TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

DEPARTMENT OF ARCHITECTURE

PULCHOWK CAMPUS

PULCHOWK, LALITPUR

swawolambi

SCHOOL FOR VISUALLY IMPAIRED

A THESIS SUBMITTED TO:

DEPARTMENT OF ARCHITECTURE, PULCHOWK CAMPUS

IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF

BACHELOR OF ARCHITECTURE

SUBMITTED BY:

SHRAWAK SHAKYA

074-BAE-236

DATE: MAY 18, 2023

CERTIFICATE OF THESIS APPROVAL

Date: May 18, 2023

To,
The Chairman and Members of Jury
Department of Architecture
Pulchowk Campus
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Dear Sir/ Madam,
In compliance with the requirement of the course of 5th year, Architectural Design Thesis (AR851) for the Bachelor in Architecture degree, I hereby respectfully present my thesis for evaluation and approval.

Project Title: Swawolambi | School for Visually Impaired
Project Location: Raniban, Kathmandu

Respectfully yours,
Shrawak Shakya (074-BAE-236)
(Thesis Candidate)

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CERTIFICATE BY THESIS CO-ORDINATOR

This is to certify that this thesis entitled "**Swawolambi** | School for Visually Impaired" at **Raniban, Kathmandu, Nepal** submitted by **Mr. Shrawak Shakya** has been declared successful for the partial fulfilment of the academic requirement for the completion of the Degree of Bachelor of Architecture.

Asst. Prof. Anjana Vaidya Shrestha

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DECLARATION

I hereby declare that this dissertation has not been previously accepted in substance for any degree and is not being concurrently submitted in candidature for any degree. I state that this dissertation is the result of my own independent work/ investigation, except for those otherwise stated. I hereby give consent for my dissertation, if accepted, to be available for photocopying and understand that any reference to or quotation from my thesis will receive an acknowledgment.

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LIST OF ABBREVIATIONS

BPS	Blind and Partially Sighted
BYAN	Blind Youth Association Nepal
CWD	Children with Disability
ECC	Expanded Core Curriculum
HRW	Human Right Watch
ICD-10	International Statistical Classification of Diseases and Related Health Problems 10th Revision
LO	Lateral occipital
MOE	Ministry of Education
NFD-N	National Federation of the Disabled – Nepal
UNICEF	United Nations Children's Fund
VA	Visual Acuity
VI	Visual Impairment
WHO	World Health Organization

GLOSSARY

Acuity	A measure of the ability to detect fine detail. Often measured as the smallest letters that can be read (e.g. on the Snellen chart) and expressed in relation to the normative value (see acuity scales). Alternatively, tested as the finest grating of black and white stripes that can be distinguished from a uniform field of the same average luminance, usually expressed as the highest detectable spatial frequency. The Snellen chart contains rows of successively smaller letters. Children of 3–5 years can more easily identify letters, or simply shaped symbols, when presented on individual cards as in the Lea Symbols test or the Cambridge Crowding Cards.
Contrast sensitivity	The ability to detect the difference between light and dark parts of the image. It can be measured as the minimum contrast required to see gratings at different spatial frequencies, typically plotted as the contrast sensitivity function. At the high spatial frequency limit of visual acuity, contrast sensitivity drops to zero.
Cornea	The curved transparent surface at the front of the eye, through which light passes into the pupil. The curvature of the cornea, along with that of the lens, is responsible for focussing light from distant objects onto the retina.
Cortex	The layer of gray matter (nerve cell bodies) forming the outer surface of the cerebral hemispheres, and including many areas engaged in the processing and use of visual information
Disability	Set of physical and mental disorders which keep a person from an independent individual and social life

Field of Vision	Field which both the eyes can easily see in the front. The normal field of vision is 180 degrees in front of eye.
Low Vision	Impairment of visual functioning even after treatment, and/ or standard refractive correction, and has a visual acuity of less than 6/18 to light perception or a visual field of less than 10 degrees from the point of fixation, but who uses, or is potentially able to use, vision for the planning and/or execution of a task
Optic radiation	The fiber tract which carries visual information from the (Lateral geniculate nucleus) LGN to area V1 of visual cortex. It forms the majority of the white matter in the occipital pole of the brain.
Photoreceptors	The sensitive cells within the retina which convert light energy into electrical signals that can be processed by other nerve cells in the retina and brain. Rod photoreceptors are very sensitive to dim light but do not provide good acuity or colour vision. The cone receptors, less numerous except in the fovea, provide high acuity and can signal the difference between different wavelengths (colours) of light.
Universal design	The design of products, environments, programs, and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design.
Visually Impairment	A person with low vision is one who has impairment of visual functioning even after treatment and/or standard refractive correction, and has VA of less than 6/18 to light perception, or a visual field of less than 10 degrees from the point of fixation, but who uses, or is potentially able to use, vision for the planning and/or execution of a task.

ABSTRACT

For years, architectural theorists and architects have been discerning how architecture is perceived and what sets good architecture apart from the rest. With the increase in demand for an inclusive society, these questions are to be raised about universal design and the concept of universal design. The field of architecture is open to all. While designing, no one should be left alone. For those who lack the proper vision to analyze architecture, the same cannot be said. They may not be able to see the architecture, but they can definitely feel it. Every architect should take into account the needs of people who are visually impaired. Any impairment should not prevent someone from appreciating the architecture. The report looks in depth into the introduction to "Visual Impairment", their needs and problems, multisensory experience, non-visual perception, design guidelines and lighting requirements, material perception, and how they perceive the surroundings in urban and individual contexts based on the case studies and literature reviewed. What kinds of visually impaired people exist? What distinguishes them from people who can see architecture? What needs to be done to feel like architecture meets, and how do they perceive it? Even though inclusiveness in design is encouraged by architecture for the blind, it is rarely discussed or used in the final product. The report aims to discuss the paradigm of universal design and people with visual impairments by applying the obtained data and guidelines to designing schools for Visually Impaired Children.

Education is the main aspect that influences how a person's personality develops and is a source of knowledge. According to Article 24 of the CRPD, states must make sure that children with disabilities, including blind children, "are not excluded from the general education system on the basis of disability" and that they have access to "inclusive, quality, free primary and secondary education on an equal basis with others in the communities in which they live." The empowerment of women, protection of children from exploitation, dangerous labor, and sexual exploitation, promotion of human rights and democracy, environmental protection, and population control all depend heavily on education. This report dives into designing a accessible milieu.

CHAPTER 1: INTRODUCTION

1.1. BACKGROUND

How is architecture experienced? What makes good architecture? These are the key questions for both Architectural theorists and architects who have been curious about how architecture is perceived and what sets good architecture apart from the rest. With the development of an inclusive society, these questions are to be raised about the design concept of universal design. According to the Convention on the Rights of Persons with Disabilities, “universal design” has been defined as “the design of products, environments, programs, and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design.” (Ahmer, 2014).

Figure 1: Universal design features in Urban Environment

(Source: https://nacto.org/publication/transit-street-design-guide/)

According to the World Health Organization (WHO), "Disability is a set of physical and mental disorders which keep a person from an independent individual and social life." Visual impairment is one of the most common disabilities among other disabilities. According to a 2011 report published by the World Health Organization, about 285 million people worldwide are visually impaired, of whom about 39 million are blind and 246 million have low vision. Studies state that 1.2 per thousand children suffer from some form of visual disability, with more than 90 percent of those living in developing countries. Disability is triggered by the interruption in the relationship between disabled people and their cultural, social, and physical environment due to the lack of accessibility for people with special needs in such environments. (Soleimani-Sefat, Rostami, Shahin, & Movallali, 2016)

"In about 1 billion people (about 15% of the world's population) who experience disability, nearly 285 million (4.24% of total population) people of all ages worldwide are visually impaired. (Left); Almost 18.9 million (7.24% of school-age children) children under 15 years of age are visually impaired globally (Right)"

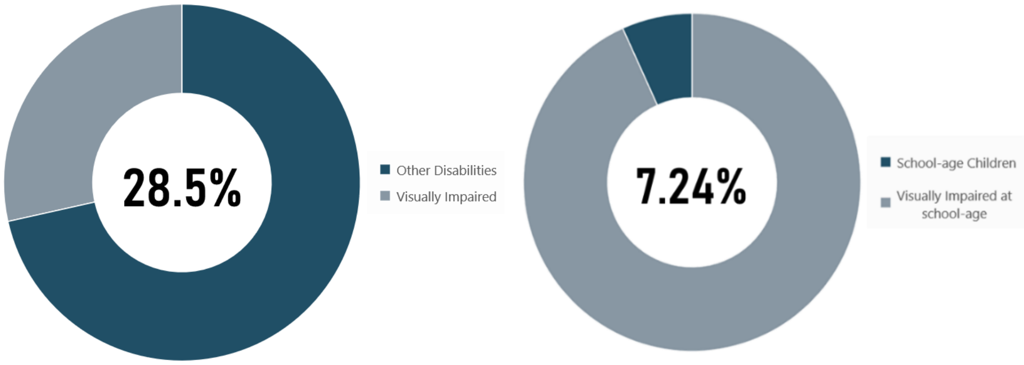


Figure 2:Estimated Total Population of VI (Left); :Estimated Population of VI Children of school age(Right)

With the goal of achieving a better and more sustainable future for all, the Sustainable Development Goals (SDGs) were adopted by all United Nations Member States to address the global challenges we face in poverty, inequality, climate change, environmental degradation, peace and justice. Nepal, as a member state of the United Nations (UN), has devised a road map to become "Peaceful, Just and Inclusive Societies" to ensure social development, and promote equal opportunities and fair participation for everyone in the community. Even though, inclusiveness is thought to foster social integration and protect particularly disadvantaged and vulnerable groups, children with disabilities (CWD) often encounter different forms of exclusion from their basic human rights, which would have a significant impact on society. Due to the processes not being disability inclusive, the available statistics vary substantially. Both disabled children and adults are estimated to make up 0.5% to 25% of the total population in Nepal (Human Right Watch, 2011). They are denied access to social services, the chance to attend school, or opportunities for employment later in life (UNICEF, 2013). Even though they are in great need of basic human rights healthcare services and basic education, they commonly have less access than children without disabilities (Kuper, et al., 2007). In particular, CWD in low- and middle-income families is likely to face obstacles in transitioning from childhood to adult independence (UNICEF, 2013). They have an increased chance of staying in or facing poverty, malnutrition and poor health. These children need a supportive environment to be able to develop to their utmost capacity.

