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THROUGH DIFFERENT EYES

Figure 1: An interior space transitioning from colour to grayscale, simulating the experience of severe colour blindness (achromatopsia).

Many of us take our vision, and our ability to see colour for granted. But as designers, we must challenge ourselves to consider the experience of those who cannot. For most of us, colour is a fundamental element in design; it is often the first aspect we consider when creating a space. While it isn't the only factor that shapes a room, colour is undeniably one of the most influential. But how would a space be perceived if colour were completely absent? What if colour didn't exist at all? By stepping into the shoes of individuals with colour vision deficiencies, we can begin to understand the significant impact this has on their interaction with spaces and strive to create designs that are genuinely inclusive and accessible. Despite the importance of colour in design, accessibility for those with colour vision deficiencies is still largely overlooked. How can a visual disability affecting millions remain so under-researched and ignored in the design world? While there is ample information about colourblindness as a condition and principles of interior design, little to no research connects these fields, particularly in practical solutions for inclusivity. This absence highlights a broader lack of inclusivity in design. To address this, I combined established knowledge from both areas to develop new insights and solutions: a process that has only deepened my passion for inclusive design.

Colourblindness, often referred to as "color deficiency," may seem like a minor limitation, but it removes a critical element of how we experience the world (What Is Color Blindness?, 2024). This condition affects "1 in 12 men" and "1 in 200 women", amounting to over 3 million individuals in the UK and around 300 million worldwide (About Colour Blindness, n.d.).

Despite these substantial figures, the interior design world often overlooks the needs of people with colour vision deficiencies. While many companies proudly promote their commitment to 'inclusive and accessible design,' the reality is that most spaces fail to accommodate these ideals. Barriers can range from colour-coded public signage to retail systems and digital interfaces that rely heavily on hue for navigation. Failing to address the needs of those with colour vision deficiencies leaves a significant gap in inclusive design. True inclusivity requires more than surface-level adjustments; it demands a deeper understanding of how colourblind individuals navigate their surroundings. So, how do individuals with colour vision deficiencies truly perceive and experience space? When they cannot rely on colour as a visual cue, what alternative sensory features can we integrate to provide inclusive experiences and engagement?

Lighting, as fundamental to design as colour itself, offers an inclusive solution to the challenges faced by those with colour vision deficiencies. Unlike the static nature of colour, lighting is a dynamic and versatile tool that influences how we perceive form, depth, and contrast. For individuals unable to rely on colour for distinction or guidance, lighting can compensate for the limitations in colour recognition, offering an alternative means of perceiving the environment, providing clarity and enhancing spatial understanding. This essay will explore the transformative potential of lighting in interior design, examining how it can enrich spatial experiences, address accessibility barriers, and create environments that are not only inclusive but also universally engaging and functional.

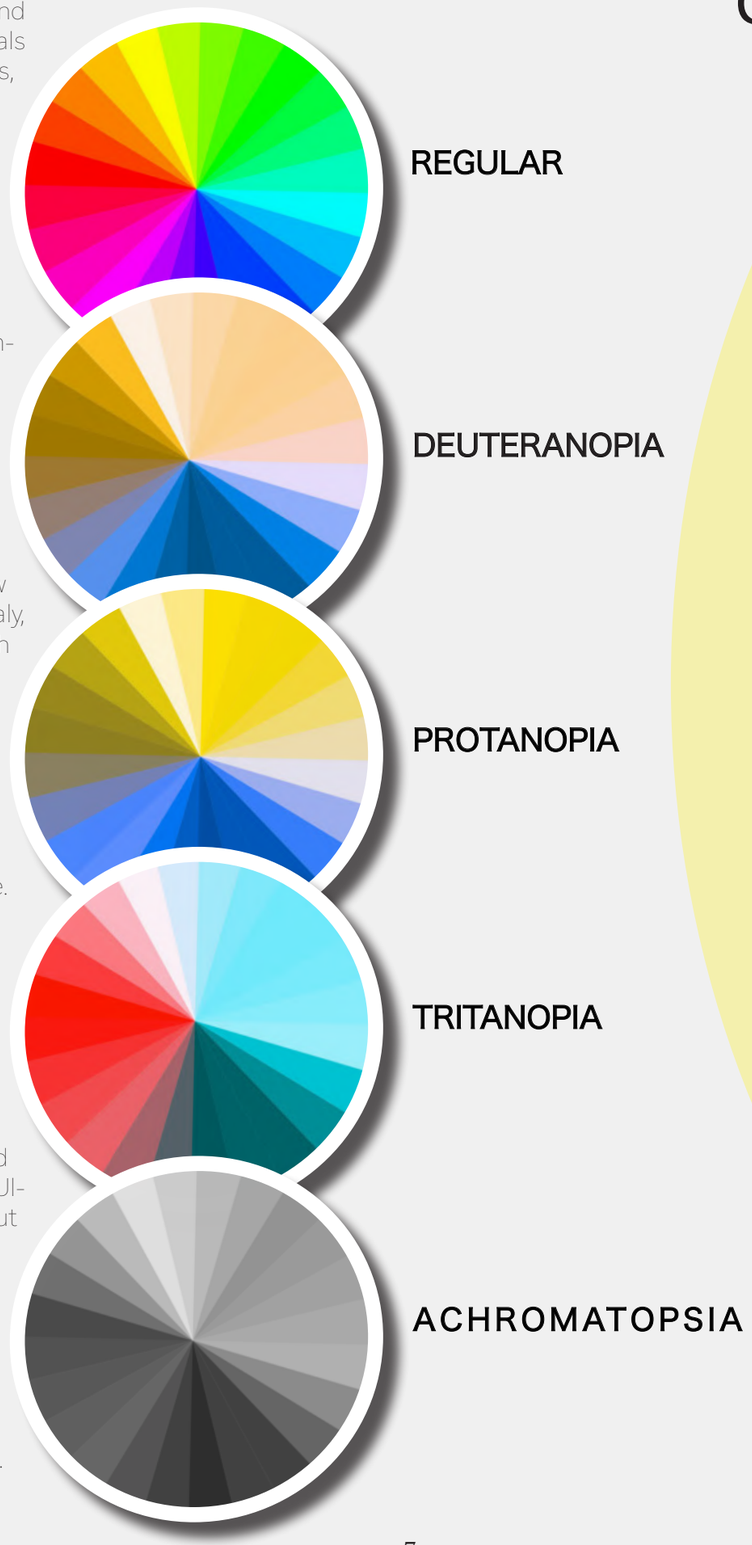
Figure 2: Another interior space transitioning from colour to grayscale, highlighting the visual challenges of achromatopsia.

Our ability to perceive the colours relies on two types of light-detecting cells in the retina, known as rods and cones. While rods are sensitive to light and darkness, cones are responsible for detecting colour. The human eye contains three specialized types of cone cells, each sensitive to 'red, green, and blue' wavelengths of light. By processing input from these cones, our brains enable us to recognize and perceive the colours we experience (What Is Color Blindness?, 2024). Individuals with "normal colour vision are known as trichromats," (About Colour Blindness, n.d.) meaning all three types of cone cells function properly, allowing them to perceive a full range of hues (About Colour Blindness, n.d.). However, when one of these cone types is impaired, the colour spectrum narrows, leading to mild forms of colourblindness that alter how certain colours are distinguished. In its most severe form, known as 'achromatopsia' none of the three cone types are functional, resulting in a complete inability to perceive colour and rendering vision entirely monochromatic (What Is Color Blindness?, 2024).

Red-green colour deficiency, the most common form of colourblindness, includes two primary subtypes: protanopia and deuteranopia (Color Blindness: Types, Causes & Treatment, n.d.). Protanopia, often referred to as "red blindness," occurs when the retina lacks red photoreceptors, impairing the ability to perceive red wavelengths of light (Dane, 1907). In contrast, deuteranopia results from the absence of green photoreceptors, making it difficult for individuals to detect green light (Reese et al., 2024). Despite their differences, both conditions limit the ability to distinguish between red and green hues (Evans, 2003, p. 8). Another common form of colourblindness is "blue-yellow CVD," also referred to as tritanopia. This condition arises from a genetic anomaly, requiring only one chromosome to develop (Evans, 2003, p. 31). Individuals with tritanopia are unable to perceive blue light, which significantly alters their colour perception. As a result, their vision is dominated by shades of red, pink, and purple (Color Blindness: Types, Causes & Treatment, n.d.). The severity of this and other forms of colourblindness can vary widely, with some individuals experiencing difficulties only in low-light conditions: an area where thoughtful lighting design can provide crucial support (What Is Color Blindness?, 2024). The challenge lies in using light to empower those who perceive colour differently, creating environments that are both intuitive and inclusive.

