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Multi-sensory Design for people with visual impairments

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Multi-sensory Design
For People with Visual Impairment.

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Capstone

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Title:	Multisensory Architecture For people with Visual Impairment
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Abstract

Architectural design commonly focuses on the visual qualities of its manifestation, leaving people with visual impairments aside from its qualitative goals. In order to counteract this phenomenon and appropriately address people with low visual acuity/legal blindness, we must understand the people within this large community as well as current policies focusing on different types of accommodations for spatial practicality. Understanding the people will entail a dive into what a visual impairment is, what it is like, and understanding how people perceive the world as a whole. Then it is necessary to understand current policies that designers have adopted in order to benefit those with physical disabilities by making all space accessible to all people. After establishing an understanding of the current state of the issue we can move forward by breaking down a set of guiding principle that is based on sensory cues. This will lead to an understanding of how to make architecture a multisensory experience for everyone while specifically benefiting those with visual impairments.

Introduction

People with low vision or legal blindness experience the world differently than those with a high level of visual perception. People who have been blind since birth do not struggle as much with living with the condition as it is essentially who they are. However, people who have developed blindness have a very difficult transition into the new lifestyle. Cristina Hartmann, a writer with limited sight and hearing, states that the "most destructive part of losing one's sight is the feeling of incompetence".[1] In the transition period, she broke drinking glasses, stepped on her cats, and would lose her things constantly throughout the day. This can be a very discouraging and frustrating way of life that is also inescapable. Daily routines and habits have to be relearned. An example of a frequent mundane task that becomes altered with an acquired visual impairment is getting groceries. The journey to the grocery store becomes much more difficult as one can no longer drive directly to the desired location. Walking through a city is no longer understood by street signs and built aesthetics but by memory, sound, and smell. A person with low vision can choose to have a seeing-eye dog, a cane, or a sighted navigator to help navigate a city. Cristina Hartmann prefers the white cane strategy as "a white cane doesn't shed, poop, require vet visits, or develop a mind of its own" and a navigator takes away a sense of independence.[2] After arriving at the grocery store searching a list of specific items is altered as braille is not incorporated on aisles, cans, or refrigeration doors. Typically, a legally blind individual will ask for assistance when arriving to the store for help with the hunt, go with a friend, or just order the items online.[3] After the items have been purchased and brought home, one is tasked to put everything in their proper locations and clean fruit and vegetables. Removing stickers from the purchased piece of fruit becomes an excruciatingly tedious task as stickers are not easily perceived. This is just one example of a frequent task that will change after one is diagnosed with a visual impairment.

The understanding of space loses all visual qualities and is replaced by other sensory cues. John hull, a blind professor at the University of Birmingham who lost his vision mid-career, considers himself "a sighted person who cannot see".[4] When visiting places that he already knew, his experience was formed by the visual memories that he had from before he had lost his sight. He argues that the world changes scale after losing the ability to see. New experiences are created within reach of the body, and when life is silent, it also disappears.

The field of architecture is seduced by a common bias of visual optics. While the visual qualities of architectural spaces are important, there should be an equivalent amount of focus and attention brought to the other 4 senses. In this proposal, I will explore how architecture can employ a set of multi-sensory design tactics in order to increase the quality of life and spatial understanding to people with visual impairments. Architecture is inherently experienced by the body. The sense of smell draws memories of our past. The sense of touch provides a haptic understanding of materiality. The sense of hearing gives an omni-directional source of orientation and context. All of the senses are important and should play an integral role within the influence of architectural design. Integrating the senses into the design process will produce engaging and multi-sensory places for the visually impaired and the sighted.

The World Health Organization estimates that 253 million people live with visual impairment in the world.[5] The Center for Disease control and Prevention states that 3.4 million Americans are diagnosed as legally blind, 21 million with medical eye conditions, and 17% of Americans 65 and older have reported to have "vision trouble".[6] This correlates to one out of every five people older than 65. This community is typically overlooked and forgotten by designers since visual content is held to the highest esteem. Good design should account for this group for they are filling the spaces that we produce. How can design focus on a more holistic account for the body that is experiencing it? In this essay, I will identify key strategies of designing for the full spectrum of the senses through the investigation of case studies and a development of guiding principles.

1 Hartmann, Cristina. "What is it like to be deafblind?".
2 Hartmann, Cristina. "What is it like to be blind?".
3 Rogers, Priscilla. "Reevaluating the Best way to do my Shopping as a Person Who is Blind"
4 Hull, John. "Notes on Blindness: Journey Through the Dark".
5 World Health Organization, Blindness and visual impairment, (2017).
6 Center for Disease Control and Prevention. "The Burden of Vision Loss"

What is Visual Impairment?

Blindness is commonly misunderstood by the majority of the sighted. Some believe that if an individual is blind then they do not see anything. All they see is blackness. This not necessarily the case as there is a wide range of visual impairments that would cause someone to earn the title "legally blind". Some people that are "legally blind" will have trouble seeing the focal point of what they attempt to focus on where others can only see the focal point and no peripheral information. There is currently a process in place that determines if one can qualify for the term.

The world health organization estimates that In the United States, 26.9 million adults (18+) currently experience low vision, legal blindness, or total blindness.[7] Blindness is categorized and reported by a ratio derived from the "Snellen eye chart". The process determines an individual's vision acuity by testing the sharpness of their vision with the distance from the chart.[8] Someone with 20/70 vision standing 20 feet from the Snellen eye chart can only see what a person with 20/20 vision (perfect vision) can see 70 feet from the chart. Within the results of this common test are three categories of visual impairment; low vision, legal blindness, and total blindness.

This is a cut and dry way to define a visual impairment (as there are other types of blindness within this category) but it allows for patients to qualify for disability benefits. Within all three of these visual impairments are several different eye conditions that will cause individuals to see the world in a different way. Cataracts, Glaucoma, Macular Degeneration, and Diabetic Retinopathy are some of the most common eye conditions that will cause a person to fall into any of the above discussed categories. Common issues faced is depth perception, reduced visual field, sensitivity to glare, and difficulty adjusting from light to dark. When designing for the "visually impaired" it does not mean that the design can eliminate visual aspects completely but should design visual cues to help with those living with these conditions. It also means that all design should use a multi-sensory approach. Designs should focus more on the touch, sound, and smell of spaces in order to reach all people with all perceptions of the world around them.

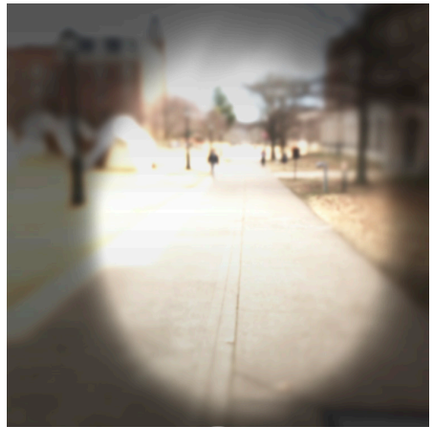
7 American Foundation for the Blind: Statistics about children and youth with vision loss. (March 2019)
8 World Health Organization, Blindness and visual impairment, (2017).

Low vision is diagnosed when an individual scores a 20/70 or lower on the Snellen eye chart.[9] This person "has measurable vision but has difficulty accomplishing or cannot accomplish these tasks even when prescribed corrective lenses" (Corn & Lusk, 2010, p. 4-5). This is the most common range in visual impairments as 2.9 million Americans 40 and older fall into this category. (AFB).

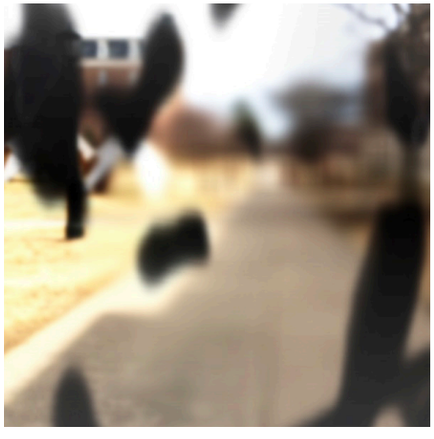
Legal Blindness requires an individual to score a 20/200 or lower on the Snellen eye chart while wearing correctional eyewear. With this impairment, you can only read the top line of the chart at 20 feet away.

Total blindness is the rarest of the visual impairments. It is diagnosed when an individual has an inability to see anything. Their eyes have no light perception. This is a cut and dry way to define a visual impairment (as there are can be influences affecting the way in which one sees) but it allows for patients to qualify for disability benefits.

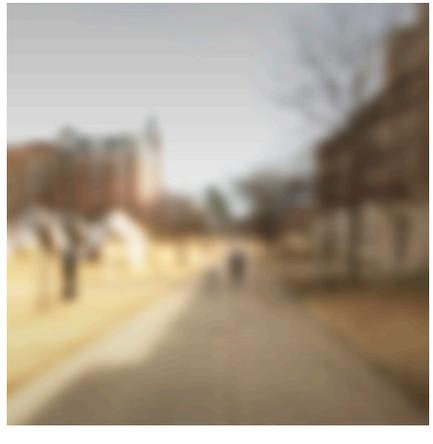
Glaucoma



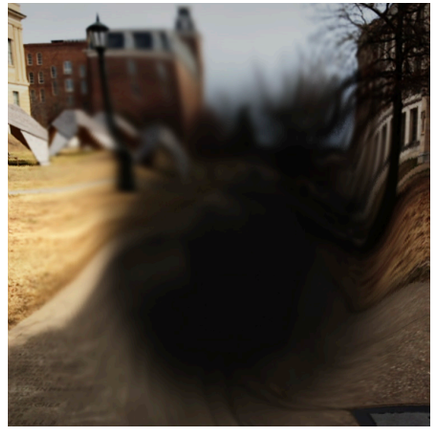
Diabetic Retinopathy



Cataracts



Macular Degeneration



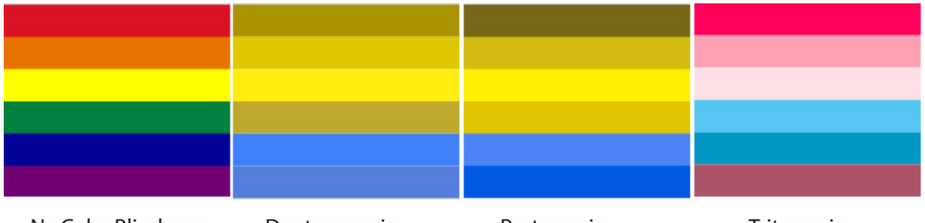
9 American Foundation for the Blind: Key Definitions of Statistical Terms. (August 2017).