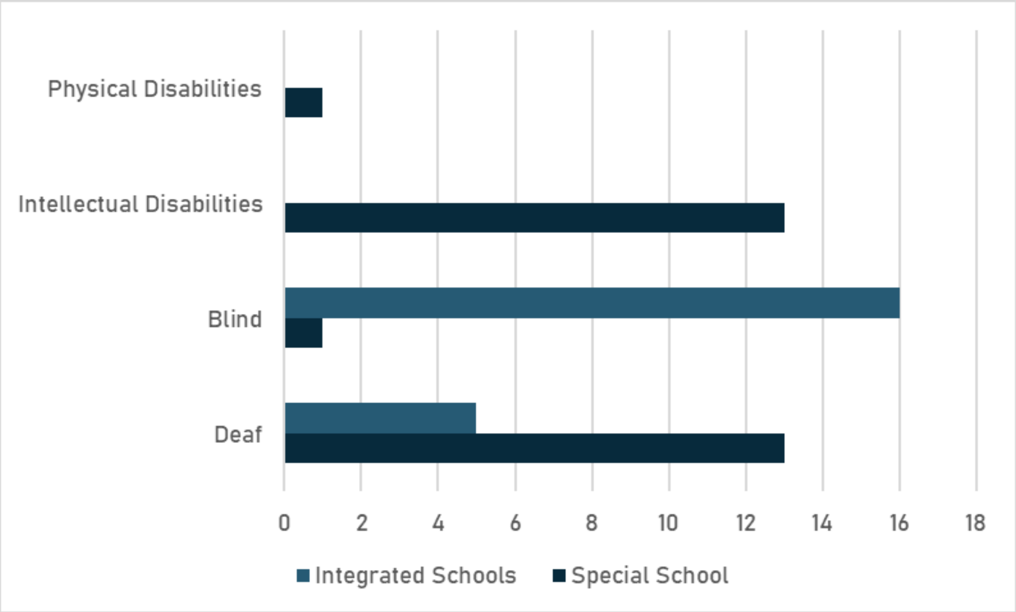


Figure 3: Number of Special and Integrated Schools across Nepal

Among the 32,130 schools across the 75 districts in Nepal (MOE, 2009), there are 13 special schools for the deaf , 1 school for the blind , 13 schools for children with intellectual or developmental disabilities, 1 school for children with physical disabilities, 5 integrated schools for the deaf and 16 integrated schools for the blind (Human Right Watch, 2011). It is estimated that Nepal has 60,000 to 180,000 children ages 5 to 14 with disabilities (Human Right Watch, 2018). In 2016, UNICEF found that 30.6 percent of children with disabilities, or approximately 15,000 to 56,000 children, ages 5 to 12, did not attend school. Of 68,306 children attending school, 1,509 children with disabilities attend special schools, and the rest 6.3 percent, are deprived of basic education, totaling more than 329,000 children (Human Right Watch, 2011). It is estimated that the literacy rate of people with disabilities is approximately 20%, whereas the general literacy rate is 65.9%. According to the Ministry of Education, Science, and Technology, there are 9548 blind and partially sighted (BPS) students undergoing study from grades 1–12. Among these are 4,764 in grades 1–5, 2,987 in grades 6–8, 1,504 in grades 9–10, and 292 in grades 10-11. At least 66,934 blind children do not attend any institution or school, i.e., 49.49% of BPS children are deprived of their basic education rights. If this deprived group of BPS children were provided equal opportunity, they could live a fully independent life, reach out to a career they wanted, and be productive members of their communities.

Vision does most of the sensing in the case of normal people (Vishnu & Fazil, 2019). Thus, most spaces are visualized and designed based on human visual perception, making them frigid for blind individuals (Malekafzali, 2021). Architecture should serve to support their impairment. To create such supportive spaces, seamless transition and barrier-free circulation between spaces should be developed to enhance a sense of continuity in movement and the incorporation of additional features that facilitate a multi-sensory experience, such as a sensory garden that allows visitors to enjoy a wide variety of sensory experiences by stimulating the senses, should be designed. Shadows are especially significant for the sight-impaired because they offer contrast with light. Similarly, sound is essential for comprehending spatial relationships as it is omnidirectional and constantly present, which helps to distinguish between open places and enclosed spaces for the blind. (Vishnu & Fazil, 2019). As a result, an attempt is made in this study, as a part of the curriculum for the 5th year of the Bachelor of Architecture, to extract the qualities of space that accommodate the needs of visually impaired people using multi-sensory and holistic designs.

1.2. RATIONALE OF THE RESEARCH

Education is a sole contributor to the development of the human personality and a source of knowledge. Article 24 of the UN Convention on the Rights of Persons with Disabilities (CRPD) requires states parties to ensure that children with disabilities, including blind children, "are not excluded from the general education system on the basis of disability" and that they have access to "inclusive, quality and free primary and secondary education on an equal basis with others in the communities in which they live". Education has a vital role to play in empowering women, safeguarding children from exploitation and hazardous labour and sexual exploitation, promoting human rights and democracy, protecting the environment, and controlling population growth. From the recent UNICEF studies conducted in South Asian countries covering

Bangladesh, India, Pakistan and Sri Lanka, the number and percentage of out-of-school primary and lower secondary school-age children in these countries are as follows:

	Dimension 2: Primary school-age children		Dimension 3: Lower Secondary school-age children		Dimensions 2 and 3
	Out-of-school primary school-age children as a percentage of the total primary school-age population (%)	Number of primary school-age out-of-school children (Million)	Out-of-school lower secondary school-age children as a percentage of the total lower secondary school-age population (%)	Number of lower secondary school-age out-of-school children (Million)	Total number of primary and lower secondary school-age children not in school (Million)
Bangladesh	16.2%	2.6	30.7%	3.0	5.6
India*	6.4%	7.8	5.7%	4.0	11.9
Pakistan	34.4%	6.6	30.1%	2.8	9.4
Sri Lanka	1.9%	0.03	3.2%	0.04	0.07
Total		17.0		9.9	27.0

Figure 4: Number and percentage of out-of-school primary and lower secondary school-age children, Bangladesh, India, Pakistan and Sri Lanka (UNICEF, 2014)

Summarizing the reasons for such large number and percentage of out-of-school primary and lower secondary school-age children in these countries are as follows:

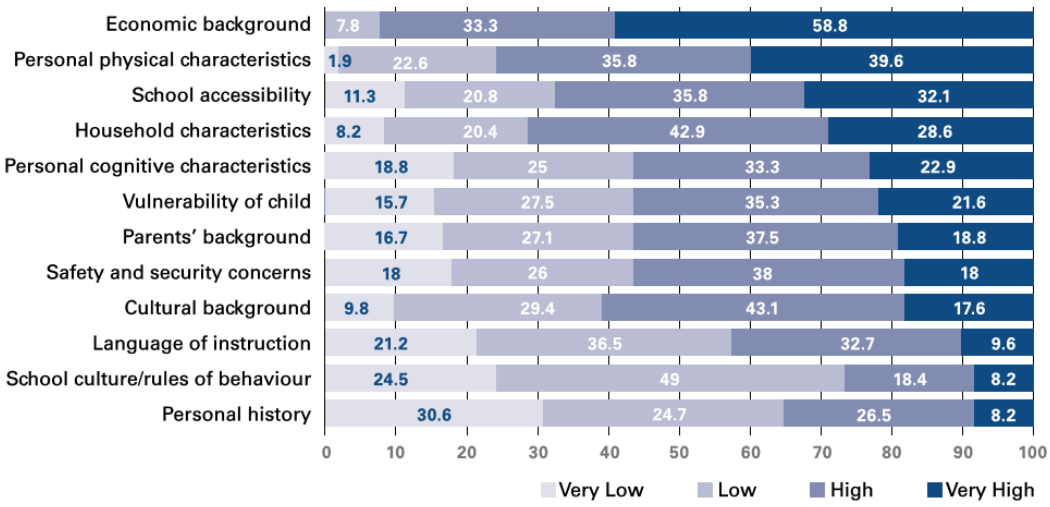


Figure 5: Prevalence of Barriers in Developing Countries

Similar reasons for large number of out-of-school children in Nepal can be felt. An estimated 90 percent of children with disabilities in the developing world do not go to school (UNICEF, 2014). In the case of Nepal, due to the census not being disabled-friendly, the exact number of disabled children cannot be determined. It is estimated that Nepal has 60,000 to 180,000 children from ages 5 to 14 with disabilities, of whom 30.6 percent are children with disabilities, or approximately 15,000 to 56,000 children, ages 5 to 12, did not attend school. At least 66,934 (49.49%) blind children do not attend any institution or school. The right to quality inclusive education is still a pipe dream for visually impaired children in Nepal, especially if they happen to be girls, especially in remote rural areas, due to:

- Lack of disability-friendly educational infrastructure and facilities,
- Lack of teacher training,
- Rigid curriculum,
- Double marginalization (in case of girl and lower caste people) and,
- Social taboo related to the cause of disability,
- Lack of educational institutes to cater the demands of disability-friendly environment,
- Lack of awareness of the right to education among parents,
- Inaccessibility of and long distance to schools.

If these problems were to be rectified by providing equal opportunity from an administrative and architectural perspective, students could lead an independent life. The administrative portion to rectify the problems faced by the students is out of the scope of the research as it involves planning and policy-making to promote an inclusive education policy. As for the architectural perspective, some of the questions mentioned below had been hovering over my mind:

- Based on the government’s inclusive education policy, mainstream schools are to be made inclusive. Is it better to provide an inclusive school rather than a special school?
- Can the integrated mainstream school rectify the absenteeism of disability-friendly educational infrastructure and facilities?
- Can the integrated mainstream school provide the required guidance to both the normal and children with disabilities without segregation?
- Are the spaces provided in integrated mainstream school comfortable to children with disabilities?

- Can the integrated mainstream school the cater to the safety and health concerns?
- Can the integrated mainstream school satisfy the demands of enrollment as this gives birth to competition between normal children and children with disabilities?

Upon thinking about these questions, the limitations of an integrated school can be felt, as it is difficult to provide reasonable accommodations to support individual learning, which include braille textbooks, audio, video, and easy-to-read learning materials, and staff to assist children with self-care, behavior, or other support needed in the classroom. It is difficult to teach visually impaired children due to a lack of visual materials. When the teacher teaches in the class and new words come up during a lesson, it becomes difficult to describe and explain the lesson. To ensure that the school fulfills its duty, a full range of textbooks in braille or material in audio and adequate staff who aide in supporting children's participation, provide personal care assistance, or take on other support roles are required. Such disability-friendly educational infrastructure and facilities are mostly possible in cases where certain disabilities are mostly focused: a special school.

The School for the Visually Impaired intends to educate the BPS children by removing the barriers to education for Children with Disability by providing the appropriate classroom along with disability-friendly educational infrastructure and facilities, including the study of spaces provided to children with disabilities and their comfort level. Since the special school is focused on the BPS children, the occurrence of segregation and inferiority will reduce drastically and can satisfy the demands of enrollment better in comparison to an integrated school. Similarly, the educational spaces, recreational spaces, and residential spaces for visually impaired people differ from those for normal children. Thus, the required spaces for the BPS children can be fulfilled by the special school rather than the integrated school.

In conclusion, the project revolves around the idea of providing better infrastructure and facilities that can help the blind experience spaces more easily by stimulating other senses. The final goal of the project is to help the BPS children live an independent lifestyle and socialize with the community for the betterment of their communities.

Similarly, the project also aims to halt the exclusion of persons with disabilities from social structures, as they are rarely regarded as subjects in society due to the mindset of the general public. BPS persons will be able to demonstrate their actual work capacity by changing society's worldview at a rapid pace.