While society may not often regard colourblindness as a disability, it should be treated with the same level of seriousness as other conditions (About Colour Blindness, n.d.). Recognizing the specific needs of colourblind individuals allows designers to approach projects with empathy and ingenuity, finding solutions that make a meaningful impact. For designers, addressing the needs of individuals with severe colour vision deficiencies requires moving beyond colour entirely, focusing instead on alternative tools like lighting and contrast to ensure accessibility. Thoughtfully designed spaces can alleviate frustration and ensure that clients can navigate their environment with ease and confidence. Ultimately, the goal is to design spaces that not only accommodate their needs but enhance their daily lives, ensuring accessibility and inclusivity. The daily obstacles faced by individuals with colour vision deficiencies underline the pressing need for environments that thoughtfully address their requirements; an area often overlooked in contemporary design practices. Designers have both a professional obligation and an ethical duty to create spaces that are safe, intuitive, and universally accessible, embodying the core principles of inclusivity. Achieving this demands a shift beyond purely aesthetic considerations, placing usability and accessibility at the core of every design decision.

Figure 3: How colours appear across various colour vision deficiencies.



UNDERSTANDING COLOURBLINDNESS

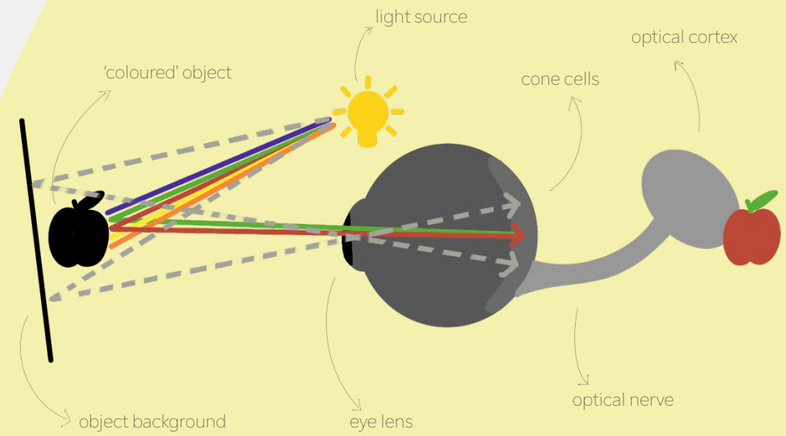


Figure 4: How a coloured object passes through the eye and cone cells.

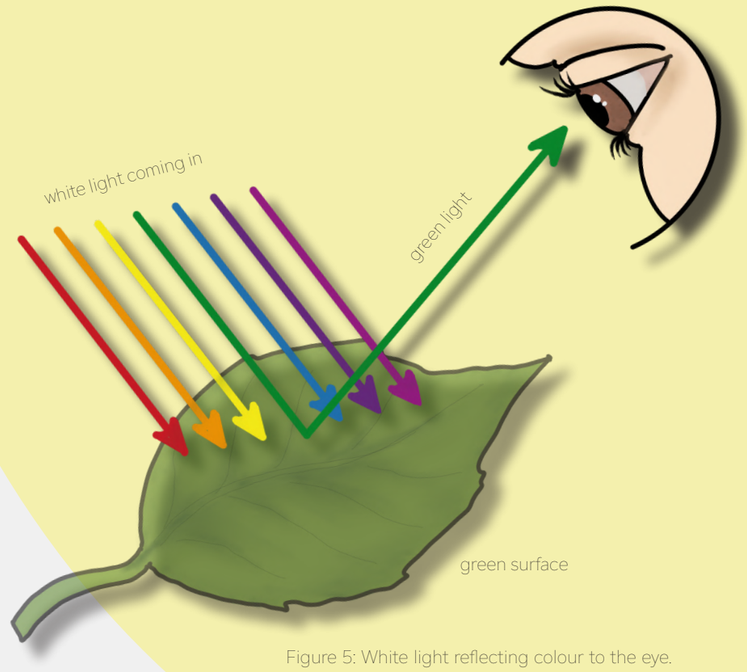
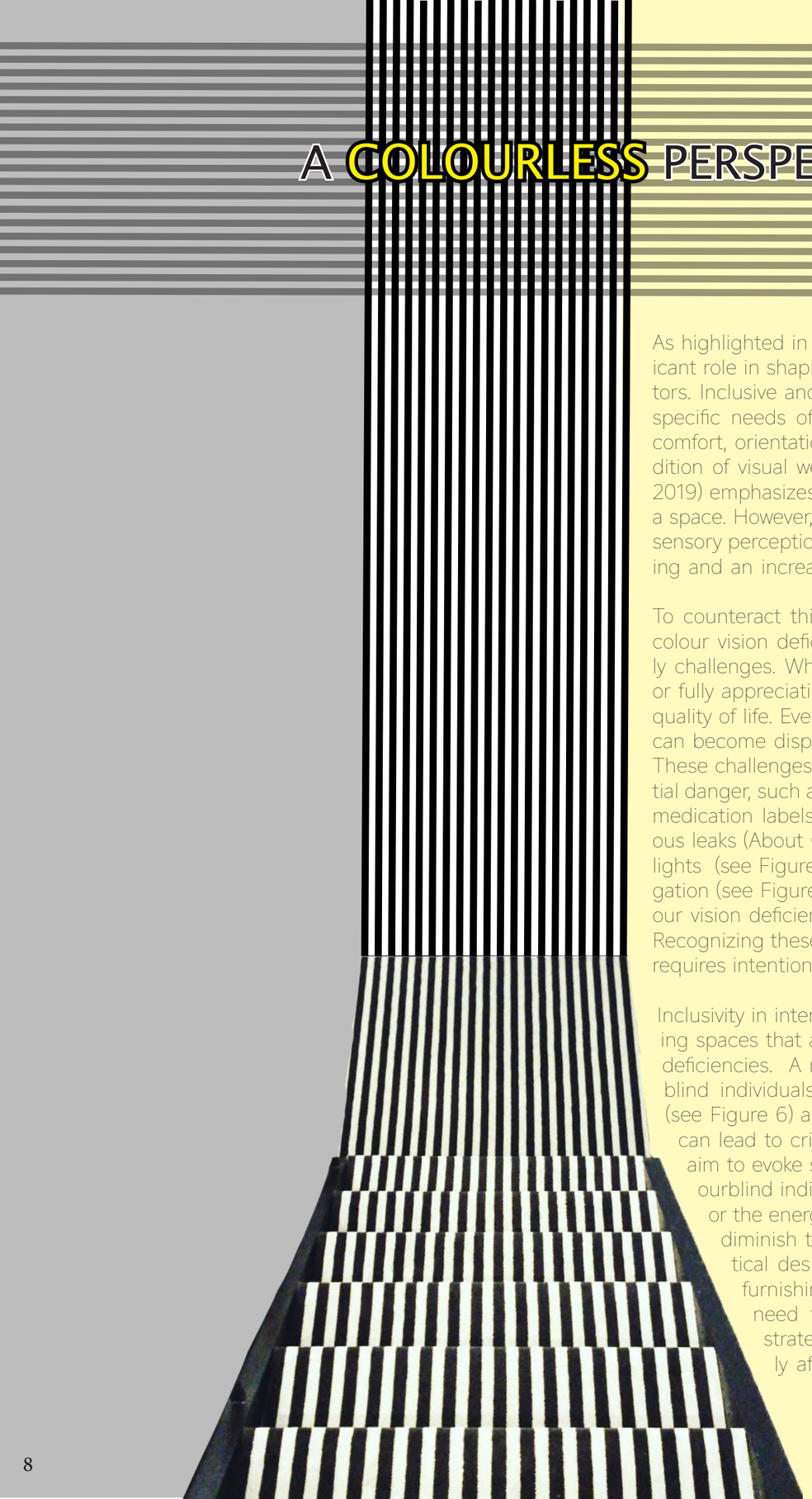


Figure 5: White light reflecting colour to the eye.