Color Blindness

Another form of blindness is color blindness. It is estimated that 5% of males and 1% of females have an inability to perceive colors from each others.[1] Color blindness does not affect the visual clarity of a persons surroundings but will create issues with differentiating certain colors from others. The most common type of color blindness is a difficulty in perceiving the difference between red and green.[2] The following most common is the inability to differentiate yellow and blue. The lack of perception of any of the colors is possible but very uncommon.

Living with color blindness is not as life altering as some of the previous eye conditions discussed. It does however create difficulty seeing the difference between colors, the brightness of colors, and different shades of colors. Web designers will take this into account when laying out a website. They will make the important content such as links and buttons visible with a high contrast ratio of color. The colors used on the website should be on opposite ends of the color range allowing for a high value contrast when seen in a monochromatic lens. Black text on a white background is the best example but there my be variation in the menu and navigation of a website. Navigation should stand from the body of the website. If an element is meant to stand out (URL Link) should not only be differentiated by color but by another aspect such as underlining it or size. Transit maps also suffer from being confusing for those with color blindness. Routes are typically color coded in order to differentiate the multiple courses. This can cause a misreading of green route from the blue route. Designers need to take this into account when making graphics. Design should be accessible to all types perception. Using programs like Photoshop one can easily check to see if the colors need to be adjusted in brightness or hue. This will allow design to not be compromised but to be enhanced and pleasuarbale to everyone.

1 Usability.gov. Improving the User Experience. "Color Blindness & Web Design."
2 National Eye Institute. "Color Blindness".



No Color Blindness | Deuteranopia | Protanopia | Tritanopia

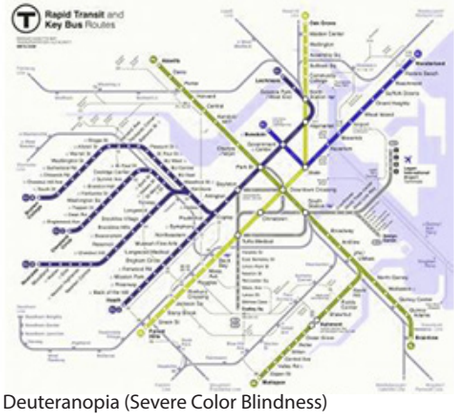
99Designs. "Why all designers need to understand color blindness".

Regular Google Logo

Red Green & Red Yellow Color Blindness.

Ficket, Matthew. "Color Universal Design and Architecture". Payette.

Normal



Deuteranopia (Severe Color Blindness)

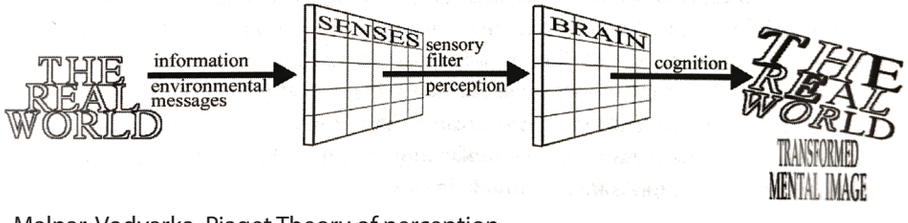
Perception

Understanding how we perceive the world is important when discussing sensory design for a visual impairment. Most people think that vision and perception are the same thing as most of our day is guided by vision.[10] However, vision is different than perception. Vision occurs when light and images go through the eyes while perception is how the brain interprets and makes sense of those light signals. After our eyes react to a stimulus, it moves the information into our brain in order process what it is picking up. The understanding and processing of our surroundings is not only from our eyes but combined with information from the other senses to build an entire picture. Tornado warnings are perceived through our ears, a potential gas leak is picked up through our nose, and an involuntary reaction against a hot pan is through touch. perception of our environment is a complex topic and has been extensively researched.

One of the earliest understandings of perception is the Gestalt Theory. One of the ideas in Gestalts theory is that an understanding of our environment is filtered through a figure ground process. Perceiving an object is achieved by the brain reading the edges or profile of a physical object and labeling everything else as "background". The size of the profiles allows for an idea of distance.[11] While the brain is processing individual figures, there is a holistic approach to understanding the parts. A common phrase within this field of thought is that "the whole is greater than the sum of its parts." A very important point in Gestalt theory is the idea of closure. This is the idea that when we perceive an element that appears to be unfinished or incomplete, the brain will piece it together in order to understand it for what it is. The brain is able to do this because it is constantly picking up patterns and referencing cues from previous perceptions.

In a later theory of perception, Piaget's theory, perception is based on an individual's own built up experience.[12] It is not a universal way to understand perception since everyone will have different backgrounds, but it helps to understand a process to it. Piaget states that the world is taken in through the bodies senses, then processed through the brain, and then re-presented into the perceived elements own category. All of this is a way to understand and organize the world around us.

Understanding space through edges and profiles will serve as basic principle when designing for people with a visual impairment. An articulation of edges and profiles through materiality, color, and texture will produce a sense of clarity for depth and the physical environment. The ability to categorize sounds and smells as pleasant or unpleasant will also play a role in this venture as people have attached meanings and ideas to all sensory intake. The smell of an apple orchard in the spring is a pleasant experience as it will inevitably bring an individual's memories of this fragrance into the overall constructed experience.



Malnar. Vodvarka. Piaget Theory of perception.

Policy

Now that we have developed a basis of understanding for what "visual impairment" means, what it is like to be "legally blind", and how visual perception is understood, we can move into Policies of disabilities. I will focus on two policies that designers will refer to known as Universal Design, and ADA. Both offer insights into the development of the view and actions towards disabled community as well as architectural barriers that have had to be heavily investigated in order to allow for equal access for everyone. Both policies make the statement that design should have a zero-tolerance policy for any type of discrimination toward any kind of people group. Design brings order and joy to the built environment and should allow for all and everyone to be a part of it. As we move forward in history we become more and more connected to one another leaving physical and social barriers an idea of the past.

Universal design is a design lens which looks to benefit the widest range and variety of people in the world. It pushes designers to produce good design that can potentially meet all of the needs of all people that would use it. It is intended to allow for proper access, understanding, and use by all age groups, size, ability, and disabilities. This has become considered a way to measure if a design is good as the use and joy of a design is the fundamental goal of what designers attempt to achieve. Its goal is to account and bring joy to everyone.

In the twentieth century, extreme medical advancements allowed for people to live longer and a more productive life with physical disabilities. With injured soldiers returning home from the war and people living longer into their elder years, there was a quick realization that accommodation must be made to account for this wide array of lifestyles. This manifested in a strong push for equal rights in government legislation. This brought a large amount of attention to the design community as they understood that it was necessary to begin to create accessible and usable products and environments. In the 1970's, barrier free environments were becoming the norm as it was a growing concern to account for people in wheelchairs .[13] It also became implemented in all products to be as easily used and understood as possible. This practice began to inform designers from the beginning stages of the design process. In 1997 seven principles of Universal design was written by Ron Mace and a committee of 10 at North Carolina State University.[14] The principles were used as way to evaluate existing designs and to guide those currently practicing both in product design and in spatial design. Essentially, universal design is good design that focuses on the users in all conditions.

3D Printed Sculpture:
Allows for equal experience for both sighted and non sighted

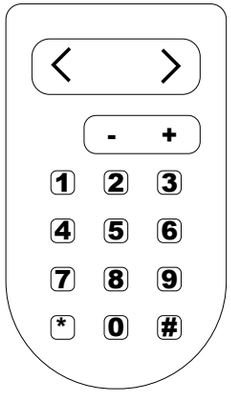
Principle 1: Equitable use.

It will provide appealing, equal, and identical means of use for all people by not segregating or stigmatizing any of the users. People with a visual impairment (and everyone else) require equal use and understanding of information. Art museums will often exhibit 3D printed replicas of famous works of art in order to allow for people with visual impairments to experience the art in a tactile nature. This begins to allow for an equal experience for both the sighted and non-sighted in the art scene.

Accessibility Settings:
iphone can be used by sight or listening.

Principle 2: Flexibility in use.

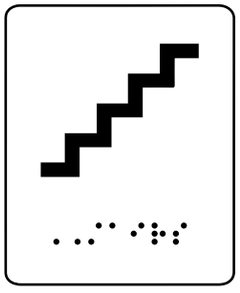
This means that the design brings a variety and adaptability to the method of use in order to accommodate for a variety of conditions. Objects like automated teller machines (ATM) practice this step as it gives tactile and audible feedback to those with a visual impairment. More and more this becoming regularized as iPhone's have a "VoiceOver" tool that will explain what is occurring on screen to help aid those with low vision. This provides an alternative way to use the tool that adjusts to those with different types of needs.



Remote w/ Raised Lettering:
Easily understood by just feeling it.

Principle 3: Simple and Intuitive Use.

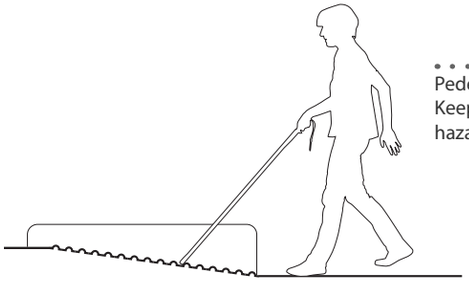
Design should be simple and consistent with the expectations of the users in order to avoid an unnecessary complexity. Refining elements for the visually impaired to be simply understood should include high contrast when separating elements such as edges, light switches, and fixtures. When holding an object, like a remote, there should be a clear front and back to the object. Objects should read as they are without a level of complexity to ensure it. In regard to people with a visual impairment, the understanding edges and profile either through touch or limited sight is very important when bringing clarity.