1.3. IMPORTANCE OF THE RESEARCH

Studies conclude that there appears to be a complementary relationship between disability and poverty in Nepal. The majority of people with disabilities in Nepal fall below the poverty line, which is estimated to be more than 80%; however, there are no exact head counts or surveys focusing on this aspect (Blind Youth Association Nepal, n.d.). A very small number of people with visual impairments have opportunities for their livelihood. Persons with visual impairments are generally ill-treated in society because of deep-rooted traditional beliefs and subordination. They are not able to have a respectful and dignified life in society, as it is often seen as a resultant effect of the sin of the past generation, and due to this assumption, they are physically incapable. They are excluded from social structures and rarely regarded as branches of society. The lack of accessible physical infrastructure, coupled with the mindset of the general population, has made it even worse. For such a misconception to be aloof from society, BPS people should be given equal opportunity to demonstrate their actual work capacity by changing society's worldview at a rapid pace. Thus, the importance of the research in this very thesis project is:

Independence:

- To be self-reliant through social, economic and medical rehabilitation,
- Boost confidence and develop equal skills in respect to normal student,
- Enhance the socialization skills in personal and social adjustment.

Architectural Aspects:

- Develop or apply new ideas through the research, during planning phase to make the educational infrastructure and facilities disability-friendly,
- Adopting new modern technologies to help in the navigation,
- Explore different design strategies through multisensory architecture tools.

Others:

- Create awareness of the rights of people with disabilities by utilizing all available means, mass and mediums,
- Adopting new modern technological ideas that can implemented for academic purposes,
- Eliminate the misconception of publics about the causes of blindness and their competency.

1.4. PROBLEM STATEMENT

As already stated above, among the 32,130 schools across the 75 districts in Nepal (MOE, 2009) are 13 special schools for the deaf, 1 school for the blind , 13 schools for children with intellectual or developmental disabilities, 1 school for children with physical disabilities, 5 integrated schools for the deaf and 16 integrated schools for the blind (HRW, 2011). According to the Ministry of Education, Science and Technology, there are 9548 blind and partially sighted (BPS) students undergoing study from grades 1–12. At least 66,934 blind children do not attend any institution or school, i.e., 49.49% of BPS children are deprived of their basic education rights. The right to quality inclusive education is still unattainable for the visually impaired in Nepal due to the lack of disability-friendly educational infrastructure and facilities, trained instructors, double marginalization (in the case of girls and lower caste people), social taboo related to the cause of disability, a lack of educational institutes to cater to the demands of the disability-friendly environment, the inaccessibility of schools, and the long distance to schools. Some of the critical issues that the research seeks to address are:

Architectural Aspects

- Lack of adequate space and facilities that comply to disability-friendly educational infrastructure and facilities in the current schools in accordance to the curriculum which were turned into integrated school,
- Lack of Reasonable Accommodation and Physical Accessibility which accounts to the Principle of Universal Design,
- Lack of understanding of sensory experience and Multi-sensory Architectural Guidelines to help in navigation and space perception.

Administrative Aspects

- Lack of Information about Possibility and Availability of Education for Children with Disabilities,
- Low Enrolment, High Drop-Out, Low Attendance Rates, Low Pass Rate, Denied Admission and School Fees,
- Segregated and Inferior Quality of Education,
- Lack of Adequately Trained Teachers, Monitoring, Inflexible Curriculum and Evaluation System.

Social Issues

- Ineffective Social Support as disability develops a barriers to getting along the Society,
- Lack of Access to Health Care,
- Stigma against Children with Disabilities and Their Families.

1.5. RESEARCH QUESTIONS:

Research questions help researchers in organizing their thoughts, prioritizing their efforts, and selecting the best method or viewpoint from which to interpret each topic of interest. This research will be focused on answering these research questions:

- What are the adequate space requirements to design a comfortable space and facilities that comply to disability-friendly educational infrastructure and facilities?
- How can the architectural form be optimally designed to help the visually impaired people perceive the space better through sound and lighting manipulation?
- How to establish landmarks through senses, and natural phenomena to help in mobility and orientation?
- How to utilize natural and artificial lighting, colour, and material to help in the perception of space?
- How to establish safety features in injury prone areas such as staircase, etc.?
- How should the curriculum be designed to help the students to be independent?

- What are the design strategies and guidelines for people with visual impairment?

1.6. OBJECTIVE OF THE RESEARCH

Based on the research question, the clear statements of the aims to be achieved through the research was attained, which are as follows:

1.6.1. GENERAL OBJECTIVE

- To provide adequate spaces which cater to the requirement of the users through different multisensory architecture tools.

1.6.2. SPECIFIC OBJECTIVE

- Exploring how space can be perceived through sensory experience,
- Develop guidelines for designs that enhance the experience for the visually impaired,
- Study the characteristics of the material to know how the visually impaired people perceive the material,
- To understand the principles of design and design strategies to cater the visually impaired people,
- Create space that contributes to social development, language, and communication development of the visually impaired people,
- To research the ways to cater to the needs of all kinds of disabilities through architecture providing a safe and productive learning environment.

1.7. EXPECTED OUTPUT

After the completion of the project, the following results are expected to be achieved:

- Designing the multi-sensory school, which will cater the needs of the visually impaired students,
- Develop the adequate expanded core curriculum through which the requirement for adequate space and function can be developed,
- To provide adequate spaces which cater to the requirement of the users based the expanded core curriculum,

- Develop an architectural standard, principles and design strategies for visually impaired,
- Create space that contributes to social development, cognitive development, language and communication development of the student.

1.8. SCOPE AND LIMITATION OF THE PROJECT

1.8.1. SCOPE OF THE PROJECT

The project mainly targets on providing education to BPS children aged from 4 – 20 years till secondary level by providing an adequate space for their skill improvement and understanding of the phenomena. This research also focused on finding out the guidelines that were developed to aid visually impaired people, the problems faced by them, lighting requirements and material perception. Recent studies and research were used as a reference in finding out the design guidelines and how they perceive the space around them. The study was focused on understanding how the visually impaired children attending two different schools embody the space around them, and understand, in-depth, the suitable materials for them.

1.8.2. LIMITATION OF THE PROJECT

The study won't look in-depth, the urban context, administrative portion, governmental plans and policies to help aid the visually impaired people. The study on lighting requirement, anthropometric data, multi-sensory experiences, development of expanded core curriculum and program formulation will be solely based on the literature reviews and case studies.

CHAPTER 2: RESEARCH METHODOLOGY

2.1. APPROACH OF THE STUDY

Individuals mostly accept sensory information as fact since it offers a level of evidence that one can withstand or challenge. Such sensory information which is regarded as true belief has been categorized as empirical or a posteriori knowledge. In contrast, non-empirical or a priori knowledge, which explains or justifies knowledge without reference to sensory experience, has received widespread acceptance in the field of philosophical approaches to knowledge formation. The posteriori and priori knowledge are the theoretical foundations for quantitative and qualitative research approaches. Williams (2007), thus quotes that "Research is the process of collecting, analyzing, and interpreting data to understand a phenomenon". The research process will be systematic in defining the objective, managing the data, and communicating the findings if it occurs within established frameworks and in accordance with the existing guideline. The frameworks and guidelines guide researchers on what to include in the research, how to conduct the research, and what kinds of conclusions are likely to be drawn from the data gathered. At least one question regarding a particular topic of interest forms the basis of research. Research questions help researchers in organizing their thoughts, prioritizing their efforts, and selecting the best method or viewpoint from which to interpret each topic of interest. The three common approaches to conducting research are: (Williams, 2007)

- Quantitative methods,
- Qualitative methods, and
- Mixed methods.

Based on the type of data needed to respond to the research question, the mixed approach seems to answer the required numerical and textural data. While conducting research through mixed method, researchers can combine quantitative and qualitative methods for data collection and analysis into a single study. That is, in order to answer the research question(s) outlined for a specific research study, researchers gather or analyze both narrative data, which is typical for qualitative research, and numerical data, which is normal for quantitative research (Williams, 2007).

The mixed-methods approach to research is an expansion of rather than a replacement for them. The objective a mixed-methods approach is to maximize the benefits and minimize the drawbacks of both quantitative and qualitative research methods (Williams, 2007). Based on the research question and the objective of the research, the mixed approach looks more suitable to identify and understand the prevalence of certain design features, followed by focus groups to explore the reasons why these features are important through analysis of both quantitative and qualitative data

When conducting research on architecture for visually impaired individuals, it is important to use a research methodology that is appropriate and effective in addressing the research questions and objectives. Here are some research methods are to be applied within this study:

- Case Studies: Case studies involve in-depth analysis of a particular architectural project or design that has been implemented for visually impaired individuals. This can provide insights into the specific design features that were effective in addressing the needs and challenges or limitations that were encountered.
- Surveys and Questionnaires: Surveys and questionnaires can be used to gather data from visually impaired individuals and/or architects and designers who have experience working in this area. This can provide quantitative data on the prevalence of certain design features, as well as qualitative data on experiences and perceptions.
- Interviews and Focus Groups: Interviews and focus groups can be used to gather in-depth qualitative data on the experiences, needs, and perspectives of visually impaired individuals and/or architects and designers working in this area.
- Observation: Observational studies involve direct observation of visually impaired individuals navigating through an environment, with the aim of identifying specific barriers and challenges. This can provide valuable insights into the types of design features that are most effective in addressing the needs of this population.
- Experimental Studies: Experimental studies involve manipulating specific design features and/or environmental conditions to assess their impact on the navigation and overall experience of visually impaired individuals. This can provide valuable insights into the specific design features that are most effective in addressing the needs of this population.

2.2. METHODOLOGY OF THE STUDY

The methodology of an architectural thesis can be divided into three main phases, which are the preliminary phase, research phase, and design phase. Each of these phases plays a crucial role in the development of the thesis and helps to ensure that the final project is well-researched, well-planned, and well-designed.

2.2.1. PRELIMINARY PHASE:

The preliminary phase of the methodology is the initial stage of the research project, which includes problem identification, project justification, and establishing objectives. This phase is essential for laying the foundation for the research project and establishing a clear direction for the work to follow.

The preliminary phase of methodology involves several key steps, including problem identification, project justification, and establishing objectives. These steps are important because they provide a clear and concise framework for the research project, ensuring that the study remains focused and on track.

2.2.1.1. PROBLEM IDENTIFICATION:

The first step in the preliminary phase of the methodology is to identify the problem that the research project aims to address. This step involves conducting a thorough review of existing literature and identifying any gaps in knowledge or areas that require further investigation.

2.2.1.2. PROJECT JUSTIFICATION:

Once the problem has been identified, it is important to provide a justification for the research project. This involves explaining why the research is important and what benefits it will bring to the field. Justification can include social, economic, or scientific factors that support the need for the study.

2.2.1.3. ESTABLISHING OBJECTIVES:

The next step is to establish clear and concise objectives for the research project. These objectives should be specific, measurable, and achievable, and they should outline what the study aims to accomplish. Objectives should be based on the problem identification and project justification, and they should provide a clear framework for the research project.

By identifying the problem, justifying the project, and establishing clear objectives, researchers can ensure that the study remains focused and on track, leading to meaningful and relevant results.