A COLOURLESS PERSPECTIVE



As highlighted in Delcampo - Carda et al. (2019), our physical environment plays a significant role in shaping our "welfare and behaviour", regardless of age, abilities, or other factors. Inclusive and supportive spaces must "adapt the physical environment to meet the specific needs of its residents" (Delcampo - Carda et al., 2019), enhancing their visual comfort, orientation, and overall well-being. Visual comfort, defined as "a subjective condition of visual well-being induced by the visual environment," (Delcampo - Carda et al., 2019) emphasizes how our surroundings directly influence how we feel and interact with a space. However, for individuals with visual impairments, such as colour vision deficiency, sensory perception is often compromised. This can lead to a diminished sense of well-being and an increased feeling of insecurity and exclusion (Delcampo - Carda et al., 2019).

To counteract this vulnerability, designers must address the needs of individuals with colour vision deficiencies through empathy and a deep understanding of their daily challenges. While some struggles may seem minor, such as matching clothing or fully appreciating art and design, others can seriously impact their safety and quality of life. Everyday decisions, like picking ripe fruit or preparing meat safely, can become disproportionately challenging, disrupting the rhythm of daily life. These challenges extend beyond mere inconvenience and into areas of potential danger, such as misinterpreting colour-coded wires (see Figure 9), mistaking medication labels, or failing to distinguish gas stove settings, risking dangerous leaks (About Colour Blindness, n.d.). This extends to challenges with traffic lights (see Figure 7), road borders, and public signage, essential tools for navigation (see Figure 8), that become significant obstacles for individuals with colour vision deficiencies due to their reliance on colour (Yandikaputri et al., 2021). Recognizing these challenges is only the first step; designing truly inclusive spaces requires intentional strategies that rely on lighting to ensure clarity and accessibility.

Inclusivity in interior design is not merely a consideration but a necessity for creating spaces that are functional and welcoming to all, particularly those with colour vision deficiencies. A room designed without acknowledging the challenges faced by colourblind individuals can inadvertently create significant difficulties. Poorly defined stairs (see Figure 6) and hidden emergency features, such as exit signs or fire extinguishers, can lead to critical, even life-threatening situations. In contrast, interior designs often aim to evoke specific moods or aesthetics through colour schemes. However, for colourblind individuals, these nuances, whether it's the warmth of a soothing ambience or the energy of vibrant tones, can go unnoticed. This disconnect in perception can diminish their experience of the space's intended atmosphere. Additionally, practical design elements, such as low-contrast wallpapers or subtle colour-coded furnishings, may become sources of confusion or frustration, highlighting the need for intentional, inclusive design practices. These challenges demonstrate how easily design elements that seem inconsequential can significantly affect how colourblind individuals interact with and experience a space.

Figure 6: Poorly designed staircase illustrating navigational challenges for colourblind individuals.

Figure 7: Traffic light visibility across different types of colourblindness.

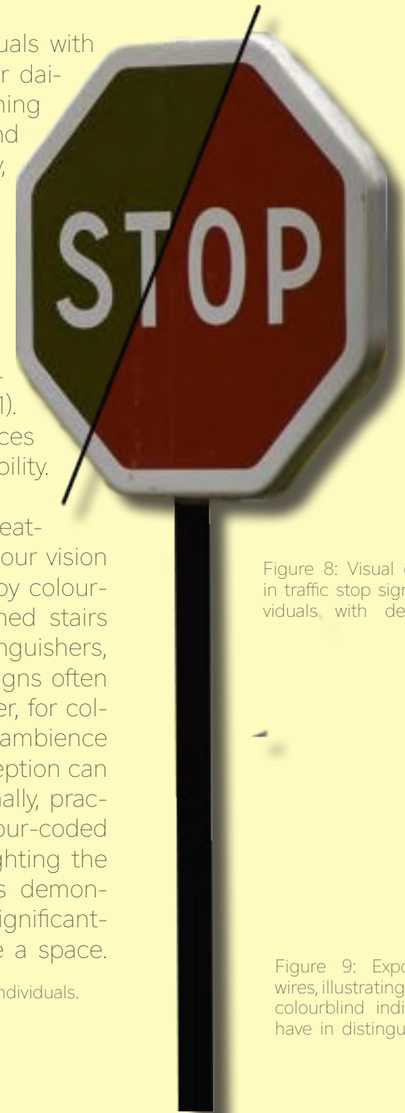


Figure 8: Visual differences in traffic stop signs for individuals with deuteranopia

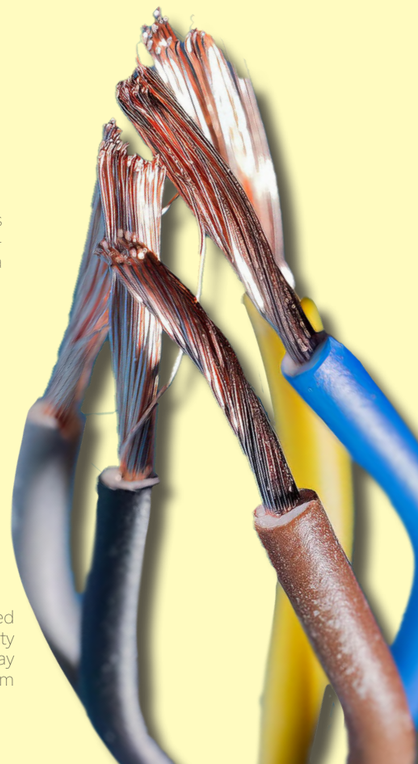


Figure 9: Exposed frayed wires, illustrating the difficulty colourblind individuals may have in distinguishing them

Figure 10: Illuminated edges highlighting wall-floor connections, aiding those who cannot rely on colour

THE LANGUAGE OF LIGHT

We spend a substantial portion of our lives in spaces that depend heavily on lighting, whether it's the natural sunlight that shifts throughout the day or the artificial lighting designed to support our daily activities. Lighting is far more than a practical necessity; it shapes how we experience a space, influencing our mood, perception, and even our sense of comfort and safety. Fortunately, lighting is a uniquely versatile design element, offering the ability to adapt and transform spaces by enhancing contrast, drawing attention to focal points, and meeting a wide range of functional and aesthetic needs. At the same time, it possesses a unique capacity to shift and adapt naturally over time. This duality allows lighting to be both precisely controlled and fluidly dynamic, making it a versatile and powerful design element. For colourblind individuals, it becomes an essential feature, compensating for the lack of colour perception and enriching spatial interaction. This chapter will examine lighting strategies that create inclusive, functional spaces accessible to all.

Spatial perception, is defined as "the subjective interpretation of a certain situation," (Yücetas, 1997) encompassing the ability to comprehend the relationships between objects, their positions, and the body within a given space. This concept extends to the visual perception of depth, orientation, and movement within an environment. For individuals with colour vision deficiencies, lighting becomes an invaluable tool that enhances usability, navigation, and spatial experience. Lighting goes beyond mere illumination, shaping spaces with contrasts, shadows, and highlights that accentuate textures, define contours, and clarify boundaries. When applied thoughtfully, these elements can create visual hierarchies that improve safety, comfort, and confidence for colourblind users. By leveraging lighting to emphasize edges, corners, and surfaces that might otherwise blend into the background, designers can bring these details to the forefront, ensuring a functional and comfortable environment.