Stair Signage
Can be understood by sight and touch

Principle 4: Perceptible Information

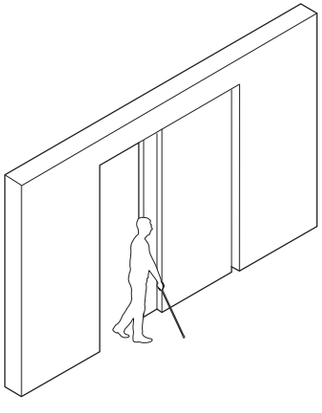
The presentation of information should have a variety of techniques and effectively contrast surroundings in order to effectively convey information to a user. Information should appeal to the eyes (with clear contrast, size, and font), the skin (with raised lettering and/or braille), and the ears (with audible information). People with low vision or blindness rely heavily on touch and hearing to perceive information so any necessary information such as building maps, fire exits, street signage, or room keys should have this applied to its manifestation.



Pedestrian Curb Detail:
Keeps pedestrians aware of hazardous edges.

Principle 5: Tolerance for Error.

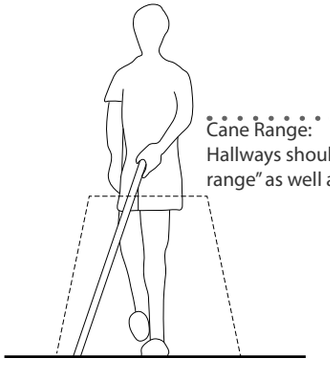
Designed elements must be arranged in a way that minimizes hazards and errors. This implies that a design would not support unconscious activity while supporting an action that requires vigilance. Warnings are incorporated as a way to provide safety to the users. For visual impairments things like curb edges and stair landings need to be appropriately details to provide warning to the user. The detail should send a message through the supposedly used cane to the user stating that there is an upcoming level change. This will provide a sense of safety and awareness to users with a visual impairment.



Automatic Door:
Requires no physical effort to walk through.

Principle 6: Low Physical Effort

This states that design should avoid required physical effort for the users. It is encouraged that people should be able to "maintain a neutral body position" while experiencing the design and is minimizes the physical effort required. This does not apply directly to people with visual impairments but to everybody. For example, the weight of a door should have an appropriate weight in order for users to be able to open it with ease. Stairs and ramps should maintain a reasonable pitch of incline to avoid fatigue from the users.



Cane Range:
Hallways should accommodate the "cane range" as well as the person.

Principle 7: Size and Space for Approach and Use.

Designs should have a clear line of site, appropriate reach for both seated or standing orientation, appropriate hand / grip size, and provides necessary space for potential elements or assistance. The height and placement of handrails, elevator buttons, door handles, light switches, and soap/towel dispensers should be consistent throughout all spaces to help those with low vision with there location.

ADA. While Universal design was a set of guidelines for all people in all conditions there is another set of principles that focuses on those with specific disabilities. "ADA Standards" (Americans with Disabilities) creates a standard for quality control in regard to disabled users.

It began with the independent living movement which challenged the idea of segregation and institutionalization of individuals with physical or mental disabilities. Before, people fell into the idea of "out of sight, out of mind". In 1973 "rehabilitation act" which "banned discrimination on the basis of disability by recipients of federal funds.[15] This caused ignorance towards those with disabilities to truly become viewed of as discrimination by the public. This act stated that even though there is a wide array of disabilities (mental / physical), this group suffered from similar struggles in regard to employment, education, and access to society. After a continuous fight for legislation, in 1988, witnesses of blindness, deafness, down syndrome, and HIV infection spoke of the social and architectural barriers that have been a part of their lives without a second thought from the public to the Senate Subcommittee. The feeling of discrimination had nearly defeated them. After this, the running president Bush made this top priority and a strong factor in his presidential campaign bringing a large amount of attention to the issue. By July 26, 1992, the act was passed and implemented bringing action towards the accessibility for those with disabilities.[16]

The American with Disabilities act became a standard manual focused on architectural designs requirements for making spaces accessible for people with disabilities. The types of conditions that the standards address are old age, walking disabilities, deafness, and blindness. In regard to blindness, the main focus of the "ADA Standards" is to eliminate any obstacles (wall protrusions, slippery floors, level floors) that would potentially harm a user with a visual impairment. The standard also lays out ideal signage for architecture that will help people with low vision still have access to the information. This is done by having a strong contrast between the figure and background as well as incorporating braille and raised lettering into the signs (or elevator buttons).

Advisory 407.2.1.3 Clear Floor or Ground Space. The clear floor or ground space required at elevator call buttons must remain free of obstructions including ashtrays, plants, and other decorative elements that prevent wheelchair users and others from reaching the call buttons. The height of the clear floor or ground space is considered to be a volume from the floor to 80 inches (2030 mm) above the floor. Recessed ashtrays should not be placed near elevator call buttons so that persons who are blind or visually impaired do not inadvertently contact them or their contents as they reach for the call buttons.

Advisory 307.2 Protrusion Limits. When a cane is used and the element is in the detectable range, it gives a person sufficient time to detect the element with the cane before there is body contact. Elements located on circulation paths, including operable elements, must comply with requirements for protruding objects. For example, awnings and their supporting structures cannot reduce the minimum required vertical clearance. Similarly, casement windows, when open, cannot encroach more than 4 inches (100 mm) into circulation paths above 27 inches (685 mm).

4.4.2 Head Room. Walks, halls, corridors, passageways, aisles, or other circulation spaces shall have 80 in (2030 mm) minimum clear headroom (see Fig. 8(a)). If vertical clearance of an area adjoining an accessible route is reduced to less than 80 in (nominal dimension), a barrier to warn blind or visually-impaired persons shall be provided (see Fig. 8(c-1)).

A4.30.2 Character Proportion. The legibility of printed characters is a function of the viewing distance, character height, the ratio of the stroke width to the height of the character, the contrast of color between character and background, and print font. The size of characters must be based upon the intended viewing distance. A severely near-sighted person may have to be much closer to recognize a character of a given size than a person with normal visual acuity.
4.30.4 Raised and Brailled Characters and Pictorial Symbol Signs (Pictograms). Letters and numerals shall be raised 1/32 in (0.8 mm) minimum, upper case, sans serif or simple serif type and shall be accompanied with Grade 2 Braille. Raised characters shall be at least 5/8 in (16 mm) high, but no higher than 2 in (50 mm). Pictograms shall be accompanied by the equivalent verbal description placed directly below the pictogram. The border dimension of the pictogram shall be 6 in (152 mm) minimum in height.

4.30.5 Finish and Contrast. The characters and background of signs shall be eggshell, matte, or other non-glare finish. Characters and symbols shall contrast with their background--either light characters on a dark background or dark characters on a light background.

4.34.5 Equipment for Persons with Vision Impairments. Instructions and all information for use shall be made accessible to and independently usable by persons with vision impairments.

A4.13.12 Automatic Doors and Power-Assisted Doors. Sliding automatic doors do not need guard rails and are more convenient for wheelchair users and visually impaired people to use. If slowly opening automatic doors can be reactivated before their closing cycle is completed, they will be more convenient in busy doorways.

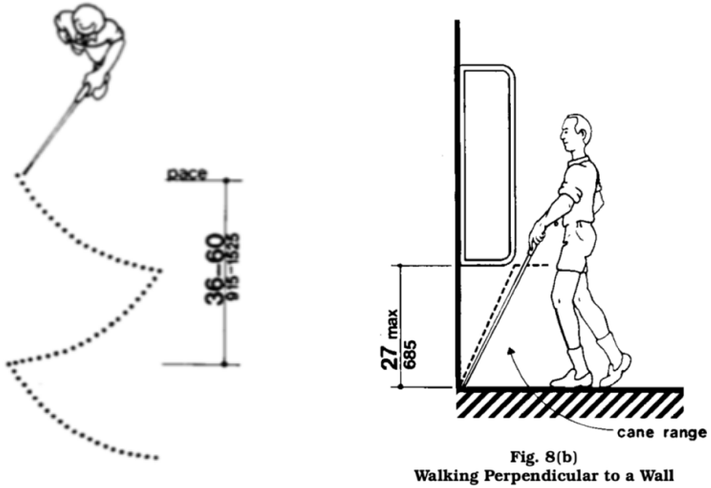
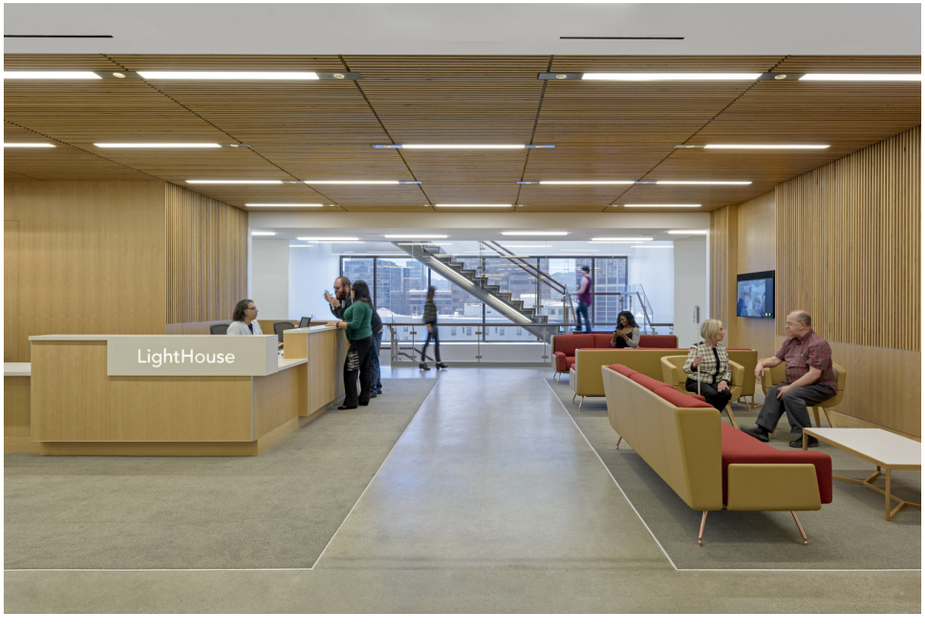


Fig. 8(b)
Walking Perpendicular to a Wall

Principles

Now that we understand what blindness entails and what policies have been developed to accommodate the disabilities, we can now take a phenomenological approach to the topic at hand. It is one thing to accommodate for people in a pragmatic point of view but in order to enhance the qualities of architecture, we must envision the overall experiential aspects of what the senses can bring. Designers take utilitarian ideas and make them into something unique and enjoyable for the individuals who will interact with the product. First, I will walk through the senses. This is necessary as the sensory organs are the key into unlocking architecture that is experienced in a multi-sensory fashion. Then, by looking at numerous case studies, I will discuss how they use design to enhance the senses. Thirdly, a set of multi-sensory principles will be formed in reaction to specific architectural elements (doors, walls, floors…etc.)

