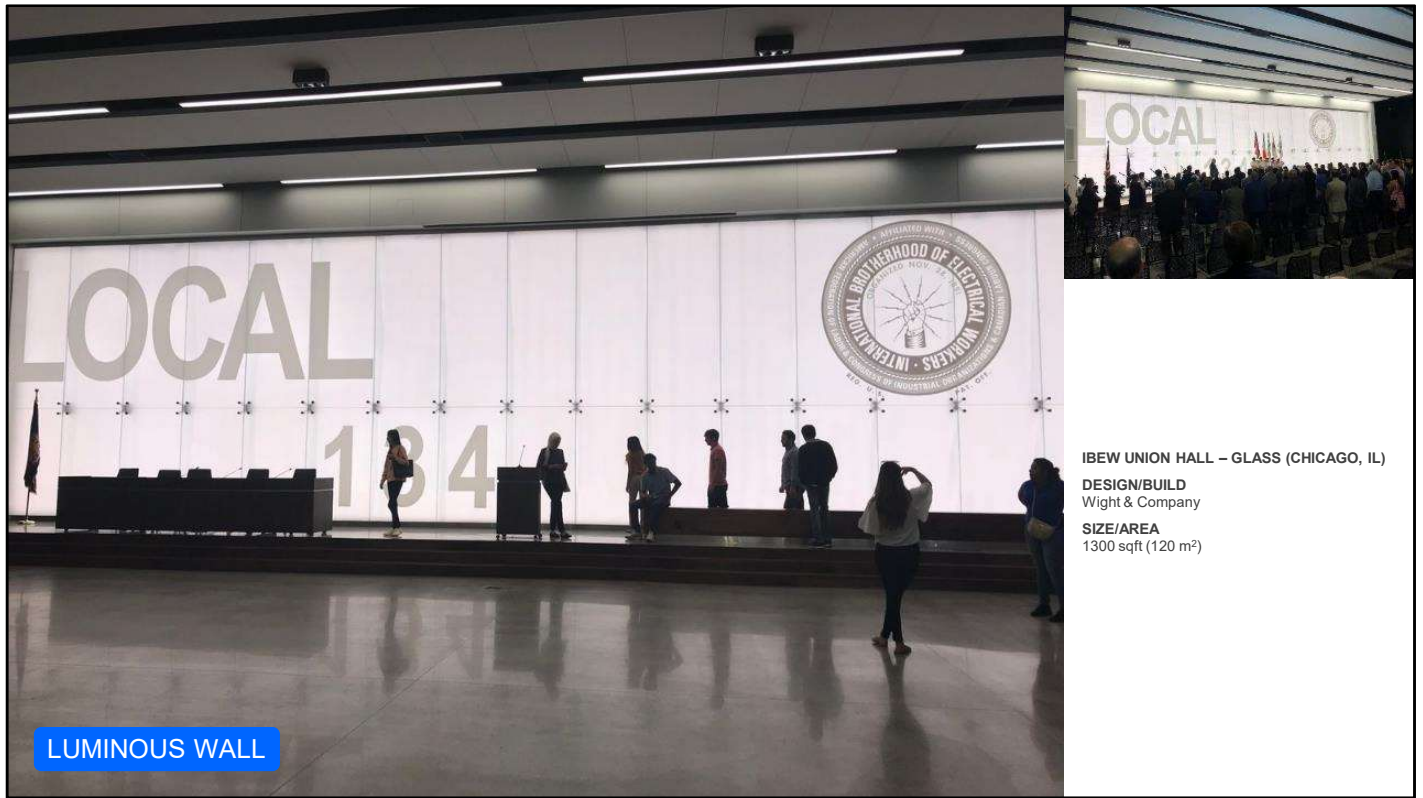
**SIZE/AREA**

1100 sqft (100 m<sup>2</sup>)

## Speaker Notes:

- This massive white onyx luminous wall is a focal point of the lobby area of this office tower