Figure 11: LED strips enhancing step visibility and guiding movement

Figure 12: Round backlit bathroom mirror illustrating visual lighting frames

Lighting also plays a critical role in guiding movement and reducing the risk of accidents, an essential consideration for inclusive design. Much like colour zoning, lighting zones can delineate functional areas and pathways, improving orientation and navigation (Jaglarz, 2011). When thoughtfully applied to seating areas, hallways, or transit zones, lighting would enhance clarity and contrast, transforming these commonly problematic spaces into accessible and navigable environments for all users (Delcampo‐Carda et al., 2019). According to Hepler, Wallach, & Hepler (2013, p. 22, as cited in Al-Zamil, 2017) interior designers can use lines of light to define object contours and outlines, clarifying a room's dimensions and enhancing spatial perception (see Figure 10). By incorporating variations in thickness, direction, and consistency, lines become transformative tools that influence both the viewer's experience and emotional responses. For instance, as Ballas (2013, p. 3, as cited in Al-Zamil, 2017) explains, vertical lines evoke alertness and energy, giving spaces a more commanding presence, while horizontal lines create a feeling of spaciousness and calm, making a room feel wider, lower, and more relaxing. These subtle yet impactful design elements illustrate how the orientation and movement of lines can shape both the atmosphere and perception of a space. Building on this principle, designers can further enhance spatial perception and accessibility by incorporating visual lighting frames to define objects (see Figure 12) and boundaries, such as doors and mirrors or skirting boards (RNIB, 2020). By outlining shapes through light and shadow, textures are highlighted and spaces gain a clearer visual definition. Strategic use of lighting lines, paired with functional contrast, can guide movement within a space by illuminating pathways in corridors (see Figure 13), marking transitions between rooms, or accentuating features like staircases and hidden steps. This ensures interiors are intuitive, accessible, and thoughtfully designed for individuals with visual disabilities.

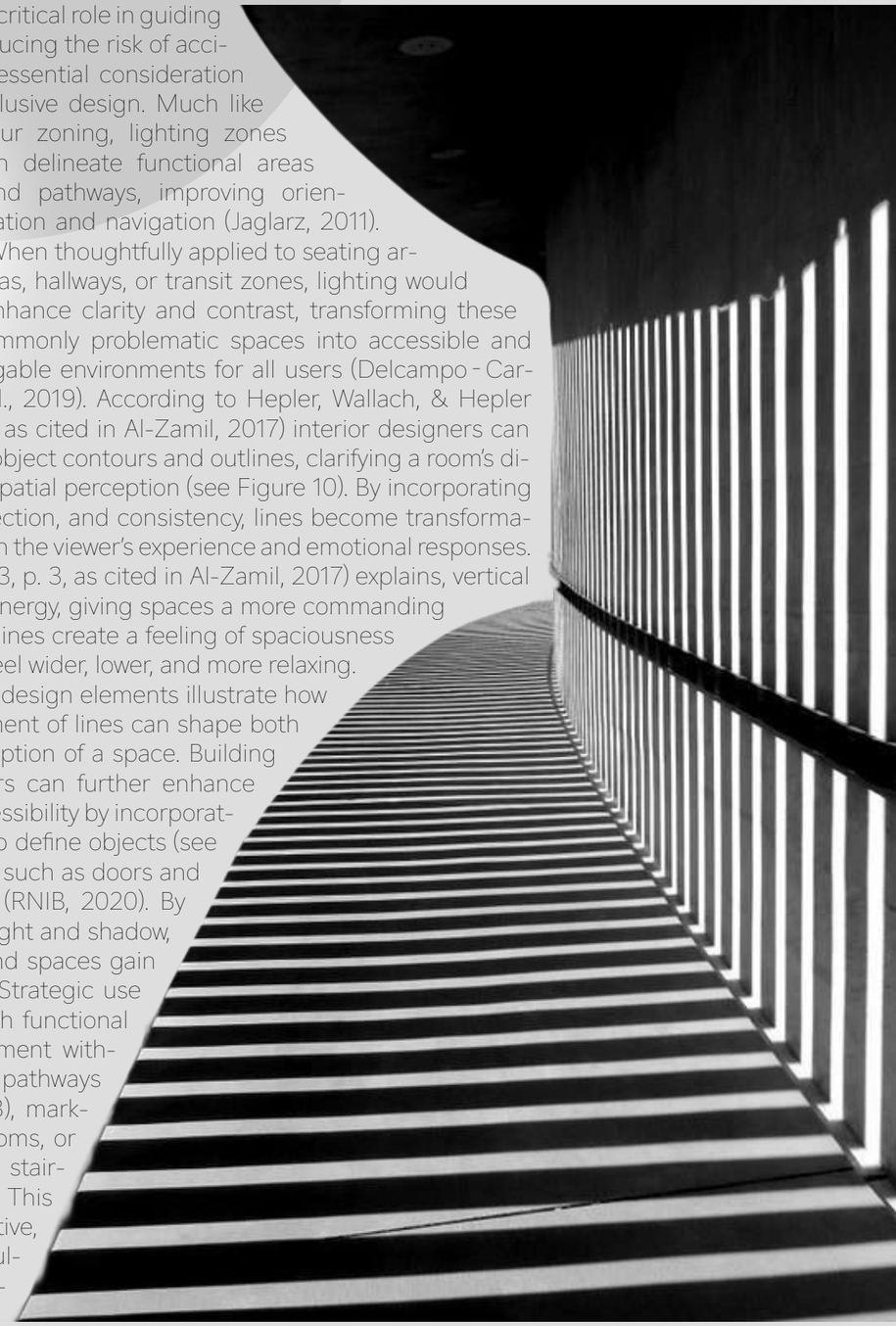


Figure 13: 'The Curving Walkway in CIRCA' demonstrating how lines enhance spatial perception and direction

THE ART OF CONTRAST

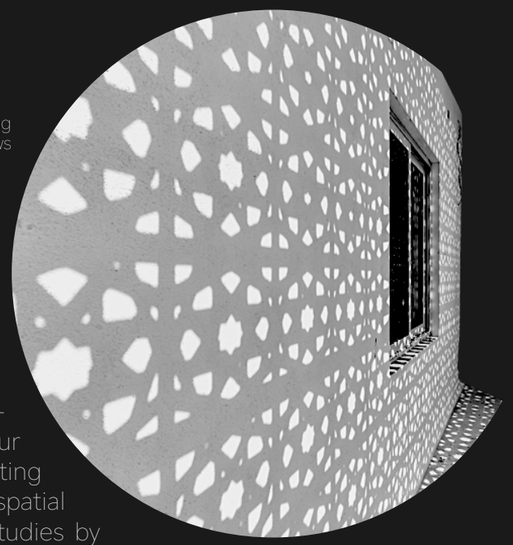


Figure 15: Mashrabiya Mosque' by NUDES, illustrating the use of patterned screens to cast detailed shadows

Beyond functionality, lighting creates mood and atmosphere through variations in brightness, temperature, and intensity, compensating for the diminished emotional impact of colour schemes (Yücetas, 1997). Lighting has a transformative impact on spatial perception, as emphasized in studies by Manav and Yener (1999), and Al-Zamil (2017); which state brighter, lighter spaces are often perceived as larger, taller, and more open. While this may seem like an obvious observation, its relevance for individuals with colour vision deficiencies is profound. Research from Abdurachman and Adhitama (2023), highlights how well-designed lighting can reduce errors, increase productivity, and provide essential support for those who cannot rely on colour cues to navigate their surroundings. According to sources such as Manav and Yener (1999), and Jaglarz (2011), lighting schemes like wallwashing and cove lighting create a sense of order and professionalism, while uplighting can transform the same space into a more relaxed and inviting environment. These examples emphasize the significance of purposeful lighting design in crafting spaces that resonate emotionally, guide perception, and enhance experience.