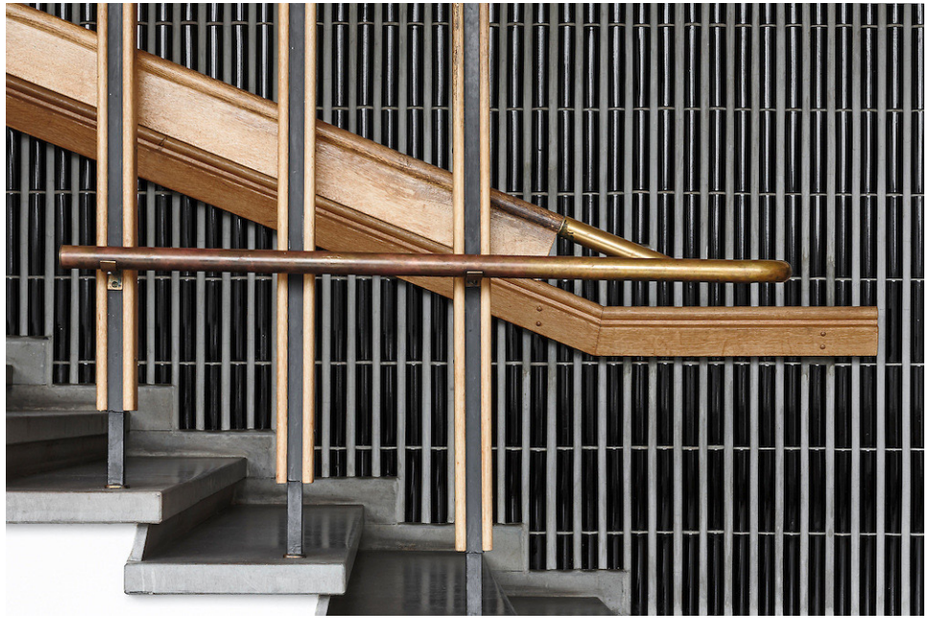


Downey. Lighthouse for the Blind and Visually Impaired.
Floorshavelowreflectivity.Materialsaredelineatedwithhighcontrastedges.
Signage is large and readable.

Sight is commonly thought of as being the noblest of the senses.[17] It is the easiest to appreciate and understand for the sighted. It allows for the understanding of objects in close proximity and great distances as well as compositional beauty. In current architectural practice, architects often design the building for its image and visual aesthetics. Pallasmaa argues that this has left "the body and the other senses, as well as our memories, imagination, and dreams homeless".[18] A design that focuses on vision alone is 2 dimensional. It fails to enhance the lives or spirits of the occupants. Visual optics, when dealt with appropriately, must be integrated into the other aspects of the building that the other 4 senses interact with. They reinforce one another.

As stated earlier, people with visual impairment are not completely detached from sight. A very small amount of people has total blindness. When a person has a visual impairment, they can still see color, light, and shapes. It is however more difficult to understand the world visually as this group will lack a certain level of visual acuity. Light plays a large role when designing for the visually impaired. Harsh beams of light or glare will result in a very uncomfortable experience as their eyes will tend to be much more sensitive than those without a visual impairment. When picking materials for a space with natural light, one must avoid a strong sun glare at all cost for this is a very unpleasant experience. Colors should be used to delineate objects in a space such as tables, stair treads, light switches, handrails, etc. This is important for when a space is primarily monochromatic a person with a severe visual impairment will not be able to perceive the different elements that make up the space. Contrasting colors should also be used to define different spatial zones (waiting area vs. reception) as a way to bring a better understanding of the way in which a space is programmed and used.

17 Pallasmaa, Juhani, The Eyes of the Skin, (Great Britain, Wiely-Academy, 2005), 15

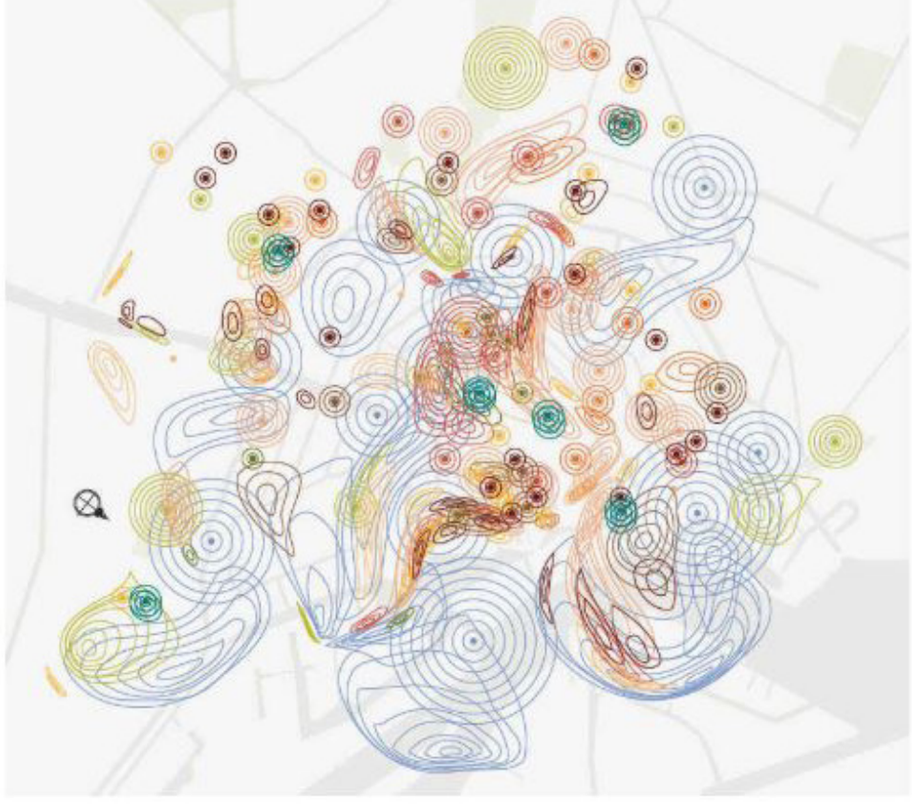


Alvar Aalto. Aalto University.
Handrail is comfortable to the touch.
Natural transition at end.
Wall has tactile ceramics applied pleasing he hand when brushed accross.

Touch gives a view of the world at bodies' reach. Pallasmaa claims that all senses are an extension of touch. He states that "the senses are specializations of skin tissue, and all sensory experiences are modes of touching and thus related to tactility".[19] Upon losing the sense of sight, the sense of touch is naturally enhanced. In John Hull's audiotapes on the Notes on Blindness he describes how the beauties of the world begin to shift after losing sight. He states that a "nice day" no longer corresponds to clear blue sunny skies but to a day that possesses a mild breeze.[20] A breeze picks up and carries scents and sounds of the world and touches the body with its consistent manner.

Within architecture, the sense of touch is activated where individuals come into physical contact with the building. Handrails, doorknobs, floors, and furniture all become an opportunity express materiality and carefully play with thoughtful ergonomics. Alvar Aalto designed handrails to be comfortable to the touch over time and to provide organic transitions while turning a corner. Aalto designed the handrails primarily out of wood so that they would age with the numbers of hands that slide across it. The sensation is pleasurable to the touch for it reflects the slow process of its formation. Museums offer exhibits that allow blind occupants to touch sculptures and sometimes paintings. This offers to the visually impaired a means to seeing beauty through a haptic experience. Designers must pay attention to temperature, materiality, air movement, and ergonomics as a way to design for the skin.

Smellmap.Amsterdam.KateMcLean.



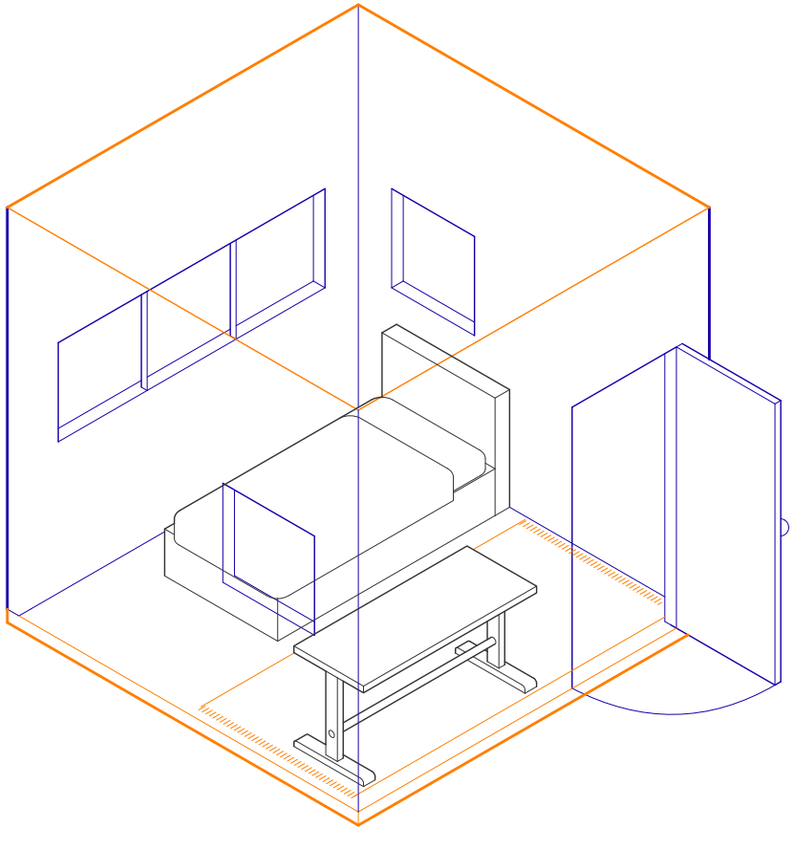
Smell has a direct effect on the experience of a space. Pallasmaa states that "The strongest memory of a space is often its scent"[21] which is ultimately true. If an individual can remember a smell after a single day, then they tend to remember that smell for a much longer time. Odors are understood as either being ambient or source perceived.[22] When an odor is ambient, it means that a smell will fill a space and become a strong piece of the perceived atmosphere of a space. A source odor is a specific point of origin and will increase or decrease in intensity as proximity varies. When dealing with weather to enhance or dampen a particular scent one must evaluate the odors intensity, quality, and acceptability. This will provide direction when designing based on olfactory qualities.