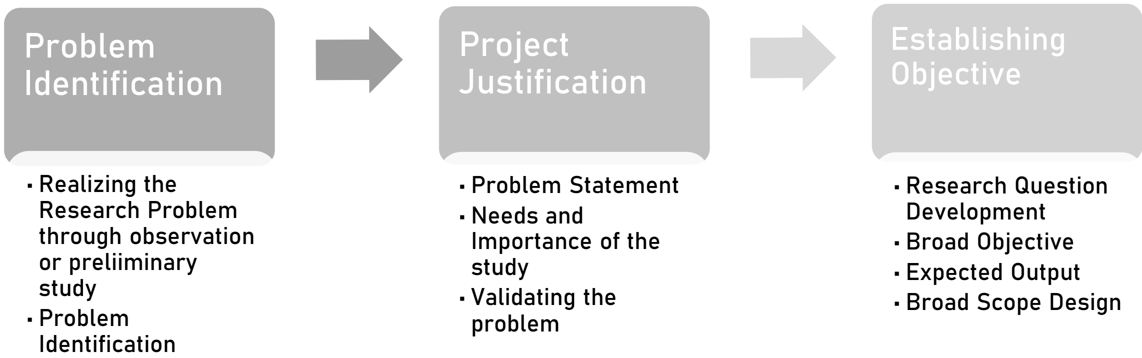


Figure 6: Preliminary Phase

2.2.2. RESEARCH PHASE:

The research phase involves conducting a thorough investigation of the problem identified in the preliminary phase. This may include a literature review, site analysis, case studies, surveys, and interviews. The research phase is crucial for collecting relevant information, identifying key themes and concepts, and understanding the context and constraints of the project. The research phase typically involves several steps outlined and briefly explained below:

2.2.2.1. PLANNING THE REVIEW:

Formulating the research problem is the first step in the planning of the review. It involves defining the main research question and objectives of the study. Developing and validating the review protocol involves creating a structured plan that outlines the methodology and approach of the study. This plan will guide the entire research process. A thorough review of existing literature is done to determine the state of knowledge and identify gaps or areas that need further investigation.

2.2.2.2. CONDUCTING THE REVIEW:

In order to do this, data must be extracted from the literature after inclusion screening and quality evaluation. Screening for inclusion entails identifying relevant literature for the study based on predetermined criteria. While evaluating quality, the chosen literature's value is assessed in accordance with specified standards. By gathering pertinent information from the chosen literature, one can extract data. A systematic approach to ensure that all relevant literature is identified and evaluated is required.

2.2.2.3. Reporting the Review:

Data must be analyzed, synthesized, and reported after this. To find patterns, trends, and links, data from the literature must be analyzed and combined throughout the analysis and synthesizing process. In order to report the findings, the study's findings must be clearly and concisely communicated to the appropriate stakeholders. To support the research problem, key findings are synthesized in this phase after a rigorous study of the literature. This phase involves a critical analysis of the literature and the synthesis of key findings to support the research problem.

2.2.2.4. Planning the Case Studies:

This include recognizing the issues, rationalizing the selection of the case study, outlining the parameters of the case, and reviewing the case. Finding the key problems of that case studies is necessary for realizing the challenges. Selecting case studies that are pertinent to the research question and objectives is a necessary step in the process of rationalizing case study selection. The extent and constraints of the case studies must be determined in order to define the scope and case boundaries. Doing a comprehensive analysis of the case studies is part of reviewing the case. In this stage, case studies that are relevant to the research problem are chosen and thoroughly examined.

2.2.2.5. Approach Standardization:

This involves a review of the literature, development of a standardized framework, and development of a documentation methodology. A comprehensive review of literature is done to identify relevant methods and approaches which helps in developing a standardized framework. This phase aims to establish a standardized approach to data collection and analysis, which helps ensure the reliability and validity of the research.

2.2.2.6. Data Collection and Analysis:

This involves collecting data, analyzing and synthesizing data, and reporting the findings. Collecting data involves gathering data from various sources, including case studies and surveys. Analyzing and synthesizing data involves combining and analyzing data to identify patterns, trends, and relationships. Reporting the findings involves communicating the results of the study to relevant stakeholders in a clear and concise manner. This phase involves collecting data through various methods, analyzing it in detail, and presenting the findings in a clear and concise manner.

The research phase of the methodology of an architectural thesis is critical for the development of a successful project. By following a structured approach and completing each step with care, researchers can ensure that the study is well-planned, well-executed, and effectively communicates the findings to relevant stakeholders.

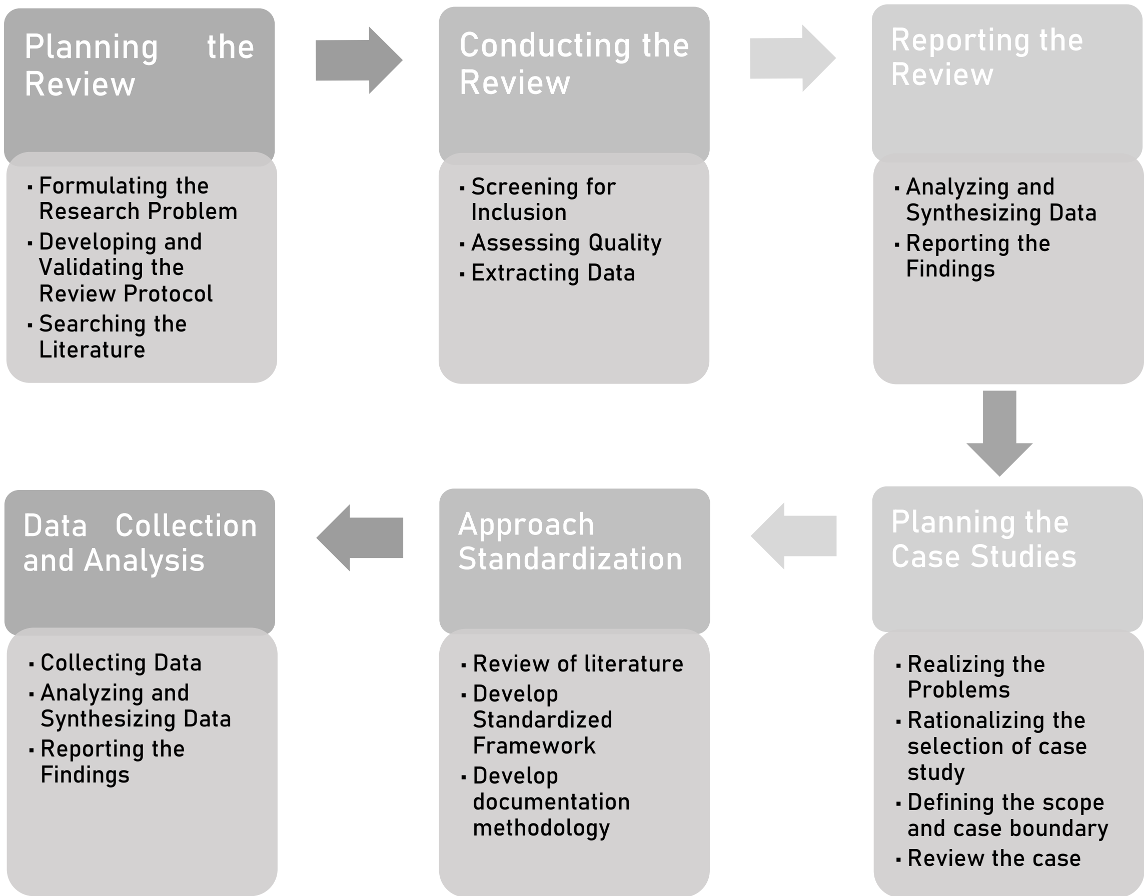


Figure 7: Research Phase

2.2.3. DESIGN PHASE:

The design phase involves using the findings from the research phase to develop a design proposal that addresses the problem identified in the preliminary phase. This phase may include conceptual design, schematic design, design development, and final design. The design phase is important for creating a cohesive and integrated design proposal that responds to the research and meets the objectives established in the preliminary phase. It is the stage where ideas and concepts are transformed into visual representations and technical drawings. This phase typically involves three main stages:

2.2.3.1. Conceptual Design:

The first stage in the design phase is the conceptual design, which involves selecting a suitable site for the project and conducting a site visit to analyze its strengths, weaknesses, opportunities, and constraints. Program is then formulated based on the needs based on the literature review, expanded core curriculum and case studies, which will guide the design process, that outlines the functional requirements, spaces, and activities that the building must accommodate. The concept for the building is then developed, which is a creative response to the design problem.

2.2.3.2. Design Development:

The second stage in the design phase is the design development, which involves translating the concept into more detailed design proposals. The conceptual sketches and diagrams are created to explore different design options and to refine the chosen concept. After selecting the most appropriate design option, one prepares planning and zoning drawings that show the building's layout and its relationship to the site.

3D visualizations are also done to help the visualize the design and to communicate design ideas to others. Once the 3D visualization is up to par, the drawings are finalized and detailed technical drawings of floor plans, elevations, and sections are prepared.

2.2.3.3. Drawing Detailing:

The third and final stage in the design phase is drawing detailing, which involves the preparation of detailed and accurate drawings that will guide the construction process. This includes finalizing the technical drawings, creating structural and service drawings that show the placement of structural elements and mechanical systems, and creating the final 3D visualization and rendering that will help to convey the design intent to the client and other stakeholders.

Throughout the design phase, the architect must consider a wide range of factors, including the building's functionality, aesthetics, environmental impact, structural requirements, and building codes and regulations.

In conclusion, the design phase is a crucial stage in the methodology of an architectural thesis. It involves translating ideas and concepts into detailed visual representations and technical drawings that will guide the construction process. The design phase requires a combination of creative thinking, technical skill, and collaboration, and it is essential for producing successful architectural outcomes.

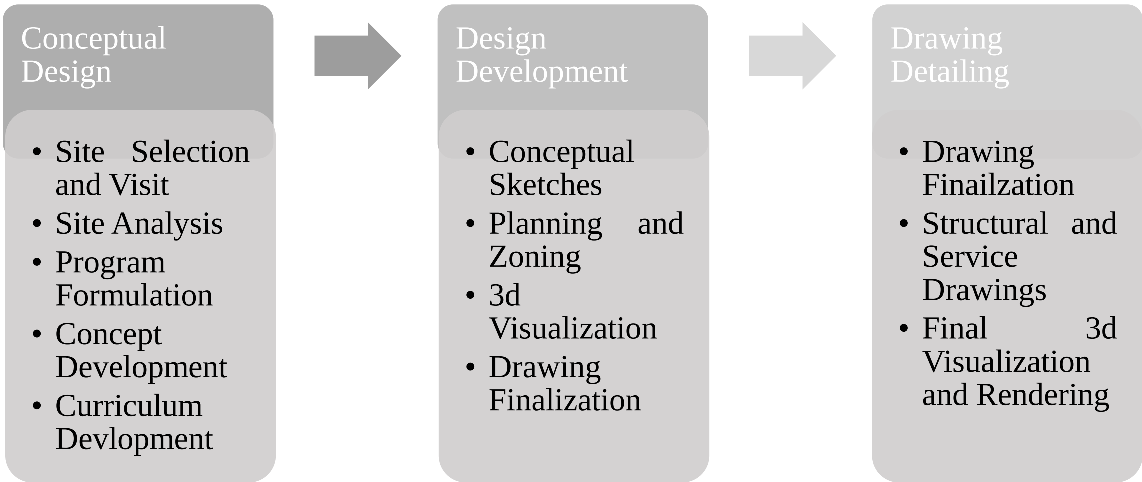


Figure 8: Design Phase

Overall, the methodology of an architectural thesis is a multi-stage process that requires careful planning, research, and design. By dividing the process into three main phases, researchers can ensure that each step of the project is well-executed and contributes to a successful outcome. The actual flowchart of the methodology of the study is provided in Figure 9.