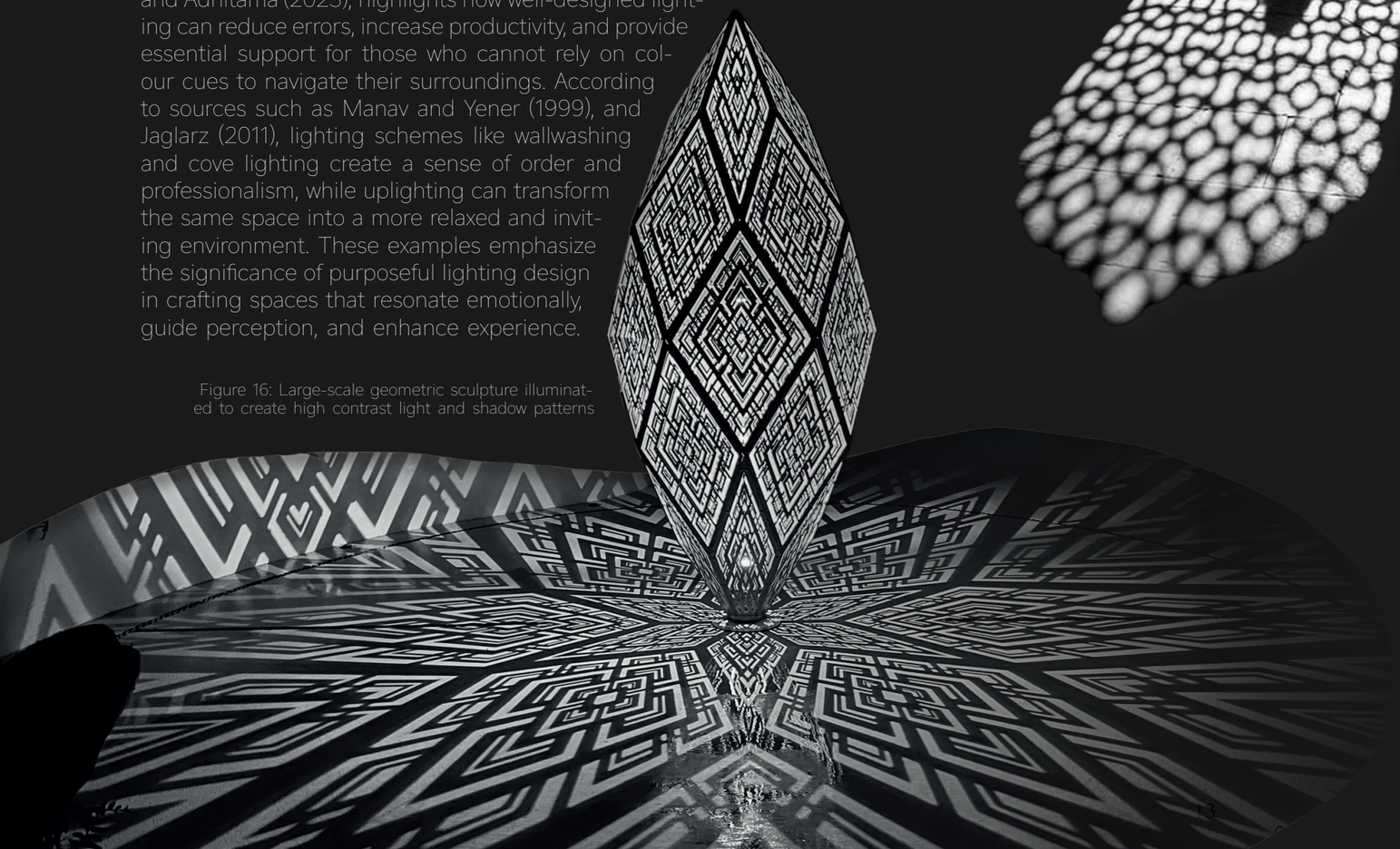


Figure 16: Large-scale geometric sculpture illuminated to create high contrast light and shadow patterns

Figure 14: Silhouette of a woman framed by Moucharabieh-patterned light and shadow projections

Lighting addresses the limitations of colour by emphasizing universally visible contrast, creating spaces that are accessible and functional for everyone. Reddit, while not an academic source, provided valuable firsthand insights into the lived experiences of individuals with colour vision deficiencies. A discussion on a colourblindness forum revealed that users prioritize "the more contrast, the better" and prefer "unique patterns, shapes, and materials" (Outback_Tracks, 2023) to improve navigation and object recognition. These real-world perspectives highlight the importance of integrating high contrast and distinctive design elements into accessible interior spaces. Building on this insight, one effective design solution involves incorporating light-filtering elements; features such as perforated panels or patterned screens that cast both beautiful and functional shadows. Beyond their practicality, such features often hold cultural significance, as seen in the distinct designs of Middle Eastern Moucharabieh, described as "an oriel" or "a window of latticework" (The Editors of Encyclopaedia Britannica, 1999). These intricate designs can be adapted for modern interiors, serving as room dividers (see Figure 17), passageway enhancements, or decorative wall features offering aesthetic richness while enhancing usability for colourblind individuals. Such designs are not just visually striking but serve a practical purpose for individuals with colour vision deficiencies. These features could shift organically with daylight or remain consistent under artificial light, ensuring functionality and accessibility at all times. Research supports this approach, with studies indicating that "light patterns influence user orientation and room comprehension" (Jaglarz, 2011). These patterns define spaces with clarity, guiding movement, encouraging interaction, and creating environments that are visually engaging and inclusive for colourblind individuals.

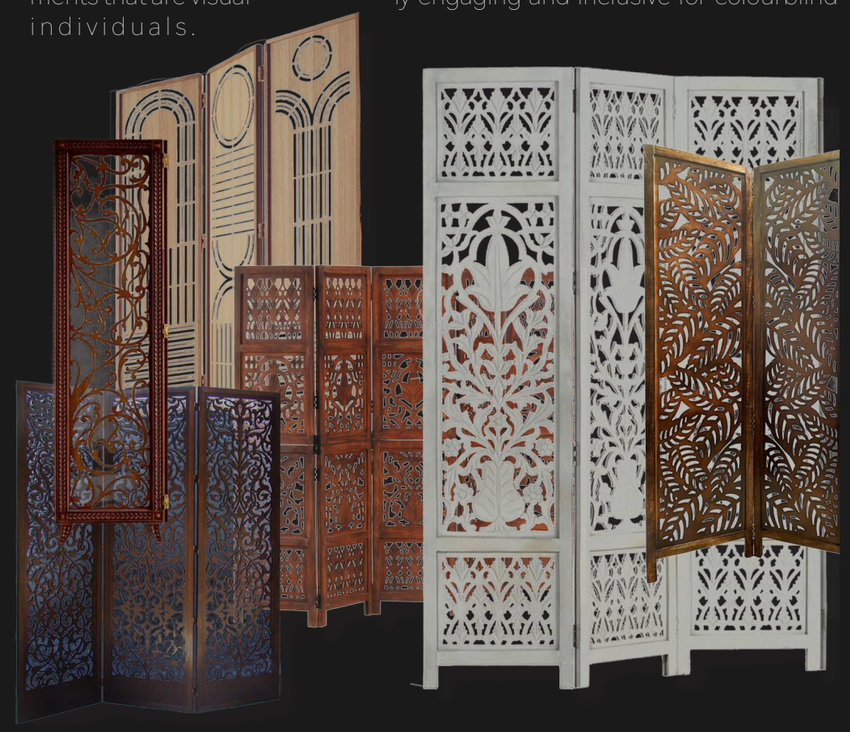


Figure 17: A collection of room dividers crafted from Moucharabieh-inspired panels

Figure 18

CHURCH OF THE LIGHT

CASE STUDY

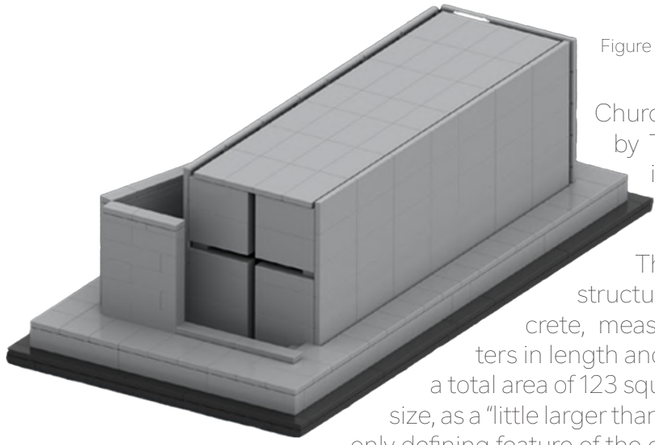


Figure 19

Church of the Light, designed by Tadao Ando and completed in 1989, is located approximately 25 kilometers from downtown Osaka, Japan. The minimalist rectangular structure, constructed from concrete, measures approximately 18 meters in length and 6 meters in width, covering a total area of 123 square meters - compared to in size, as a “little larger than a house” (Schoof, 2021). The only defining feature of the church is a striking cruciform created by a 25-centimeter-wide slit in the walls, extending from the ceiling to the floor, and wall to wall, allowing natural light to dramatically transform the interior space. The simplicity of the Church of the Light is deliberate, with natural light serving as the sole element shaping the space's experience. As daylight shifts, the light filtering through the cruciform evolves, casting lively shadows and varying in intensity. This iconic cruciform, described as "both a literal and figurative representation of faith," (Church of Light by Tadao Ando: Minimalism and the Play of Light, 2024) is the church's only source of illumination. The bare concrete walls and streaks of light direct focus to the building's form and pathways, with light guiding visitors toward the church’s entrance. The drastic contrast is “central to the church's experience," allowing light and shadow to continually transform the space. This simple yet profound design ensures that "the presence of the divine is not something seen but something felt" (Church of Light by Tadao Ando: Minimalism and the Play of Light, 2024). This case study reinforces the power of contrast and lighting in interior design, potentially exceeding the influence of colour. The Church of the Light transforms its space through the simplicity of light and shadow, creating an emotionally and spiritually impactful environment. Its use of light and shadow creates an inclusive experience, emphasizing form and pathway clarity without relying on colour cues.