Olfactory design is fairly prominent as people have noticed that smells will influence human behavior. New car smell is used by salesmen as it helps to sell older and used vehicles. the smell of freshly brewed coffee and baked cookies is used to sell homes. This is due to the odors producing a sense of homeliness and warmth. Lemon and peppermint has been incorporated in the ventilation system in offices to help employees focus. These particular scents are found to provide a feeling of alertness and bring a sense of energy.[23] Another way in which scent has been incorporated in design are Japanese restrooms using materials like cedar as a way to fill the space with a lasting clean, citrus-like scent.[24]

Daniel Libeskind, Michael Arad, Peter Walker. 9/11 Memorial. New York City.
Sound of the water feature is what creates the sense of space.

Sound is a powerful tool for orientation and understanding of atmospheric qualities. Where vision is a direct means to viewing, sound is an omnidirectional source.[25] For the visually impaired, sound is the equivalent to seeing as it allows for an understanding of distance and character of space. The sound of traffic in the distance. The crashing of ocean waves. The laughter of children playing. These are warm sounds to the ear that offer a sense place in the world. John Hull writes of the "blanket of differentiating sounds" produced by rain. He describes rain as "uninterrupted, which fills the hole of the audible environment... if only there could be an equivalent to rain falling inside, then the whole of a room could take on shape and dimension".[26]

Understanding sounds as either desirable or undesirable is important since design makes the decision to either enhance the sound or absorb it. A low to middle frequency is preferred by most and sounds that are unrelenting, loud, and high pitched tend to be unpleasant. It is also ideal for the sounds to be informative and responsive to the inhabitants.[27] Responsive sound is a result of materiality being used in a way that is reactive to an individual's action. a crushed gravel ground results in a pleasant sound when being walked across. Hard floors and walls provide an echo when walking through the space allowing for a spatial understanding. Sound is always a reaction from some sort of disturbance or action. Chairs scrapping against the floors, cars zooming past a window, glasses clinging against a ceramic plate. Pallasmaa states that "dripping water in a cave demonstrates how the ear can carve a volume out of darkness".[28] The 9/11 memorial in New York City displays how sound can be used as a way to carve a space in the middle of a hectic city. The constant sound of the waterfalls engulfs visitors making the surrounding city disappear and brings focus to the void of the destroyed building.



Framework

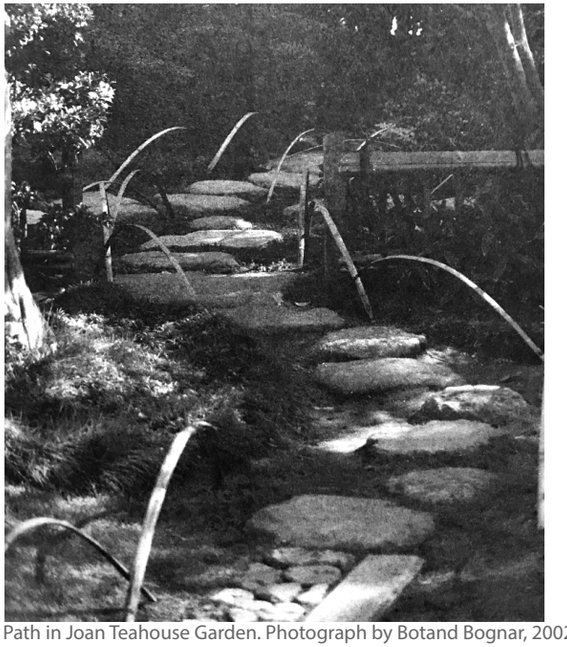
Defining the primary qualities that the eyes, ears, nose, and skin react to allows us to make a definitive judgment of a space's multisensory qualities. The eyes react to color, light, edges, and motion. The ears react to sound waves created by materials, echoes, absorption, and peripheral noise. The nose reacts to fragrances of materiality, air movement, and objects within a space. Skin reacts to temperature, humidity, and air movement and is activated through physical contact. If one is designing a multisensory space, checking through the list will focus the design to be geared toward a holistic experience for the entire the body. As I discuss existing principles of multi-sensory architecture, I will break down the architectural elements into three categories: horizontal, vertical, and entourage. The horizontal elements focus on things such as floors, ceilings, and wayfinding through a space. The vertical is about walls, doors, stairs, and windows. Entourage is about objects within the space such as signage, utensils, fixtures, and furniture.

302.1. Horizontal / Floor. In certain environments, floor surfaces will require consistency. Floors in front of elevators or corridors within hospitals will certainly require a level of consistency as well and wheelchair access. ADA states that "stable and regular surface is necessary for safe walking" regarding those who have trouble walking. A ground surface with a variation in material / height will make the user engage with it more than if the surface is perfectly level and monochromatic. Malnar explains that when a walking surface is articulated in this way then the head will tilt downward to take in what is to come. "this suggests that uneven pathways heighten our awareness of surfaces by obliging us to bring our sensory organs into best alignment to perceive them.".[1] Stone pavers or gravel will make a surface more engaging to the body. The whole body will react to a surface that has more variation in it. However, this will bring potential hazards to those with visual impairments. To successfully achieve this tactic for visual impairments, the gravel must be finely crushed and levelly spread bringing variation in the step and sound without adding tripping hazards. Crosswalks can be constructed in a contrasting material such as brick which will cause an individual walking or driving across to have a brief change in mindset. Often this slows down the passage and makes it more experiential and multisensory sense it will inevitably cause the entire body to react to the change.

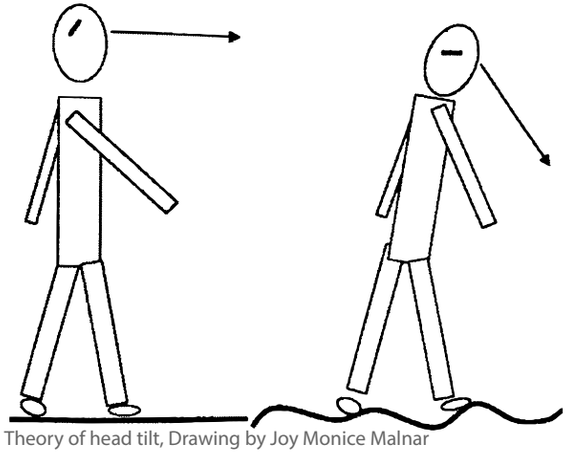
Another factor to consider when designing a floor for a visual impairment are the materials reflective and sound qualities. If a floor is too reflective then it will cause a harsh glare to shine onto potentially sensitive eyes. The material should be somewhat absorbent of light as a way to counteract glare. Materials should also take into account the sounds that will be produced when feet and canes move across it. Carpeting can be very confusing for people with low vision since it takes away the ability to hear others approaching them. The sound of feet foot traffic brings rhythm and an understanding of surrounding activity as well as the scale of a space when echoed.

"Theory of head tilt, Drawing by Joy Monice Malnar"

"Path in Joan Teahouse Garden, 1618. Photograph by Botand Bognar, 2002"

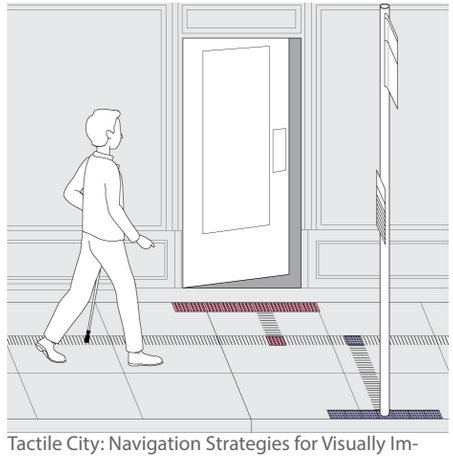


Path in Joan Teahouse Garden. Photograph by Botand Bognar, 2002



Theory of head tilt, Drawing by Joy Monice Malnar
Variation in ground activates the body to engage with the ground

301.2. Horizontal / Wayfinding. While Variation in materiality and texture can enhance the experiential quality of movement, it can also convey information to those with a visual impairment. A project in New York City called "Tactile City: Navigation strategies for visually impaired New Yorkers" addresses this directly. They propose to apply an informative texture along all of the sidewalks in New York City. The texture will be registered through the touch of the cane and guide the New Yorker through the city. The textured pattern will have variations in its spacing as a way to call out elements like trash cans, cross walks, construction zones, and doorways. Construction detours would additionally be called by an audio signal informing visually impaired pedestrians of what is to come ahead of their journey. This type of treatment has already been incorporated in spaces such as museums, hospitals, and airports. The guided texture can be applied to almost any surface as a vinyl covering (which can also house wiring) or better yet, carved into the floor (Neus museum, Berlin, Chipperfield). Lighthouse for the blind has expanded this by producing tactile maps as a means for planning out one's journey since paper maps are for eyes alone. This map is produced with physical bumps (similar to braille) that can expand on detailed information by running a pen over it.
Treating a horizontal surface with informative tactile cues will provide an informative sensation to visually impaired pedestrians. It provides a sense of security as well as independence when finding ones' way though the city, store, or museum.