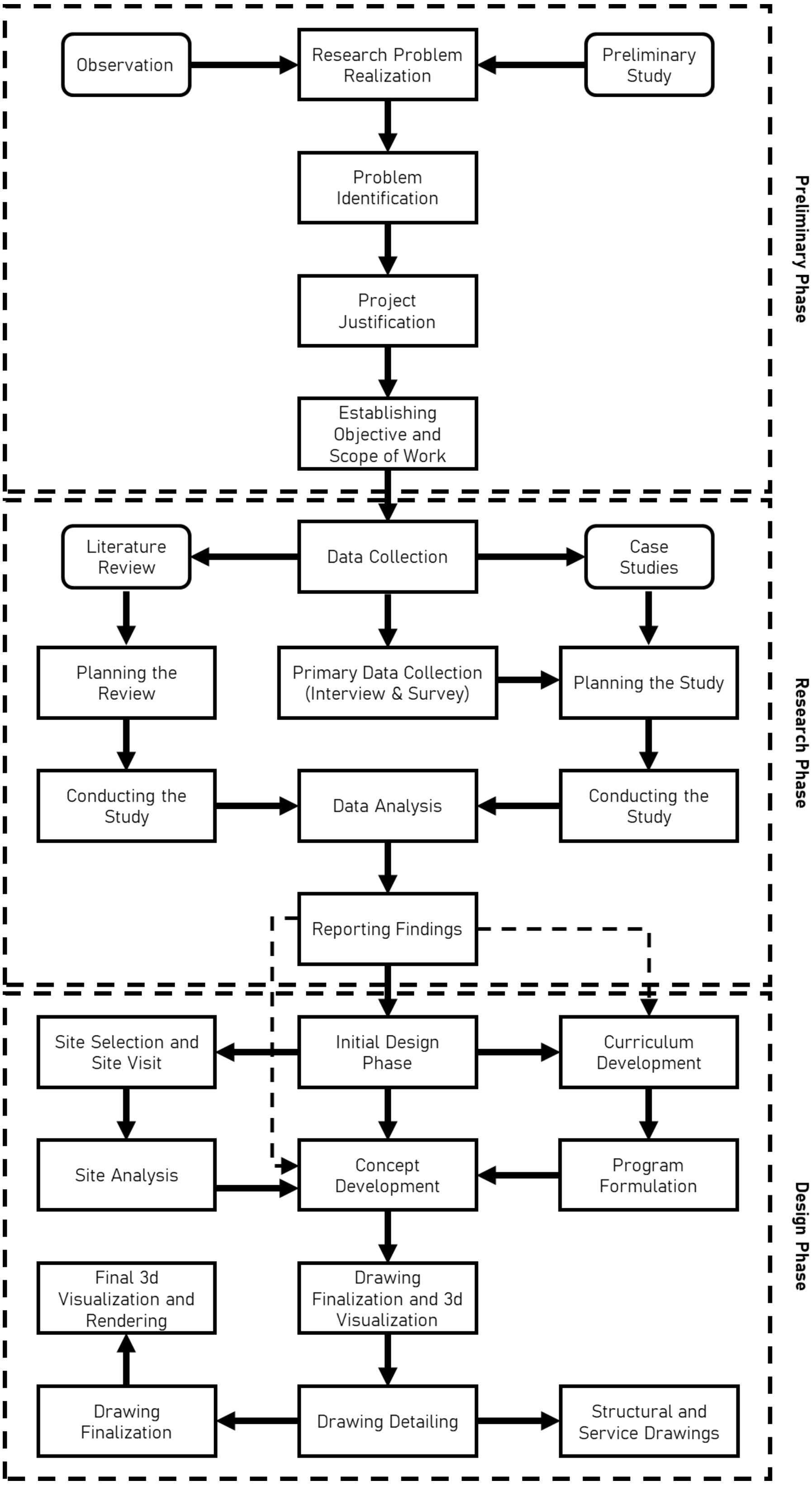


Figure 9: Proposed Methodology

CHAPTER 3: LITERATURE REVIEW

3.1. VISUAL IMPAIRMENT

3.1.1. INTRODUCTION

The visual system is exceptional in its capacity to gather light from the environment, concentrate it onto the retina, and produce a signal that is subsequently processed by the brain. Any disruption within this system can cause VI. Visual impairment (VI) is a disorder characterized by diminished visual acuity that cannot be corrected by refractive correction, surgery, or medicinal procedures (Freeman & Gower). As a result, it causes functional limits in the visual system, such as irreversible vision loss, narrower visual field and diminished contrast sensitivity, increased sensitivity to glare, and impaired capacity to perform activities of daily life such as reading or writing. Uncorrected refractive error is one of the major contributors to VI. (Naipal & Rampersad, 2018) In 1992, the World Health Organization (WHO) definition defined VI as:

"a person with low vision is one who has impairment of visual functioning even after treatment and/or standard refractive correction and has VA of less than 6/18 to light perception, or a visual field of less than 10 degrees from the point of fixation, but who uses, or is potentially able to use, vision for the planning and/or execution of a task."

Even with refractive correction, individuals with VI have trouble performing visual tasks. Additionally, by using compensatory low vision aids and/or modifying their surroundings, these people are rarely able to improve their capacity for doing visual tasks. (Naipal & Rampersad, 2018). The most prevalent myth is that blind people can only see in the dark. However, the number of persons who fully lose their vision is quite modest. Different types of vision distortion are caused by various eye disorders. We will explore the various types and causes of VI to get a glimpse of VI.

Even with refractive correction, individuals with VI have trouble performing visual tasks. Additionally, by using compensatory low vision aids and/or modifying their surroundings, these people are rarely able to improve their capacity for doing visual tasks. (Naipal & Rampersad, 2018). The most prevalent myth is that blind people can only see in the dark. However, the number of persons who fully lose their vision is quite modest. Different types of vision distortion are caused by various eye disorders. We will explore the various types and causes of VI to get a glimpse of VI.

3.1.2. TYPES OF VISUAL IMPAIRMENT

The 10th revision of the International Classification of Diseases, ICD-10, categized the VI into four levels (refer to Table 1 and Table 2):

1. Mild or no VI: It refers to a condition where a person suffers from any of the following conditions, namely:

- Visual acuity within the range of 20/20 or 1 to 6/18 or 3/10 (0.3) or 20/70 in the better eye even with correction lenses

Figure 10: Original Scene

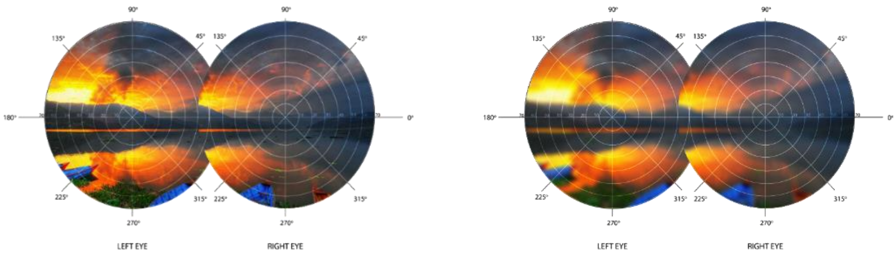


Figure 11: Full visual field and 20/20 acuity (Left) and 20/40 Visual Acuity (Right)

2. Moderate VI: It refers to a condition where a person suffers from any of the following conditions, namely:

- Visual acuity within the range of 6/18 or 3/10 (0.3) or 20/70 to 6/60 or 1/10 (0.10) or 20/200 in the better eye even with correction lenses

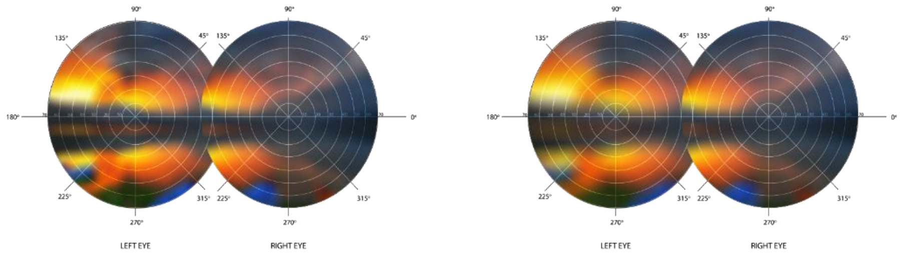


Figure 12: Mild Visual Impairment (20/70 Visual Acuity) (Left) and Moderate Visual Impairment (20/200 Visual Acuity) (Right)

3. Severe VI: It refers to a condition where a person suffers from any of the following conditions, namely:

- Visual acuity within the range of 6/60 or 1/10 (0.10) or 20/200 to 1/60 (or finger counting at 1 meter) or, 1/50 (0.02) or, 5/300 (20/1200) in the better eye even with correction lenses or,
- Limitation of central visual field no greater than 10° in a radius around central fixation for the better eyes

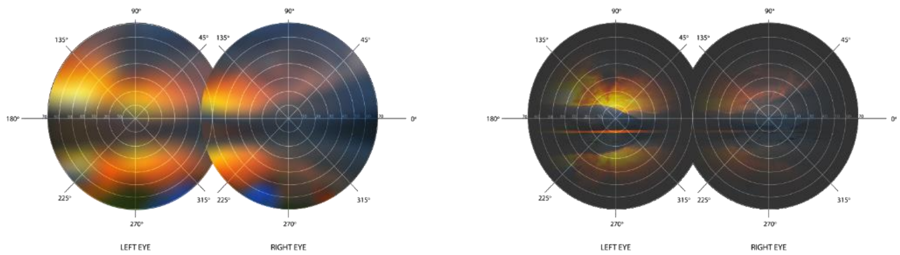


Figure 13: Category 3 Blindness (20/400 Visual Acuity) (Left) and Category 3 Blindness (10 degree cone of vision) (Right)

4. Blindness: It refers to a condition where a person suffers from any of the following conditions, namely:

- Total absence of light perception, or
- Could only perceive light, or
- Visual acuity not less than 1/60 (or finger counting at 1 meter) or, 1/50 (0.02) or, 5/300 (20/1200) in the better eye even with correction lenses.

Table 1: Categories of severity of visual impairment

Category of visual impairment	Visual acuity with best possible correction		Or central visual field*	Classified as
	Maximum less than	Minimum equal to or better than		
0		6/18 3/10 (0.3) 20/70		Mild or no visual impairment
1	6/18 3/10 (0.3) 20/70	6/60 1/10 (0.10) 20/200		Moderate visual impairment
2	6/60 1/10 (0.10) 20/200	3/60 1/20 (0.05) 20/400		Severe visual impairment
3	3/60 1/20 (0.05) 20/400	1/60 (or finger counting at 1 meter) 1/50 (0.02) 5/300 (20/1200)	no greater than 10° in a radius around central fixation for the better eyes	Blindness
4	1/60 (or finger counting at 1 meter) 1/50 (0.02) 5/300 (20/1200)	Light perception		Blindness
5	No light perception			Total blindness
9	Undetermined or unspecified			Unspecified

Table 2: Classification of visual impairment in a person

Classification of visual impairment in a person according to the International Statistical Classification of Diseases	
H54 ICD code	**Blindness and low vision** Level of visual impairment in a person
H54.0	**Blindness, binocular** Visual impairment categories 3, 4, 5 in both eyes.
H54.1	**Severe visual impairment, binocular** Visual impairment categories 2
H54.2	**Moderate visual impairment, binocular** Visual impairment categories 1
H54.3	**Mild or no visual impairment, binocular** Visual impairment category 0
H54.4	**Blindness, monocular** Visual impairment categories 3, 4, 5 in one eye and categories 0, 1, 2, or 9 in the other eye.
H54.5	**Severe visual impairment, monocular** Visual impairment categories 2 in one eye and categories 0, 1, 2, or 9 in the other eye.
H54.6	**Moderate visual impairment, monocular** Visual impairment category 1 in one eye and categories 0 or 9 in other eye.
H54.9	**Unspecified visual impairment (binocular)** Visual impairment category 9.