Figure 20

HOUSE UNDER SHADOWS

CASE STUDY

Figure 21

House Under Shadows, designed by Zero Energy Design Lab, is a residential home located in Karnal, northern India. Spanning 18,000 square feet, the structure features two floors and a double roof, developed in response to the client's request for a nature-inspired and sustainable design approach. The pergola, the centerpiece of the house, spans the entire length and width of the property. Designed with a Voronoi pattern inspired by the natural forms of tree branches, and leaves, it casts detailed, filtered shadows throughout the home. This design enhances outdoor comfort, with the pergola, constructed from locally sourced materials, reflecting heat away from the home and encouraging residents to spend more time outdoors (Oh, 2021). The residence, described as "nestled below the sweeping shadows of the day" features organic, "parametrically crafted" (Caballero, 2024) shadow patterns which adapt with the sun's movement and seasonal changes. These ever-changing shadows create a semi-enclosed, partially intimate space, allowing residents to enjoy panoramic views of the surrounding green land. This design focuses on responding to its surroundings by combining functional efficiency with an immersive spatial experience (Elengical, 2021). The free-flowing geometric layout casts intricate patterns onto the home's neutral-toned surfaces, closely aligning with my focus on contrast and light-filtering structures. The pergola's shadows interact with the homes interior and exterior spaces, creating visually striking patterns perceivable to colourblind individuals. While this design relies on natural sunlight, strategically incorporating artificial lighting could achieve similar effects, defining zones, passageways, and key areas for colourblind individuals. This approach would enhance visibility, functionality, and visual intrigue, enriching the spatial experience both practically and emotionally.

Figure 23

Figure 24

Figure 22

PAINTING WITH LIGHT: SUNLIT STAINED GLASS

Stained glass presents a versatile design solution that benefits individuals with both regular vision and colour blindness. For those with colour vision deficiencies, the challenge of creating a universal 'colourblind-friendly' palette is both complex and limiting. However, the value of stained glass lies not solely in its colour but in the intricate reflections and textures it projects. This section explores how natural light sources, like sunlight and moonlight, and artificial ones, such as electric light and candles, interact with stained glass, offering a functional and aesthetic design solution for colourblind individuals (Abdurachman & Adhitama, 2023).

Stained glass connects us to daylight, reflecting its rhythms and patterns to enhance our sense of time and harmony with nature. Its interaction with light is inherently dynamic, evolving as the intensity and angles of sunlight shift throughout the day. Environmental factors such as moving clouds, swaying trees, or passing figures influence the patterns and colours it casts, transforming spaces into ever-changing, visually engaging environments (Wagner, 1986). As both Ostadzamani et al. (2016) and Mead (2008) suggest, this evolving quality not only improves the aesthetic appeal of a space but also promotes emotional and psychological well-being, offering a sensory experience that is both functional and enriching.

Figure 25: The Montreal Convention Center in daylight, with sunlight casting beams of colour onto plain surfaces

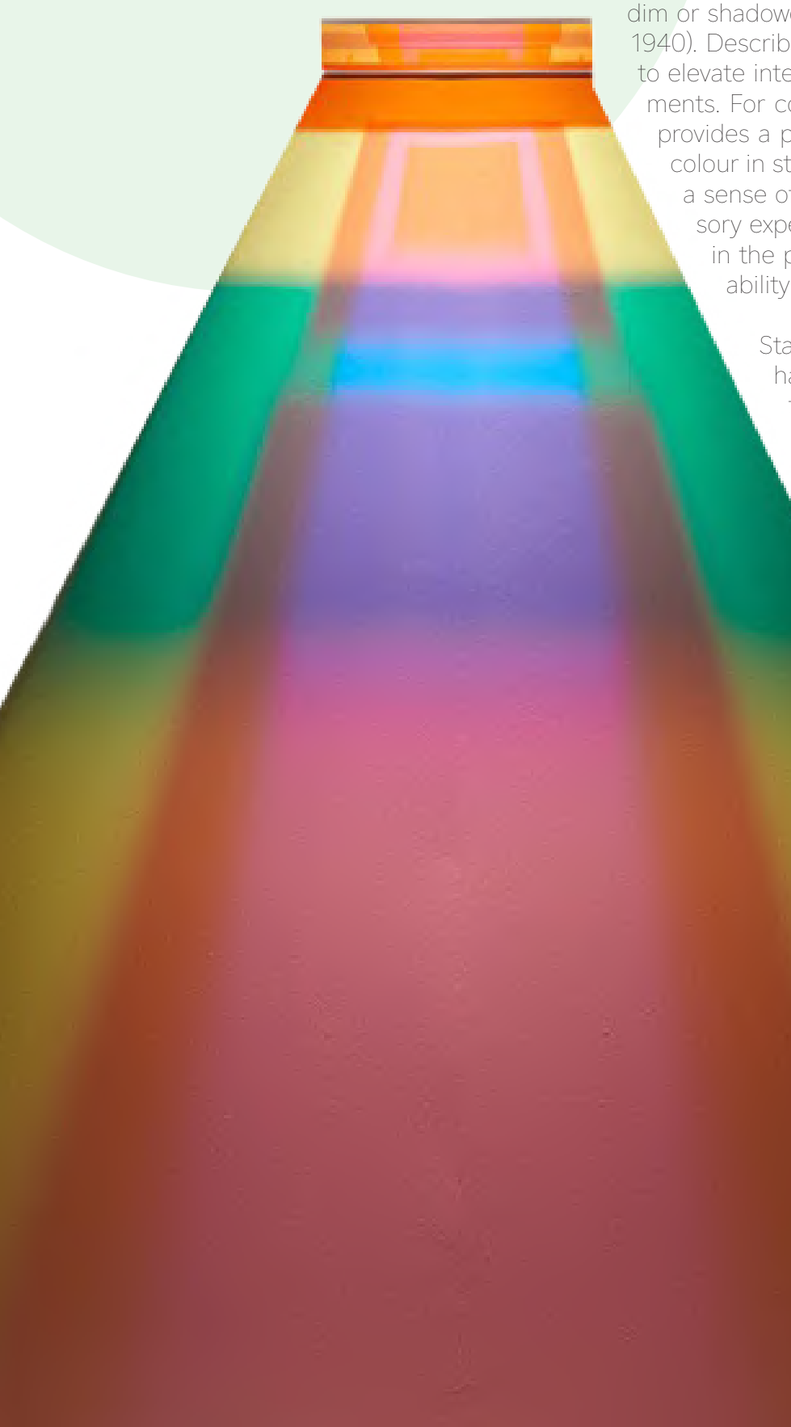
Stained glass has the power to transform otherwise mundane spaces into visually engaging and stimulating environments. It can highlight historic features in heritage buildings or create shifting reflections that mark the passage of time in cultural and religious spaces. Additionally, it serves as a decorative element, projecting contrasting patterns onto plain surfaces to add depth and visual interest. The purpose of stained glass is to replace the "uninteresting effect of ordinary sheet glass" (Hogan, 1940) with the rich, jeweled light it provides. The thickness, texture, and opacity of stained glass can be meticulously adjusted to shape how light enters and interacts with a space, producing patterns and compositions that enrich its character while cohesively aligning with its architectural intent (Wagner, 1986). These patterns, whether structured grid lines or fluid, abstract forms, can be tailored to suit specific needs and preferences. Stained glass doesn't need to rely on colour; clear, textured, or monochromatic options can still create high-contrast, striking effects. Much like the reflections from a crystal glass, stained glass can cast ornate, shifting patterns that introduce movement and energy to otherwise static environments.