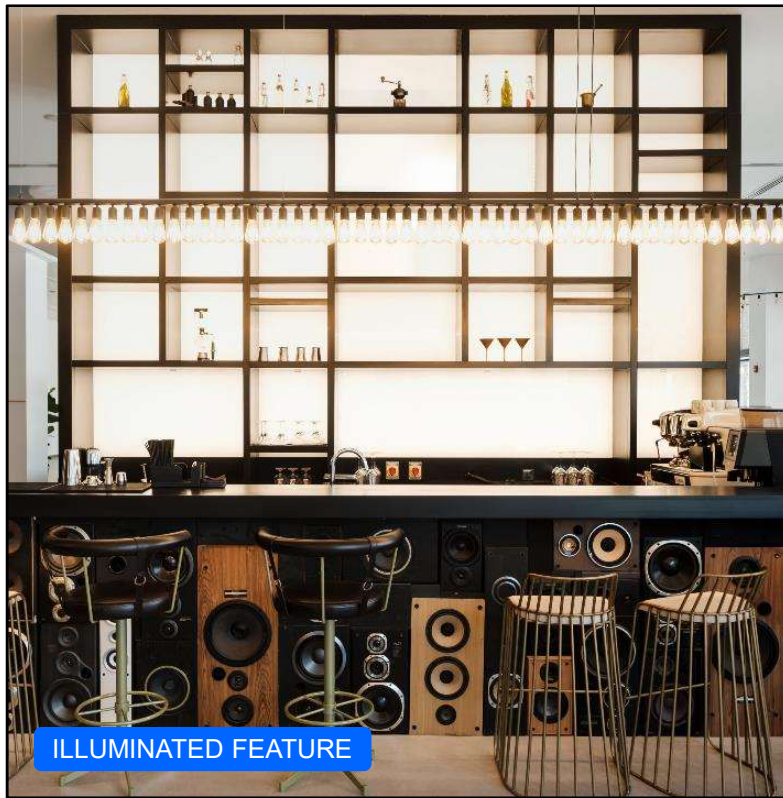
IBEW UNION HALL – GLASS (CHICAGO, IL)

DESIGN/BUILD  
Wight & Company

SIZE/AREA  
1300 sqft (120 m<sup>2</sup>)

## Speaker Notes:

- An enormous luminous wall contributes to the illumination of this hall and provides a stunning backdrop for speakers