3.1.3. Causes of Visual Impairment

Since, the relevant topic is not within the scope of the work, the causes of VI has not been gone into details. The causes of VI can commonly be classified into:

- Ocular Diseases and Anomalies

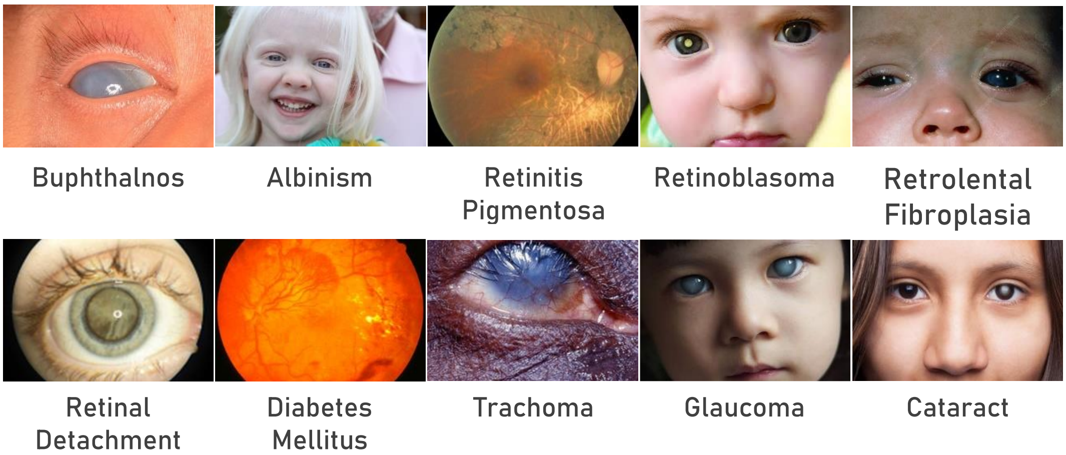


Figure 14: Types of Ocular Diseases and Anomalies

- General and Systemic Diseases
  - Hypertension
  - Vitamin A Deficiency
  - Chronic Diarrhoea
  - Multiple sclerosis,
  - Thyroid gland disorders,
  - Other systemic diseases
- Injuries and Accidents
  - Traumatic and chemical injuries
  - Lodging of foreign body in the eye
  - Chemical burns

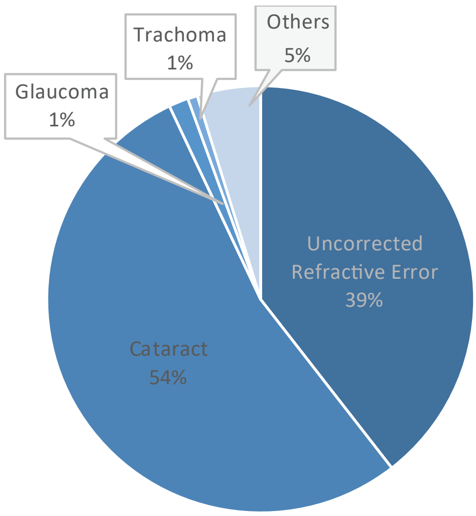


Figure 15: Major Causes of Visual Impairment in Nepal

3.1.4. MYTH AND MISCONCEPTION ABOUT VISUALLY IMPAIRED

Myth	Strictly looking at visual acuity, patients with 20/20 VA in one eye and No Light Perception in the other eye are considered legally blind.
Fact	Legal blindness is an impairment in BOTH eyes (we always consider the better seeing eye). (Phan, 2013)
Myth	Individuals with visual impairment or those considered legally blind always use a white cane.
Fact	Less than 2% of Americans who are blind or visually impaired use a cane for orientation and mobility. (Jernigan, n.d.) A person with low vision may use a white cane in specific situations, but many do not rely on a cane for mobility guidance. (Phan, 2013)
Myth	Low vision patients are born with their impairment.
Fact	Some diseases may cause visual impairment at birth (albinism, aniridia). Others are acquired later in life, such as age-related macular degeneration and trauma. (Phan, 2013)
Myth	People with visual impairment cannot live independently.
Fact	Regardless of one's level of visual loss, it is not a barrier to living a free and independent life. (Phan, 2013)
Myth	Individuals with low vision must read Braille because they are unable to read regular print.
Fact	The type of print patients with low vision read varies. Some use Braille, others use larger fonts, and there are those who read normal size print with an optical device. (Phan, 2013)
Myth	People who have low vision are unable to drive.
Fact	Currently, some countries allow individuals with low vision to have a restricted driver's license. Many may require the patients to use a bioptic telescope while behind the wheel. (Phan, 2013)

Myth	Blind people have superior hearing
Fact	They will learn to concentrate, discern and derive a lot of meaning from sound, and make use of it in innovative ways. This are not distracted by sight, but this is listening qua paying attention. On a straight up listening test, blind people hear at a normal level. (Wannop, n.d.)
Myth	Blindness is a tragedy. For people who suffer from blindness, life has lost all meaning. People who are blind or visually impaired are mentally retarded or less informed.
Fact	With proper training and opportunity, the average person who is blind or visually impaired can compete in terms of equality with the average person who is sighted. In other words, the person who is blind or visually impaired can be as happy and lead as full a life as anybody else. (Jernigan, n.d.)
Myth	People who are blind or visually impaired are helpless and require supervision in their daily activities for safety's sake.
Fact	People who are blind or visually impaired are by and large much more independent than others give them credit for. Many are mobile and independent. Many view their blindness as a mere physical nuisance and not a disability. (Jernigan, n.d.)
Myth	All people who are blind or visually impaired see nothing at all. People who are blind or visually impaired are always in total darkness.
Fact	Actually, the definition of legal blindness covers a range of conditions. Some have tunnel vision, others peripheral. Some can read large print. Others have focused difficulties. Most blind people are not completely without sight, while some have light perception but cannot make out color, shape, or detail, nor depth. (Wannop, n.d.). Only about 10-15% of people who are blind or visually impaired "see" total darkness. The majority of people who are considered blind have some sight, rather than no sight at all. (Jernigan, n.d.)

Myth	Blindness means your job options are limited.
Fact	People who are blind have successful careers in many fields. People who are blind can succeed in almost any career with the right technology and accommodations, including professional fields, tech jobs and more. The only barrier is often an employer's willingness to give blind candidate a fair chance. (Blindness Myths and Facts, n.d.)
Myth	People who are blind can't use most technology.
Fact	Technology is a way of life for people who are blind. VI use computers, mobile phones, apps and other tech to enhance their independence and make the world more accessible. Many people who are blind say technology has revolutionized their lives. (Blindness Myths and Facts, n.d.)
Myth	There is a strong belief that disability is due to sins in a past life. 30% of parents of persons with disabilities ponder that it was due to fate and God's will. (Human Right Watch, 2011)
Fact	The disability is mostly caused due poverty or environmental conditions and poor access to health care services.

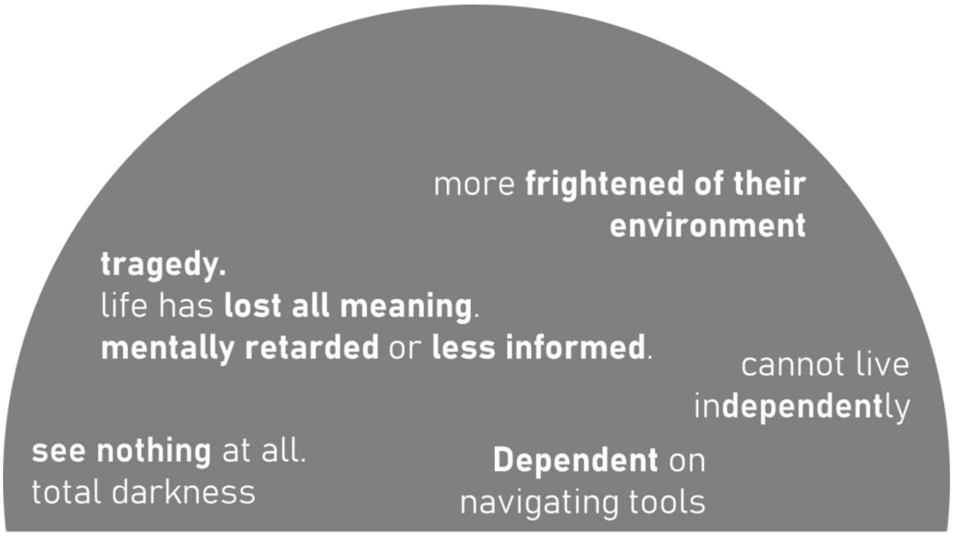


Figure 16: Common Myth and Misconception of Visually Impaired People

3.1.1. Stigma against Visually Impaired

"In the village, other people used to tease me by calling me a buffalo, telling me to find my shepherd."

- Santosh, 23-year-old deaf student studying at a special school for the deaf, Pokhara, April 2011

In Nepal, there is a widespread conviction that past transgressions are to blame for disabilities. In fact, nearly 30 percent of the parents of disabled children polled for the 2001 study said their child's impairment was due to fate and God's will. These beliefs frequently impede children with disabilities from receiving appropriate education or health treatment because their families feel ashamed of their children or do not see the advantage of sending them to school. (Human Right Watch, 2011). Humiliation against VI are usually seen in the family or within the society.

Looking within in the society, the fear factors of religion still bound the Nepalis culture. Thus, there is a strong belief that disability is due to past sins. In remote regions, blind persons are barred from religious and cultural events like wedding ceremonies and other formal occasions, as their presence is thought to bring bad luck. Such misconception makes children with disabilities (CWD) prone to stigma, bullying, teasing and verbal abuse. They are often bullied or verbally abused by the people close to them. Similarly, mothers of children with disabilities are also the victim of stigmatization or pettiness both within the family and the community. CWD and sometimes their family members are even left out during community participation. In case of girls with blindness, they are found to be double marginalized first as girls and then as girls with blindness, which often results in their social exclusion. (Human Right Watch, 2011)

Figure 17: Social Isolation & Visual Impairment

Similarly, CWD also face such problems within the family. They are often left out during family discussions. Families are ashamed of their children. Families do not see the benefit of sending Children with disabilities to school. The children are not allowed to roam outside and are kept in the room catering to the daily needs of the children, Daily corporal abuse both in home and school. Such discrimination causes the CWD to be fully dependent on others financially. If given a chance, CWD can live a fully independent life; reach out to a career they want; be productive members of their communities and lift themselves out of poverty and participate as citizens on an equal basis with others in society. (Human Right Watch, 2011)

3.2. NEEDS AND PROBLEM OF VISUALLY IMPAIRED

Designing a school that is accessible, functional, and meets the unique needs of visually impaired students requires a thorough understanding of the specific challenges they face. By studying the needs and problems of visually impaired students, designers can create an environment that addresses their unique needs and promotes their learning and development.