Stained glass reflections can mimic textures like rippling water, brickwork, or delicate lace, introducing a rich layer of materiality and depth to a space. For colourblind individuals, these patterns offer more than visual interest; they create a sensory connection that establishes a distinct spatial identity independent of colour (Ostadzamani et al., 2016). When stained glass is integrated into windows, its reflections, both sharp and soft, infuse movement and life into a room, creating a dynamic, continually evolving environment that enhances the sensory experience.

Figure 26: Daniel Buren's stained glass roof panels casting colourful reflections onto the surrounding groundscape

LIT FROM WITHIN: STAINED GLASS AFTER DARK

Figure 27: 'Light installations for Cosa Mentale' showcasing stained glass and its reflected projections on a wall



Artificial lighting, unlike daylight, offers designers precise control and stability, allowing for intentional and consistent illumination (Abdurachman & Adhitama, 2023). Combined with stained glass, it creates adjustable reflections that enhance contrast and enrich spaces. Beyond pure visibility, it conveys emotion, enhances functionality, and promotes inclusivity. By casting vibrant coloured light into dim or shadowed settings, it adds depth and vitality to otherwise muted environments (Hogan, 1940). Described as a "glass painting" (Van Rensburg, 2022), stained glass has a unique ability to elevate interiors, transforming dark settings into visually and emotionally engaging environments. For colourblind individuals, who cannot always rely on natural light for illumination, it provides a practical yet visually captivating solution. The combination of light, contrast, and colour in stained glass creates an atmosphere that is both calming and energizing, bringing a sense of warmth and connection to the space. This balance not only enhances the sensory experience but also highlights its emotional significance. It is pointed out that "even in the poorest home, a piece of glass cheers a room up," (Hogan, 1940) highlighting its ability to evoke positive emotional responses and breathe life into any environment.

Stained glass, historically described as "paintings on (in) the wall" (Van Rensburg, 2022) has the potential to move far beyond decoration, serving as a functional design tool that enhances spatial perception for individuals with colour vision deficiencies. By filtering and reflecting light in predictable and structured patterns, stained glass introduces depth, contrast, and texture into interior spaces, creating a dynamic relationship between light and shadow (Van Rensburg, 2022). Whether crafted into sheets, frames, blocks, or lampshades, stained glass elevates interiors by transforming them into visually engaging environments, imparting "an extra dimension to architectural spaces" (Wagner, 1986) elevating both functionality and beauty. While its effects on orientation remain underexplored, stained glass could support spatial awareness by influencing the distribution of light, subtly defining pathways, edges, and surfaces to aid navigation without compromising its artistic appeal. It may help suggest visual hierarchies, draw attention to edges, surfaces, and boundaries (see Figure 31), and enhance overall spatial comprehension: factors that can be particularly beneficial for individuals with colour vision deficiencies. By uniting aesthetics and purpose, stained glass demonstrates how thoughtful design can craft spaces that are both visually engaging and universally accessible.

Figure 28: Stained glass lamps that may aid colourblind individuals in spatial navigation through their patterns and reflections

Figure 29: Handcrafted stained glass lamp casting patterns and reflections that may aid colourblind individuals in spatial navigation

Figure 30

Artificial lighting offers a wide range of possibilities, from dimmable ceiling lamps to spotlights, backlighting, and wall fixtures, each serving distinct functions. This versatility can be strategically utilized to enhance accessibility and inclusivity for individuals with colour vision deficiencies. Given the limited research on this subject, I have drawn on established principles of contrast, lighting, and spatial perception to explore its potential applications. Consider a stationary ceiling lamp with a stained glass cover. The fixed nature of the lamp and its cover ensures that the light projection remains consistent over time, providing stability in its design. If stained glass integrates structured or geometric patterns, such as grids or defined shapes, it may project light in ways that delineate zones on floors and walls (see Figure 29), supporting spatial comprehension. These deliberate light patterns are regarded as "an important aspect of a successful design" (Manav & Yener, 1999) highlighting the crucial role of light's interaction in spatial perception. By customizing these stained glass designs to cater specifically to the needs of colourblind individuals, designers can intentionally highlight zones or pathways, making navigation more intuitive. In this case, these patterns rely on contrast and texture rather than colour, ensuring clarity and spatial understanding for all users. This approach creates an environment where all individuals can navigate and appreciate the space equally, achieving inclusivity and functionality through thoughtful lighting design.

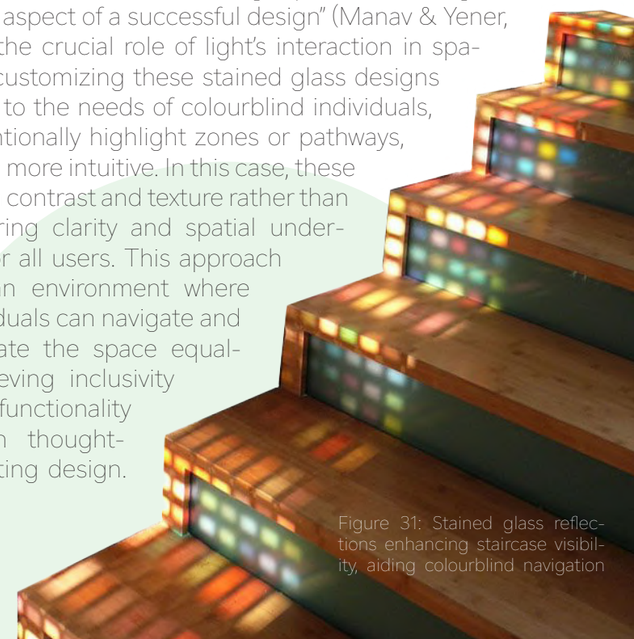


Figure 31: Stained glass reflections enhancing staircase visibility, aiding colourblind navigation

VERTICAL PANORAMA PAVILION

CASE STUDY

Figure 32: The Vertical Panorama Pavilion reimagined with a stained glass interior, showcasing its transformative spatial impact

The Vertical Panorama Pavilion is a permanent art installation located at the Donum Estate, designed by architects Olafur Eliasson and Sebastian Behmann. Visitors reach the pavilion by walking through a grove of trees, an integral component of its immersive sensory experience. Described as "a work of art that interacts with both visitors to the estate and the land itself," this open-air pavilion offers "a new hospitality experience" (Vertical Panorama Pavilion - Signum, 2025), where visitors actively engage with the artwork, stimulating all their senses. The pavilion's canopy, influenced by historical circular calendars, is designed as a conical structure with a diameter of 14.5 meters. It features 832 laminated glass panels in 24 different transparent and translucent shades. The colours are thoughtfully selected to represent four key meteorological elements: solar radiation, wind strength, temperature, and humidity, reflecting the concept of a regional weather calendar (Vertical Panorama Pavilion, n.d.). The pavilion was designed as a unique combination of a wine-tasting venue and an art exhibition, incorporating sensory design to create an immersive experience. Its impact "extends beyond physical boundaries" (Tovar, 2024), inviting visitors to engage deeply with the space and its surroundings.

This case study is particularly relevant for the way the translucent coloured glass panels interact with their surroundings, reflecting hues onto the ground and connecting the pavilion to its natural environment. The reflections maintain their colour, shape, and structure with clarity, creating striking contrasts. Even when viewed in grayscale, the pavilion retains its visual impact, intrigue and engagement; aligning with my research focus on designing spaces that are inclusive and visually compelling, regardless of colour perception.