Tactile City: Navigation Strategies for Visually Impaired New Yorkers. Cooper Union.

MAC House. So So Architects.

Neus Museum, Berlin, Germany, David Chipperfield

Horizontal

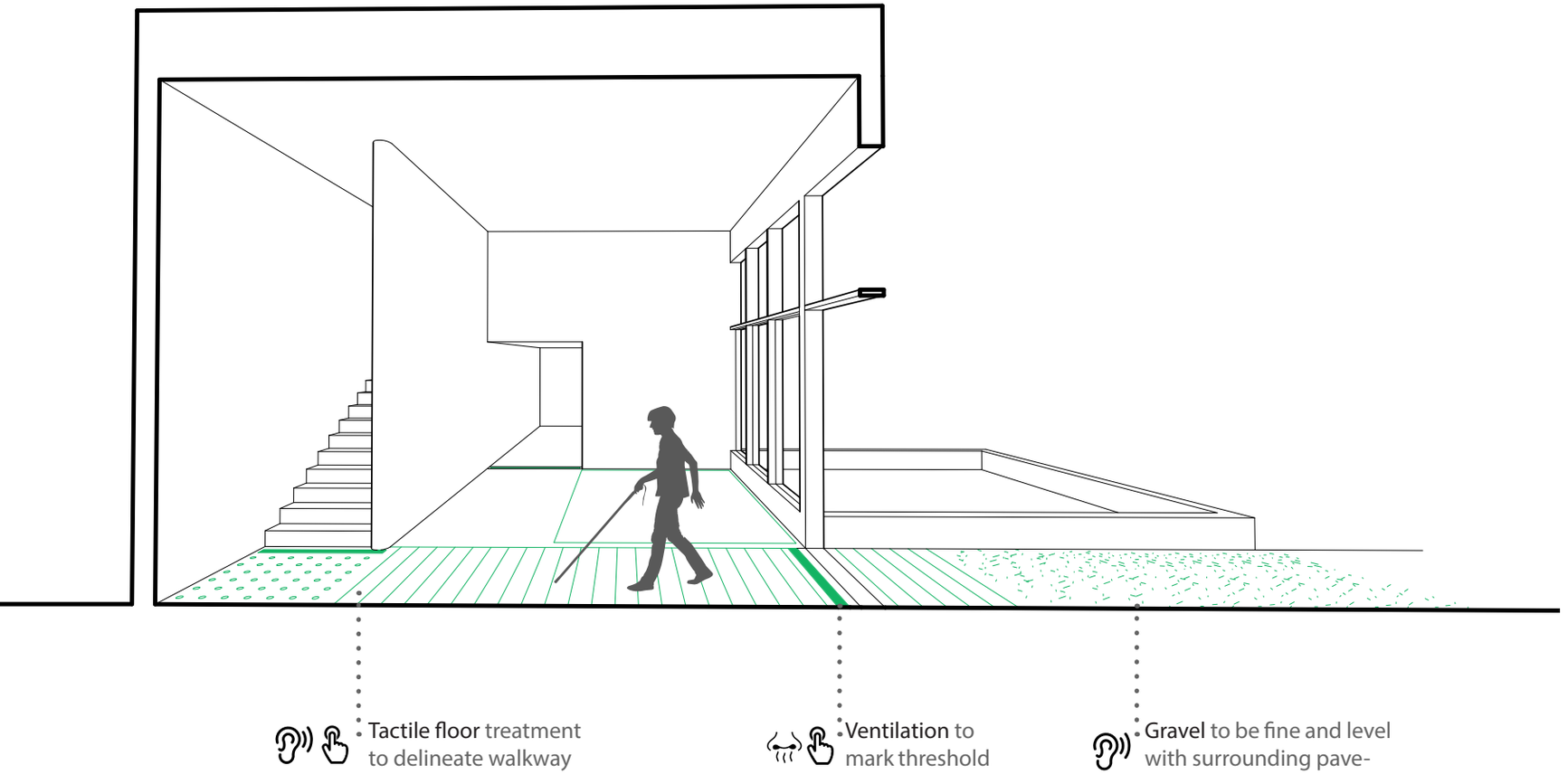
-Consistent grade to avoid tripping hazard

-Floor material to produce audible sound when walking across

-Contrasting material to demarcate zones

-Material to be non-reflective

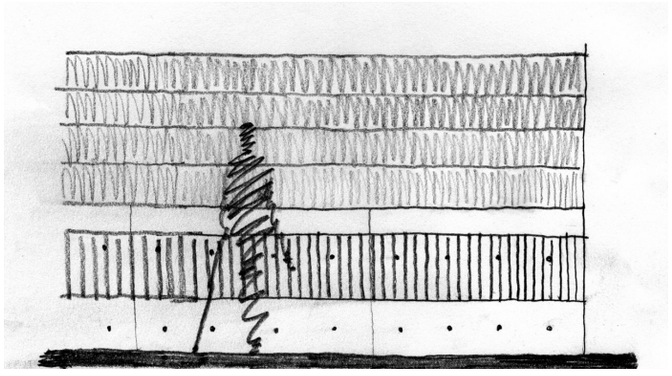
-Tactile information to inform



302.1. Vertical / Walls. Similar to ground surfaces, walls are typically advised to be treated in an extremely consistent manner. ADA advises in 307.2 to treat protrusions from walls very carefully in order to avoid having people with a visual impairment come into undetected contact with the element. The manual advises for elements to not exceed more than 4 inches of protrusion when greater than 27 inches off of the ground. This allows for people with a visual impairment to appropriately detect an approaching object with a regularly used cane.

Taller de Arquitectura designed a project that employed a unique take haptic design for people with low vision. At the "Center for the blind and visually impaired" in Mexico City the walls have a specific texture applied to each rectilinear building. The Concrete bases of the buildings on the campus have horizontal and vertical lines set into the concrete at hand height. This allows for each building to have a unique and custom icon embedded into the architecture which can easily be touch and understood before entering or re while walking against. This provides an integrated approach to the architecture that invites users to touch and engage with through a sense other than the visual. The rectilinear vertical walls in the project are ideal for a low vision environment due to their orthogonal organization. A study conducted at Stanford University discovered that curvilinear walls can by confusing for those with a visual impairment. When asked to describe curvilinear architecture, a blind member describe it as "turned forms". The individual stated that curved walls "create the idea that you walk straight forward while you in fact are turning around" (Stanford University, Architects and Visually Impaired people. 2009). Slowly curved walls are not perceived as curved in any way when vision is taken out of the equation. Straight and rectilinear walls provide the most understood and clear for people with visual impairment.

Vertical walls are not only informative and clear but can also be experientially designed for the senses. The mosques built in which Arabs would mix rosewater into the mortar that would make up the wall. When the sun would strike the finished wall, they would put off a pleasant fragrance. This method is not primarily for a functional purpose but speak to the experience of the body. Walls not only delineate and shape the space in which we inhabit but are also the most vulnerable for touch as they are at human hand height. They should be designed with touch in mind. A smoothly polished concrete wall invites a swooping hand gesture across it. A constructed tectonic wall suggests a hand or cane run across it as it produces a rhythmic sound. Corners should consider hands to guide and swing individuals 45 degrees in a new direction.

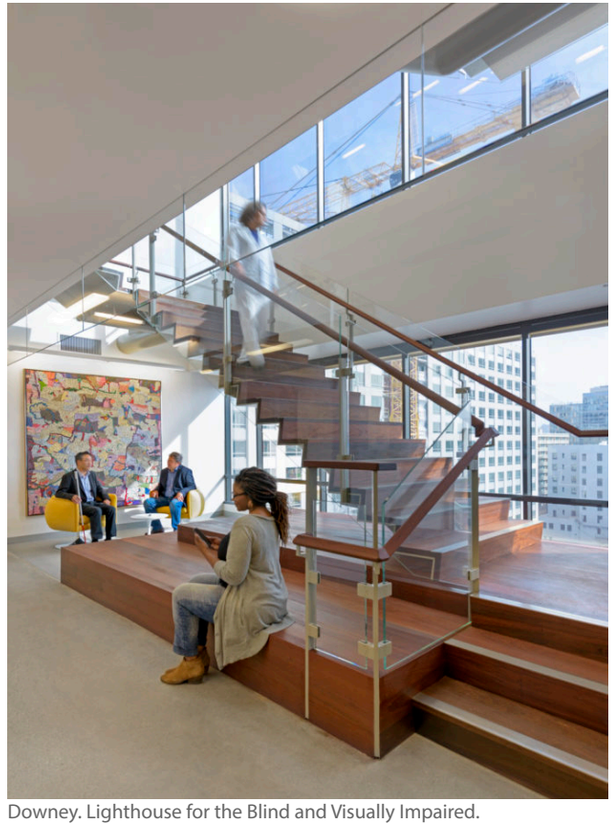


Center for the Blind and Visually Impaired. Taller de Arquitectura. Mexico City
Wall tactility to inform of buildings identity.

Hazelwood School, City of Glasgow, GB / Alan Dunlop Architect. School for blind and deaf students.

302.2. Vertical / Stairs. Stairs are an architectural element that bring the entire body into action. They provide a moment of wayfinding and orientation into the building while pragmatically bringing individuals up and down a building. The experience can one of clarity and joy or it can be dangerous and banal for those with a visual impairment. The detailing of the stair treads, risers, natural and artificial light, and handrails all come into play when producing a well experienced multi-sensory experience. The materials that make up the treads and risers shall not have a reflective or glossy finish. If it does than an unpleasant glare will be produced and disorient the individual. The materials should have a matte finish to avoid this. The materials should also emit a tone when stepping on and off in order to stimulate the ears. The treads should have a color or material differentiation on the ends of the treads in order to bring an understanding to the beginning and end of the step itself. This will make the experience much safer for those with a visual impairment. The first tread and last tread should have a sensory cue that will acknowledge that one is beginning or ending the vertical movement. This could be a haptic detail in the handrail, a subtle air vent that blows air onto the ankles, or a separate material on the first and last tread. In the Neues Museum in Berlin, raised lettering and braille is incorporated in the beginning and end of handrails to inform blind individuals where they are in building. This will enhance the senses through the skin particularly.