Additionally, studying the needs and problems of visually impaired students can help designers identify potential barriers to accessibility and inclusion, and develop strategies to address them. For example, designers can explore solutions such as accessible layouts, specialized furniture, and assistive technologies to create an environment that is safe, comfortable, and supportive for visually impaired students.

Overall, studying the needs and problems of visually impaired individuals is crucial to designing a school that is both functional and accessible for students with visual impairments. By taking a user-centered approach, designers can create an environment that meets the unique needs of visually impaired students and provides them with the support they need to succeed in school and beyond. Thus, the study on the needs and problems of VI individuals were conducted:

3.2.1. VIOLENCE

WHO defines violence as “the intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community that either result in or has a high likelihood of resulting in injury, death, psychological harm, maldevelopment, or deprivation.” According to recent global reports, people with disabilities face higher physical violence. Sobsey and Mansell in their study found out that most abused disabled children were abused by people who are close to them such as their family members or, mostly peers. (Soleimani-Sefat, Rostami, Shahin, & Movallali, 2016). This can be resolved through:

- Inclusion of social protection mechanism
- Raise Public Awareness of Disability Rights and Inclusive Education
- Awareness-raising campaigns for bullying and teasing by teachers, family members, and children

3.2.1.1. COMMUTE

For many people, commuting is a substantial source of stress, affecting temperament, health, and other aspects of psychological gratification. Individuals with impairments are unable to participate in cultural and economic activities due to mobility and communication barriers. These barriers are troublesome as they generate issues and financial stress for the person with a visual impairment owing to constraints in activity and work. Due to the inappropriate transportation system, constraints on commuting to employment develop. Based on the study, the main need of visually impaired people was an easy-to-access transportation system, the information on services related to transportation, how to access it, and where to find it. Such lack of information limited the ability to live independently of visually impaired individuals (Soleimani-Sefat, Rostami, Shahin, & Movallali, 2016). Similarly, in the context of Nepal, the lack of inclusive footpath makes the visually impaired people to relay on others for navigation. In most of the residential zones, footpath is not even provided cause them to develop a fear factor. The problems faced by VI during commute are briefed below:

- Inappropriate sidewalks and public places,
- Constraints in activity and work due to the inappropriate transportation system,
- Inadequate public transportation services adapted to the requirements of people with visual impairment.

The barrier existing between this field can be rectified by:

- An easy-to-access transportation system

- The information on services related to transportation (how to access it, and where to find it). Such lack of information limited the ability to live independently of visually impaired individuals

3.2.1.2. COMMUNICATION

For a healthy quality of life, the capacity to interact successfully with people is critical. Lack of Communication and impaired psychosocial functioning are well-documented in persons with sensory impairment. Social networks are far smaller in such teenagers than those of their sighted classmates. Students with visual impairment face communication challenges for a variety of reasons, including societal attitudes toward people with disabilities, extreme parental support and empathy, lack of visual feedback on their behavior, a lack of role models, a lack of special visual skills, rejection and negative reactions from parents because the child with visual impairment does not encourage them with a smile or direct eye contact, rejection by classmates for visual impairment, rejection due to low awareness about the games, short and self-centered talks, and lack of focus on group activities (Soleimani-Sefat, Rostami, Shahin, & Movallali, 2016). The problems faced by the individuals while communicating with others are noted below:

- Lack of Communication and impaired psychosocial functioning
- Smaller social networks than those of their sighted classmates.
- Societal attitudes toward people with disabilities,
- Extreme parental support and empathy,
- Lack of visual feedback on their behavior,
- A lack of role models,
- Short and self-centered talks, and lack of focus on group activities

The barrier existing between the individuals can be rectified by:

- Raising awareness of others to the capabilities as well as the limits of people with visual impairment.
- An attitude and without pity from others.
- Raising awareness in the field of how to communicate with people with visual impairment.

3.2.1.3. LEISURE

Leisure time can be described as time set aside for activities that are freely selected and enjoyed by the participant while not engaged in self-care, school, or employment. Although participating in leisure activities increases self-esteem, competence, and academic accomplishment, leisure activities for young people with visual impairment differ dramatically from those for their peers who are sighted. VI youth have less social engagement with their peers and spend most of their time alone. They have fewer activities, less independence, and are always accompanied by their parents. Lack of access to easy transportation, recreational facilities, information, and trained teachers and people who have good perceptions of them can all impact the leisure activities of children with VI (Soleimani-Sefat, Rostami, Shahin, & Movallali, 2016). Such problems can be resolved through:

- Increase self-esteem, competence, and academic accomplishment,
- Easy-to-access transportation, recreational facilities, information, and trained teachers.
- The need for a place for sports and recreation for people with visual impairment
- The need for funding for the use of recreational and sports facilities,
- Existence of special equipment in places of recreation and sporting.
- Vocational Rehabilitation Services.
- Counseling and social work.

3.2.1.4. EDUCATION

Disability has dual and paradoxical impacts. On the one hand, such a problem weakens and harms body operations. On the other hand, Disruption of the functions stimulates other functions to compensate for and correct the flaw. 90% of persons with vision impairments have enough vision to obtain instruction and training in the use of visual and non-visual aids, therefore training and evaluating the efficacy of services for these people is justified (Soleimani-Sefat, Rostami, Shahin, & Movallali, 2016).

Similarly, in the context of Nepal, CDW face numerous problems in educational sector. Lack of Monitoring such children can be seen in most of the schools. Similarly, lack of information about possibility and availability of education for children with disabilities in the primary cause of low enrolment followed by High Drop-Out and Low Attendance

Rates, Low Pass Rate, Denied Admission and School Fees. Inflexible Curriculum and Evaluation System causes the CWD to have segregated and inferior quality of education. Some subjects such as mathematics which requires graphical information and comparison of preceding step to solve the equation. Thus, due to the inflexible curriculum and evaluation system visually impaired children are most unlikely to get a good mark. Likewise, the lack of adequately trained teachers fails to make the school environment accessible for children with disabilities, which in many cases effectively denies these children their right to education. (Human Right Watch, 2011). The problems faced by the individuals in education sector are noted below:

- Lack of access to educational resources and facilities in ordinary schools.
- Restrictions in books, resources and educational materials.
- Lack of Information about Possibility and Availability of Education for Children with Disabilities.
- Low Enrolment, High Drop-Out and Low Attendance Rates, Low Pass Rate, Denied Admission and School Fees,
- Lack of Monitoring,
- Segregated and Inferior Quality of Education,
- Lack of Adequately Trained Teachers, and
- Inflexible Curriculum and Evaluation System

To eradicate such problem existing in the education sectors, the following needs should be addressed:

- Society education to create positive attitudes about people with visual impairment.
- Vocational education in specific fields,
- Training in the use of assistive devices,
- The need for special facilities such as books for people with visual impairment,
- Healthy children training in schools to get acquainted with the issues and problems of people with visual impairment, and
- Training school principals and personnel to work with students with visual impairment.

3.3. PRINCIPLES OF UNIVERSAL DESIGN

Universal design (also known as inclusive design or design for all) includes ethical and legal aspects related to equality, human rights, and the social dimension of our physical environment. The environment will be accessible to all, if the needs of people with reduced functionality in terms of movement, vision, hearing, or comprehension, or due to environmentally induced conditions (asthma/ allergies) will be addressed. With the world turning its attention to “Universal design,” accessibility for all could be the focus of contemporary architecture. Designing buildings and outdoor areas which can cater to the actual needs of people with disabilities within the conceptual, functional, spatial, and material perspective rather than just fulfilling the regulatory requirements is a challenging task (Ahmer, 2014).

The seven principles of universal design, developed in 1997 by a group of architects, designers, engineers, and researchers at the Center for Universal Design, North Carolina State University, are applied to guide the design process, assess the existing design, and educate the designers and clients about the characteristics of universal design. These seven principles of universal design are (Ahmer, 2014):

1. Equitable Use: The design is useful and marketable to people with diverse abilities.
2. Flexibility in Use: The design accommodates a wide range of individual preferences and abilities.
3. Simple and Intuitive Use: Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
4. Perceptible Information: The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
5. Tolerance for Error: The design minimizes hazards and the adverse consequences of accidental or unintended actions.
6. Low Physical Effort: The design can be used efficiently and comfortably and with a minimum of fatigue.
7. Size and Space for Approach and Use: Appropriate size and space is provided for approach, reach, manipulation, and use, regardless of the user's body size, posture, or mobility.

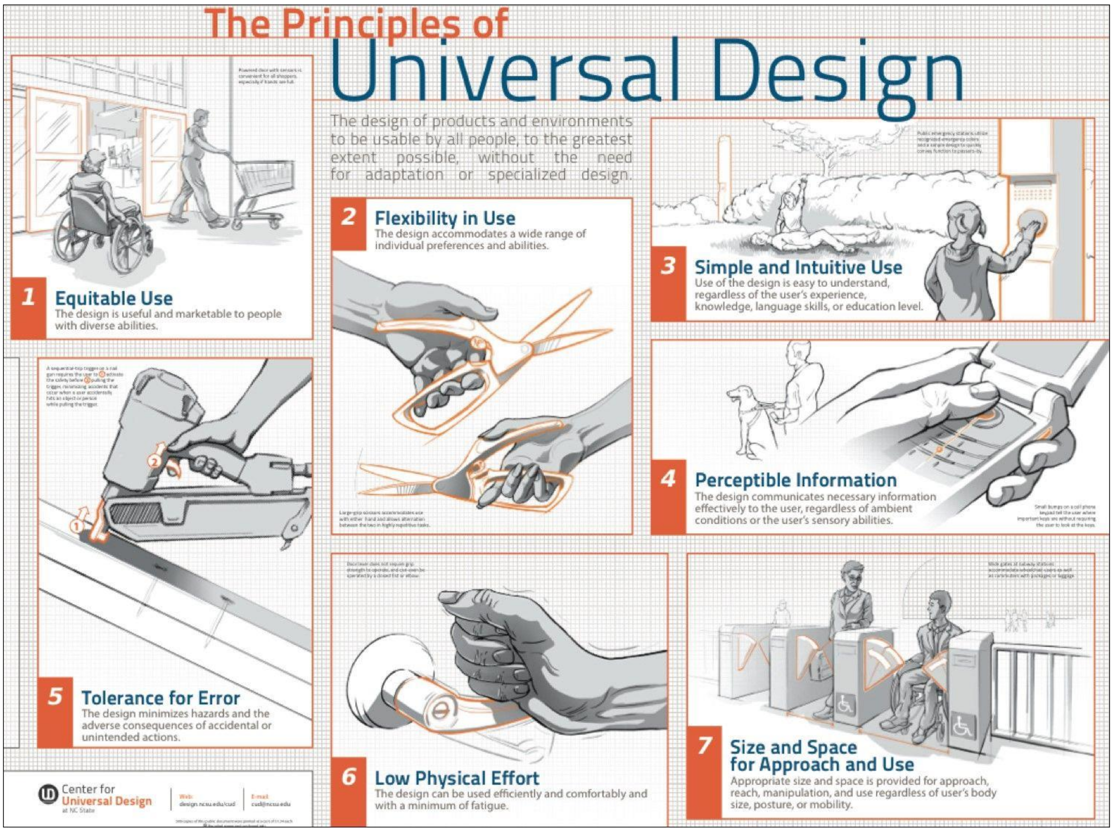


Figure 18: Seven Principles of Universal Design

(Source: https://www.gartec.com/wp-content/uploads/2021/03/principles_ud.png)

Any good architecture must relate people to space. Any structure should not require the resident to adapt to the building but needs to adapt to that resident, both from a resource and an intellectual perspective. Moreover, the function-driven spaces feel secure and adaptive in comparison to the flexible building (in the sense of modifiable buildings and space). Flexible building systems in schools enable switching between large and small groups using mobile furniture does not give the visually impaired enough time to adapt to the space. SINTEF Building and Infrastructure points out that the seven principles are inadequate in architecture during the planning and building phase since the principles are very general and do not provide specific guidelines for how to achieve universal design in practice. Therefore, while these Principles are an important framework for promoting accessibility and inclusivity, they should be viewed as a starting point rather than a comprehensive solution. Applying these principles to the design of a school for VI can help ensure that the space is functional and accessible.