THE NASIR AL-MULK MOSQUE

CASE STUDY

The Nasir al-Mulk Mosque, commonly known as the Pink Mosque, was constructed between 1876 and 1888 by Mohammad Hasan-e-Memar (Blank, 2018). Its most striking feature is the luminous coloured glass façade that spans nearly the entire structure, showcasing traditional and religious elements. These reflections accentuate the mosque's interior details, such as the famous pink tiles and the calligraphy adorning the walls. Unlike traditional stained glass, the orsi used in the mosque is crafted from a combination of wood and colourful glass, a technique originating during the Qajar dynasty. While stained glass often functions as a light source, orsi acts as "illuminated imagery", enhancing the sacred atmosphere of the mosque by blending light and colour into a "colorful spiritual feeling" (The Archeologist, 2021). The primary purpose of this design is to allow natural, colourful light to flood the interior in high-contrast geometric shapes. Since images and icons are prohibited in Islamic art, the patterns emphasize simple forms, often inspired by floral motifs (The Archeologist, 2021). The best time to experience these remarkable patterns is between October and January, particularly in the early morning hours before 10 a.m., when sunlight is perfectly positioned to illuminate the space with vibrant hues (Bakhtiari, 2025).

This mosque aligns closely with my focus on stained glass, demonstrating how coloured light reflections can accentuate specific details, such as Islamic calligraphy and intricate tilework, while enriching the spatial experience. The shifting sunlight throughout the day creates a fluid interaction between light and space, which not only enhances the visual experience but also serves a functional purpose, such as subtly aiding in the timing of religious rituals like prayer.

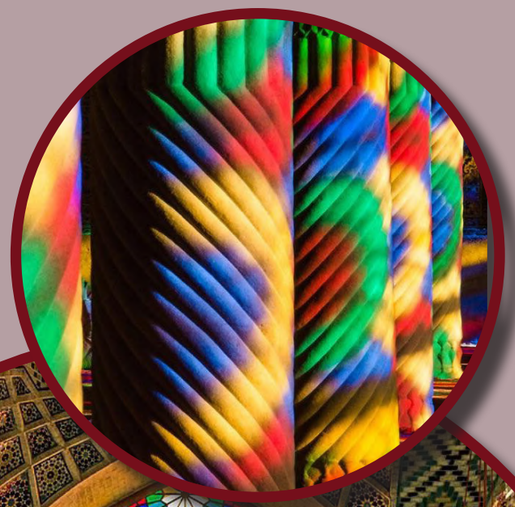


Figure 33

Figure 34

Figure 35

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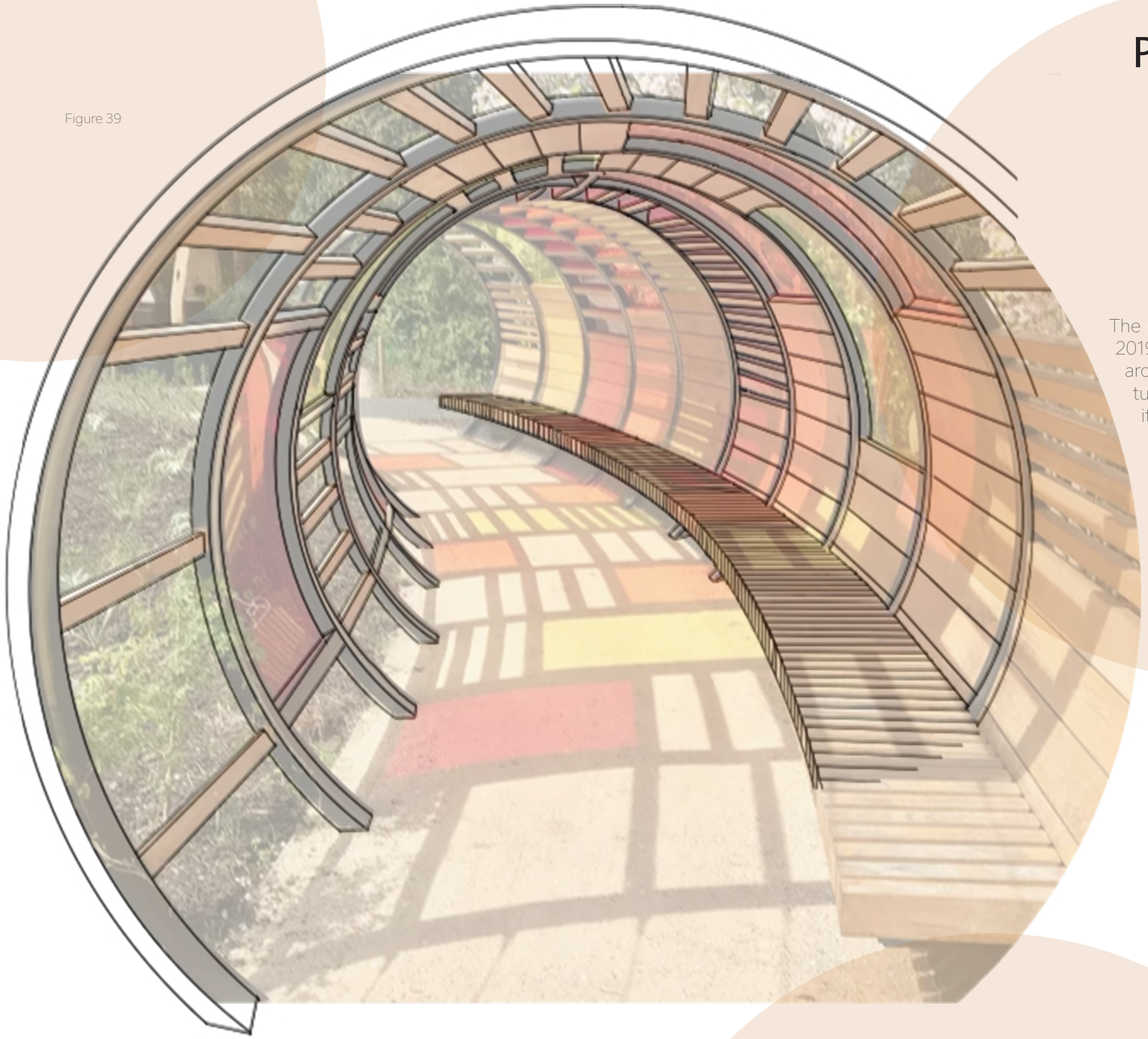

PERGOLA IN THE SUN

CASE STUDY

The Children's Garden at Kew Gardens, opened in May 2019, spans 10,000 square meters and is designed around the theme, "What do plants need to grow?" Featuring zones dedicated to air, earth, water, and sun, it encourages creative play and engagement with nature. Surrounded by mature trees and botanical flowers, it offers an immersive and sensory-rich experience for children (The Children's Garden, Royal Botanic Gardens Kew, n.d.). The 'Pergola in the Sun' interactive sculpture in the Children's Garden at Kew Gardens combines "coloured perspex panels and oak batons" (Graeme, 2019), to create a sheltered seating area and an educational space about nature's cycles. While designed with vibrant colours for children, its distinct contrasts and dynamic synergy of light and shadow align closely with my focus. As sunlight filters through, it casts patterns and tones on the surrounding surfaces, creating a sensory experience accessible to all, including those with visual impairments.

MORE THAN COLOUR

How can we design spaces that are inclusive, functional, and beautiful for colourblind individuals? The answer begins with light: one of the most fundamental and transformative elements of human perception (Manav et al., 2010). Light has the power to illuminate edges, guide movement, and create contrasts that sharpen our understanding of the world. Stained glass embodies this principle, transforming spaces with its reflections and patterns. Its true brilliance lies not in its surface but in the way light brings it to life from within; a metaphor for thoughtful design that is both purposeful and inspiring (Hogan, 1940). By engaging light and texture, stained glass offers a sensory experience that resonates emotionally while meeting the needs of every individual.

To create truly inclusive spaces, designers must adopt intentional strategies. Stained glass can be tailored in colour, shape, and opacity to direct light toward key spatial elements, reinforcing navigation and perception. Likewise, strategic lighting can define pathways, highlight focal points, and enhance spatial clarity, ensuring accessibility for all.

Designing for those with colour vision deficiencies is not a compromise; it is an opportunity to reimagine how light can shape spaces that are intuitive, engaging, and inclusive. To overlook their needs is to miss the opportunity to design with empathy and compassion. Lighting is not merely a practical tool; it is a medium for connection. By embracing its transformative potential, we can create spaces that celebrate diversity, not as a trend, but because it's simply human.

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