The staircase designed by Chris Downey in the lighthouse school for the blind and visually impaired is a good model for these types of ideals. He located the stair next to a large window that brings in natural light while being extremely careful to not allow for any harsh reflections of light onto the inhabitants. The material of the treads and risers is wood which will provide a pleasant sound when walking up and down the stair. At the end of each tread there is a contrasting material change that will be picked up visually as well as through ones shoe or cane. The handrails are smooth and rounded bringing comfort to the hand and have been notched where there is a landing. This allows for a clear understanding of the beginning and end of the stair. The stair is safe and clear for people with a visual impairment as well as an overall pleasant experience to everyone when engaging with it.



Downey. Lighthouse for the Blind and Visually Impaired.

iF Design, World Design Guide. Braille Stairs
Tactile information should be used to inform user of orientation.

302.3. Vertical / Inside Outside. On vertical walls it is necessary to have thresholds to bring people in the space as well as be able to provide an understanding of what is happening outside of the interior. Windows and doors are the architectural manifestation of this need. The detailing of these elements are similar to that of the stairs in which edges should be carefully invested in both in materiality and form. The door handle is important to be ergonomic as it is the handshake of a building. In Finland Alvar Aalto would wrap the door handle in leather chords to bring warmth to the touch when skin comes into contact with it. He would also put an element above the handle to shield the hand from getting wet when raining or snowing. It demonstrates a care towards the human body and scale and brings a sense of empathy to design. Outside and inside a door can also have ventilation strategically placed. The air should blow onto the inhabitants when entering or leaving the space as a way to provide a physical feeling on the skin that states that there is a change in temperature and humidity. ADA standards say that automatic doors are beneficial to those with a visual impairment since they can just move directly into the building but I argue that this takes away from the haptic experience of moving into a building. There is no feeling of weight or materiality of a door or handle and there is no point that invites one to come in to contact with the building.

Windows are the opportunity to provide views outward when inhabiting a space. For those that experience a visual impairment they provide something else. If a window is operable and can be opened, then the aperture will bring in the sounds and smells of the exterior into the space. This will give the space a stronger sense of place. When Charles Moore and Richard B. Oliver designed a house for a partially sighted client, they integrated smell into the building communicating a powerful understanding of the environment to the client. Moore and Oliver designed a ventilation system high up in the main living area of the building.[2] They strategically planted pine trees on the north side of the house and a peach orchard on the southern area. The high windows would catch the air carrying the scents of the landscape. The client could understand which direction the wind was blowing depending on how the room smelled. It also would allow for an understanding of the cardinal directions. It is a strong example in which a simple window can be used to create a multi-sensory experience of a place.

Alvar Aalto. Sannitorium. Window detail.
Easily Operable window brings outside in.

Alvar Aalto. Door Handle Detail.
Handle is comfortable to touch by the use of leather and height variation.

Vertical

Walls

-Lack of Protrusion

-incorporate tactile information

-Avoid long curves

-Aromatic material

Stair

-Audible materials

-Contrasting Edges

-Beginning / End Markers

-Low reflectivity

-Comfortable handrail w/ tactile information

Door

-Comfortable handle

-appropriate weight to avoid strain

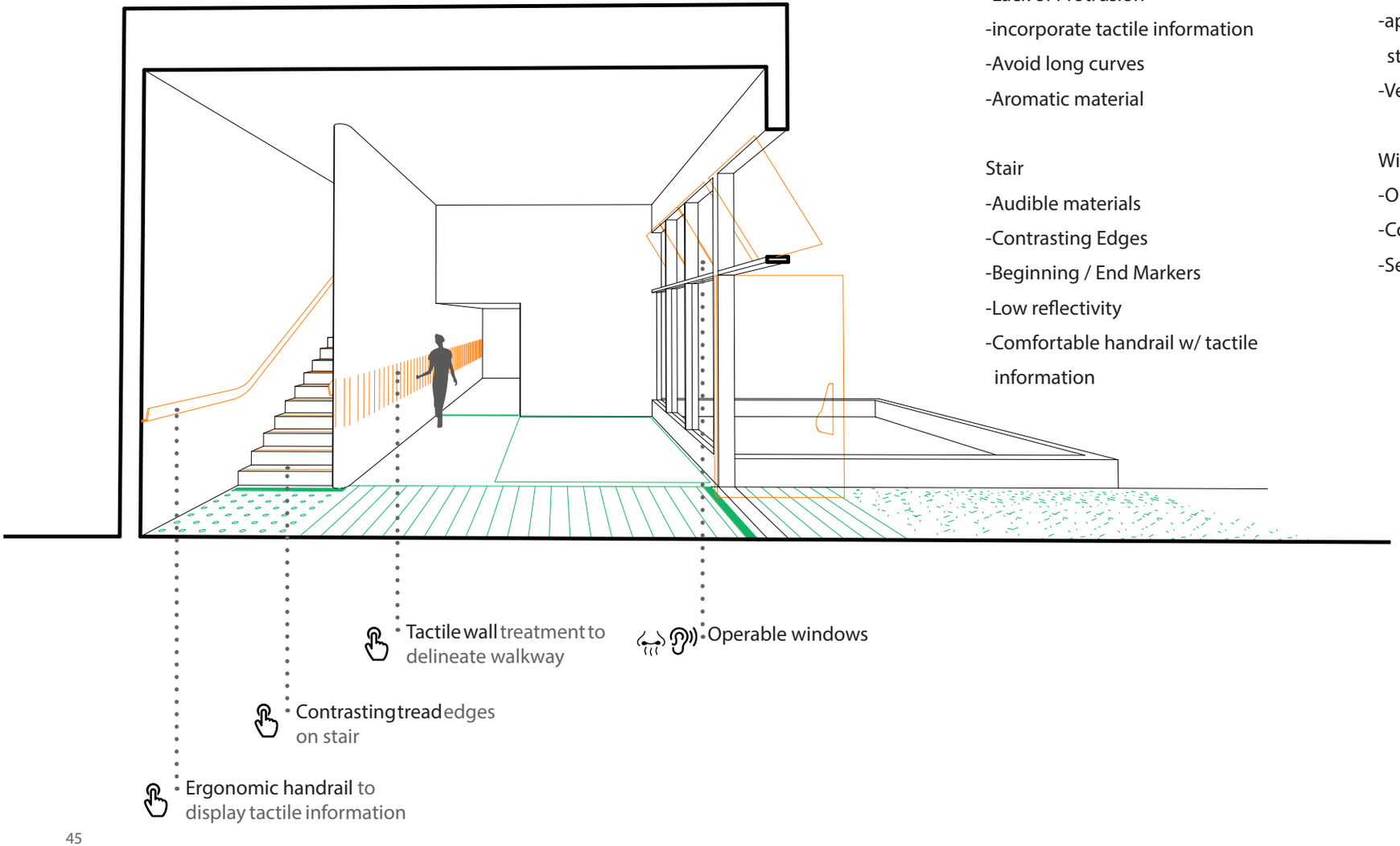
-Ventilation to mark threshold

Window

-Operable windows

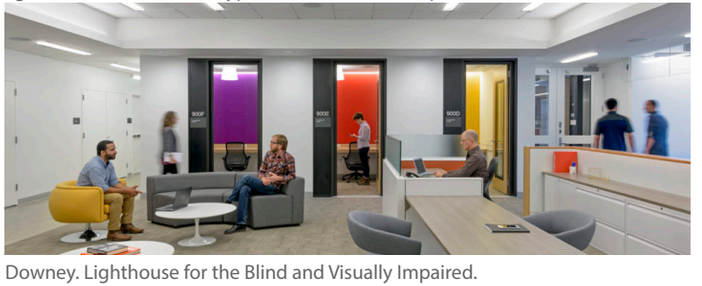
-Contrasting edges

-Seat / rail at hand height



303.1. Entourage / Value. People with a visual impairment have a difficult time perceiving edges and material change. A common test when understanding a person's visual skills is showing figure-ground images. This image will overlay multiple different profiles of commonly seen objects such as scissors, books, glasses, etc. on top of each other. If the person taking the test has certain visual impairments such as low vision or blindness then they will have a very difficult time differentiating the items. They will ultimately perceive a cluster of lines and will fail to prescribe any meaning to what they represent. That being said, the treatment of edges and surfaces must be easily delineated. Colors and texture can be an easy and stylish way to achieve this. In many modern spaces the design focuses primarily on the form resulting in a very monochromatic space. A space of one color / material to a person with a visual impairment is very difficult to understand as everything bleeds together. The image to the left show a bathroom with edges and element marked by a contrasting color. This allows for an extremely clear understanding of what is around an individual. A blind interior architect was interviewed by Stanford University and discussed how he had adjusted the interior of his house after losing his sight.[3] He demarcated zones of his living environment with varying wall materials and light colors. This provided a sense of place in his home. The attic was understood through the colors and smells of the exposed wood while his living room was felt through the contrasting lamp colors. Chris Downey at the Lighthouse school for the blind marked hallways and spaces with different lighting colors as well for similar reasons.

Dementia Care Bathroom, HEWI (Germany). Value contrast highlights fixed elements in a typical monochromatic space.



Downey. Lighthouse for the Blind and Visually Impaired.
Color Value differentiates the different rooms.