**ZABEEL HOUSE HOTEL – LOBBY BAR (DUBAI, UAE)**

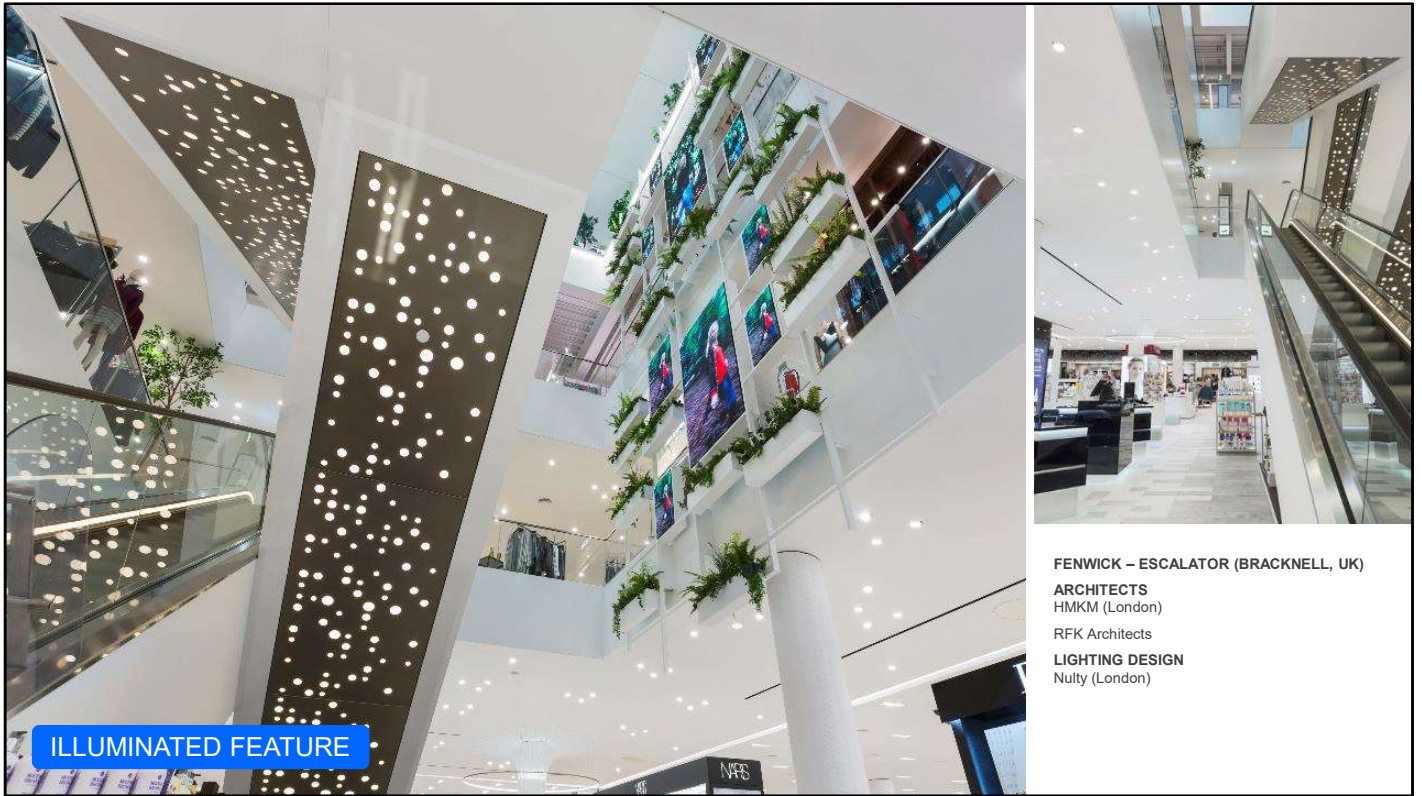
**ARCHITECTS**  
WS Atkins & Partners

ATK Engineering

**LIGHTING DESIGN**  
Neolight

## Speaker Notes:

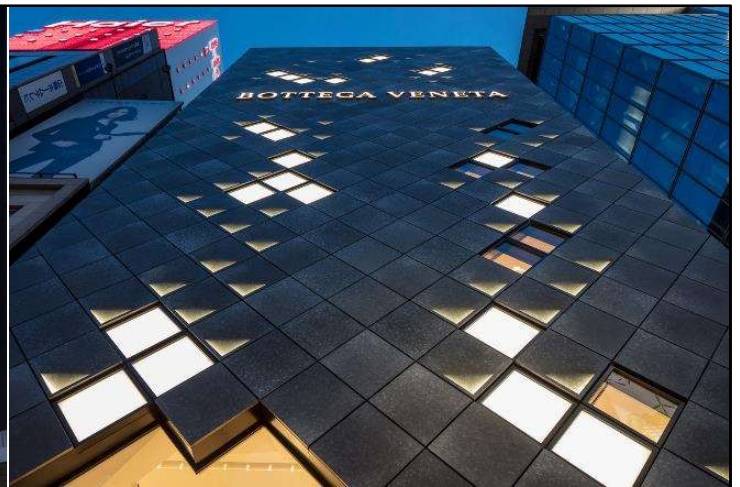
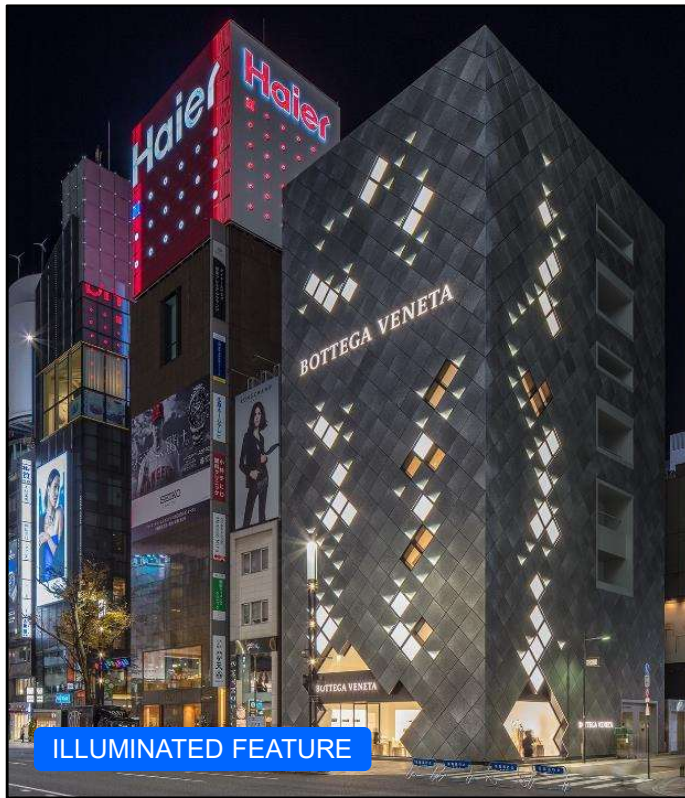
- Illumination is used to draw attention to the eclectic design of this lobby bar



## Speaker Notes:

- Large scale perforated features add visual interest to an otherwise plain element above the escalators in a high end department store





BOTTEGA VENETA GINZA (TOKYO, JP)  
ARCHITECT  
*Not Credited*

## Speaker Notes:

- Luminous surfaces are not restricted for interior use
- The store occupies a six-storey building with a façade clad in 900 sqm. (9,688 sq.ft.) of silver panels that collectively mimic Bottega Veneta's trademark intrecciato technique of interweaving leather punctuated with illuminated highlights to compete with the surroundings



## Speaker Notes:

- In conclusion: spaces no longer have to suffer from the limitations of traditional form factors that that have restricted us to points and lines of light.
- Light will become integral to the structure in the form of the surfaces that define the space.





This concludes The American Institute of Architects  
Continuing Education Systems Course

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Contact: *Presenter Name*