3 Peter-Willem Vermeersch, Jasmien Herssens, Megan Strickfaden, Ann Heylighen. "Architects and Visually Impaired People: Analyzing two ways of thinking"

303.2. Entourage / Furniture. Furniture is typically the most used objects in an a space. In many homes, offices, restaurants, and schools, furniture is used to bring relaxation and comfort to users. The placement of furniture creates pockets of space within a larger space so it is to be treated as architectural elements. Architects such as a Frank Lloyd Wright would design the furniture to compliment the buildings aesthetics and would even make the furniture to be built in / fixed to the building. He would use natural material such as wood as a material for it was a softer and more economical material. While his furniture was aesthetically consistent with the building, it provided no contrast to its surroundings. It was also critiqued for not being comfortable as it he did not always design with the human body in mind. The chairs designed for the Johnson Wax Office were only supported by three wheels causing users to frequently fall out of the chair. He also would use materials and colors that blended into the building making perception of the object difficult for a person with low vision.

The furniture line 7:1 designed by BBDO Bangkok addresses issues such as this. Their collection of furniture focuses on visual clarity for those with vision impairments manifested in tables, chairs, shelves, and plumbing fixtures. The concept of the line was based on the ideal contrast ratio of 7 : 1 as it allows for the clear understanding of edges and surfaces.[4] The furniture uses bright and vibrant colors with the edges articulated in a contrasting color. This allows for the reading of the spatial objects to be perceived even when looking through the lens of a person with low vision.

BBDO Bangkok, 7:1 Furniture Collection. Contrast visualization


BBDO Bangkok, 7:1 Furniture Collection. High contrast furniture allows for pure understanding when seen through the lens of visual impaired.

303.3. Entourage / Landscape A sensory garden is a working lot of land that is developed with the goal of activating all of the senses; sight, taste, smell, sound, and touch. It is a well received skill set for the visually impaired as well as adds to the experiential qualities of the place in which it is located. Locating the garden adjacent to a space with operable windows as a barrier allows for those qualities to bleed into the interior of a space. The careful curation of plants and water features activates all of the senses.

David Graper, a horticulture Specialist & Master Gardener Program Coordinator, gives a thorough list of plants that should be used in sensory garden. The article states which plants are best for each sense. For sight; Bleeding heart, Butterfly Weed, Cockscomb, Delphinium, and Sunflowers are some of the top picks as they produce large and vibrant colors after they bloom. Anise Hyssop's produce a black licorice scent when rubbed with the fingers. The leaves can also be used in a tea. This plant can appeal smell, taste, and touch. False Indigos appeal to the sense of hearing as it "produces brown seed pods containing seeds that create a rattling sound when shook".[5] Switchgrass also makes a pleasant sound when hit with a breeze. There are many plants that can appeal to taste as plants are used as spices and produce. Chives, mint, and Nasturtium are a few examples that are easy to grow and can be used in the kitchen. Lambs ear, Wooly thyme, and Satiny Wormwood appeal to the sense of touch as in their maturity they have soft and silky leaves and hairs. It is not advised to plant any plants with thorns such as roses or hollies.

After selecting and planting the flowers and bushes, the incorporation of a water feature and/or wind-chimes can further enhance the sound qualities of the space. These are consistent year around where some of the plants are only active for a few months out of the year. In the end the garden will activate all senses and benefit all who experience it.

5 Drietz, Rachel. Graper, David. "Creating a sensory garden". SDSU Extension.

Sight


Butterfly Weed

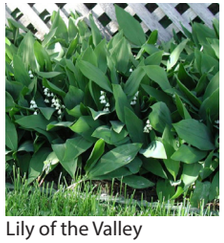

Cockscomb


Sunflower

Smell


Catmint


Creeping Thyme


Lily of the Valley

Taste


Chives


Anise Hyssop


Nasturtium

Sound


Balloon Flower

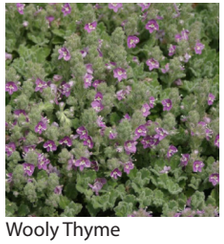

False Indigo


Switchgrass

Touch


Lambs Ear


Satiny Wormwood


Wooly Thyme

Entourage

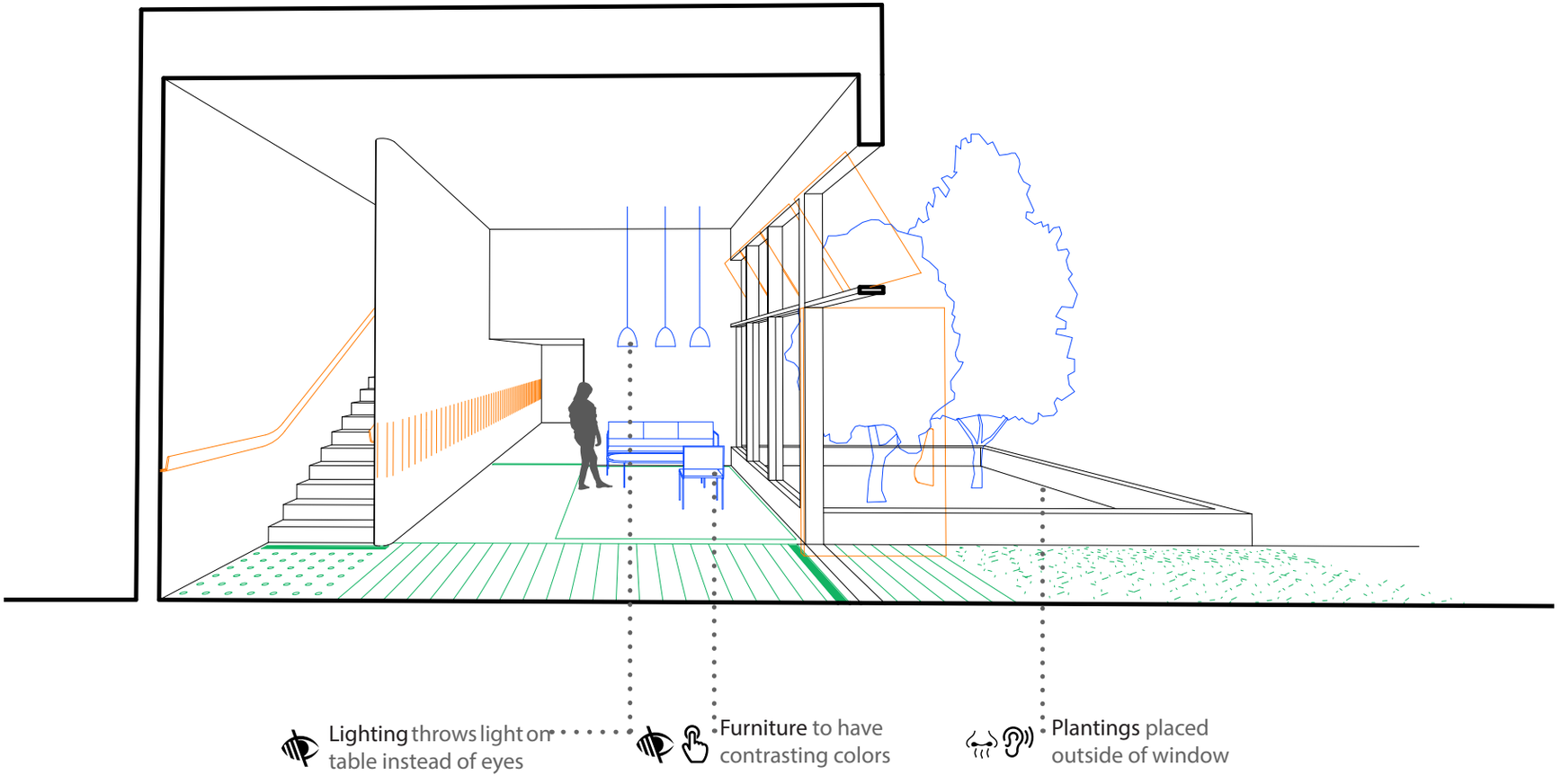
-Furniture to have contrasting colors

-Plantings / water outside window to activate senses inside

-Lighting to face focal point

-Fixtures to contrast surrounding materials

-Maintain obstacle free pathway



Conclusion

Architecture is ultimately experienced through the body, yet the majority of architectural design focuses primarily on the visual qualities of space and form. The community of people that live with a visual impairment such as low vision does not benefit from this narrow focus. Architectural design should take in all aspects of sensory cues such as touch, sound, and smell. This can be achieved if the designer chooses to incorporate these aspects of the body into their architectural vocabulary and understanding. The practice should look at policies such as the ADA standards as well as the seven principles of universal design and add an experiential quality to the design. With this mindset, architecture will truly be designed for the body and bring a clear understanding and joy to the individuals that inhabit the space. By categorizing different elements as vertical, horizontal, and fixed, we can prescribe principles to each category that will amplify the multi-sensory qualities of the overall space.

The horizontal elements such as the floors provide an understanding of way-finding through space. The materials chosen for ground surfaces should provide a sensory cues such sound and smell. A ground surface, if constructed with a material like gravel, will make an individual more engaged in the experience as it will produce a sound with each step and involves the whole body to interact with it as the surface is essentially uneven. A level ground surface should produce sound through its echoes and should absorb light to avoid any kind of glare. It should also have a way finding technique where grooves are added as a tool for those with canes and different materials reflect the spaces in which they define.

Vertical aspects of design such as walls, windows, and stairs bring a delineation of space or thresholds through space. Walls should be treated similar to floors in that the materials chosen provide a pleasant aroma, absorb light, and incorporate an understanding of way finding. When a window is added then it is best to let the inside into the outside by incorporating operability and acousitic transparency. Doors should be designed ergonomically as this is one of the consistently touched elements of a building.

The Entourage such as handrails, seats, and tables should have clearly defined edges as well as contrasting materiality and color. They should also have raised signage incorporated into the element when necessary to add to the understanding of ones location in a space. Furniture should be designed to express its use by its materiality. The materiality of objects invites the action of touch and provides a haptic joy when physical contact is made. When ventilation is integrated into the design it is important to allow air to be blown onto people in moments of transition as a way to touch the body and express the change in place.

All of these principles when demonstrated will bring a multi-sensory experience to a space. The space will become an extension of the body and an individual will experience a haptic understanding of architecture. It will bring pleasure to the human body as opposed to purely accommodating it and make a strong impression to not only those with a visual impairment, but to everyone who inhabits the design.

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