3.4. MULTI-SENSORY EXPERIENCE AND AESTHETICS

While certain design elements such as Braille signs and audio announcements have been implemented to assist VI individuals, the use of multi-sensory architecture is still limited in many places. VI people often interact with environments that were architecturally designed for the eye of the beholder i.e., intended for sighted people, which tends to neglect the non-visual senses of hearing, smell, touch, and even taste, forming a spatial barrier between them and their surroundings. This is because individuals are more attentive to visual stimuli compared to the typical spatial perception process, and it usually triumphs over information gained via other senses. As a result, design professionals prefer to concentrate on the visual sense, resulting in architectural Ocularcentrism (Oteifa, Sherif, & Mostafa, Understanding the Experience of the Visually Impaired towards a Multi-Sensorial Architectural Design, 2017)

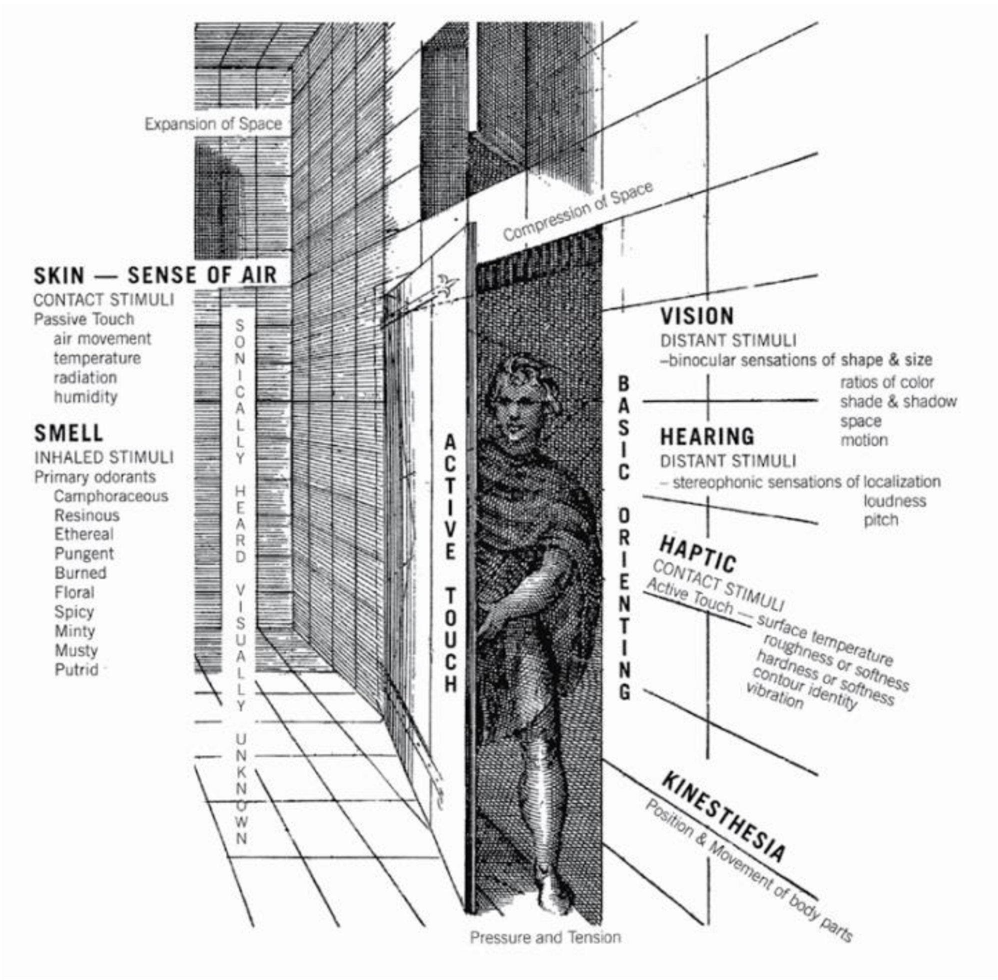


Figure 19: Ranges of the Senses, from Sensory Design by Joy Monice Malnar and Frank Vodvarka

3.4.1. VISUAL SENSES

Pallasmaa (1994), in his book "The Eyes of the Skin" quotes:

"The sight separates us from the world, while the rest of the senses joins him. Eyesight isolates; Eyesight is directional (externality)."

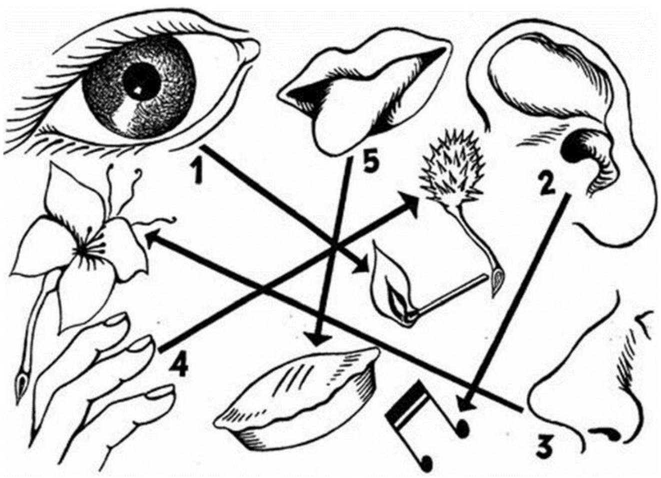


Figure 20: Order of various senses. Heilig (1992) (Heilig's rankings: vision, 70%; audition, 20%; olfaction, 5%; touch, 4%; and taste)

As already stated above, there has always been supremacy of the sense of vision over the other senses during the process of thought and perception. Most difficulties of contemporary architecture are centered on the dominance of the sense of eyesight, giving birth to the unbalanced sense system as other senses are suppressed, and the environment is misperceived. The other senses, such as sound, touch (including proprioception, kinesthesis, and the vestibular sense), smell, and on rare instances, taste, have, now begun to receive more attention from architects and designers in recent years. (Spence, 2020)

Visual perception science can be linked to architectural design practice in a variety of ways. We have an inbuilt preference for visual curvature, whether it is in internal space or the furniture that is present within that area. Curvilinear forms are often rated as being more accessible than rectilinear ones. An avoidance response is more likely to be evoked by angular forms because they may be seen as frightening, especially when they point downward or toward us. Even if they are not directly in your path, angular objects have an unconscious impact on your emotions as you go through your home. While they may appear stylish and polished, they stifle our fun tendencies. The opposite is true for rounded shapes. A circular or elliptical coffee table transforms a living area into a bustling hub for conversation and unexpected games from a place for serious, restricted engagement. It has also been demonstrated that the height of the ceiling affects our approach-avoidance behaviors. Color and lighting also have a profound impact on how we perceive space. (Spence, 2020).

Figure 21: High/ Low roof; Open/ Enclosed space. (Spence, 2020)

Figure 21: High/ Low roof; Open/ Enclosed space. Figure 21 describes a selection of the interiors shown to participants in a neuroimaging study designed to assess viewers' approach-avoidance motivation in response to curvilinear vs. rectilinear spaces. [High/Low roof; Open/Enclosed space.] (Spence, 2020)

As already stated in "Myth and Misconception about Visually Impaired", the definition of legal blindness covers a range of conditions and most blind people are not completely without sight, while some have light perception but cannot make out color, shape, or detail, nor depth. Thus, visual senses can be stimulated in visually impaired people by:

Contrast: High-contrast elements, such as contrasting colors or textures, can help visually impaired people differentiate between different areas and elements within a space.

Lighting: Lighting is extremely important for visually impaired people as it can greatly impact their ability to navigate and function in a space. Proper lighting can enhance contrast and visibility, making it easier for visually impaired individuals to identify objects and surfaces. It can also provide important cues about spatial orientation and help individuals to distinguish between different areas and functions within a space. Lighting can also play a critical role in promoting safety for visually impaired people. Proper lighting is crucial in creating an inclusive and accessible environment for visually impaired individuals, promoting their safety, independence, and overall well-being as well as impact on the mood and emotional wellbeing.

3.4.2. Tactile Senses

"Although architecture is often defined in terms of abstractions such as space, light and volume, buildings are above all physical artifacts. The experience of architecture is palpable: the grain of wood, the veined surface of marble, the cold precision of steel, the textured pattern of brick."

- Witold Rybczynski

Figure 22: Tactile Senses
(Source: Perkins School for the Blind)

Architecture frequently overlooks its tactile component. In fact, the moment we enter or leave a building, we make our first physical contact with it. According to Pallasmaa (1994) in his book "The Eyes of the Skin," "the door handle is the building's handshake." However, once inside a structure, it is important to realize that we will most likely come into contact with floors, hand rails, furniture, and other similar items. Architecture may be perceived through tactile sense through the texture of brick, the veins on the surface of marble, the cold precision of steel, and the grain of wood. The careful use of material can enhance the sense of tactility by seducing the observer (or occupant) to imagine or mentally replicate what it would be like to reach out and touch or caress an appealing surface. In other words, the tactile component is essential to the overall (multisensory) experience of architectural design. Whether the physicality is directly touched or not, this is true (i.e., merely seen, inferred, or imagined). The tactile properties of the material enhance the sense of closeness, proximity, and effect. In short, the Tactile Senses are affected by the following factors (Spence, 2020):

- Smoothness and roughness,
- Bumps and hard,

- Contact and touch,
- Texture,
- Weight and density,
- Heat or material temperature

Incorporating tactile elements into the design of architecture can help stimulate the tactile senses of visually impaired individuals. Some ways to achieve this include:

- Using textures: Incorporating textured materials such as stone, wood, or metal can provide a tactile experience for individuals. These materials can be used for flooring, walls, or furniture.
- Braille signage: Including Braille signage in key locations can help visually impaired individuals navigate the space independently.
- Handrails: Installing handrails along pathways and staircases provides a tactile guide for visually impaired individuals.
- Raised patterns: Incorporating raised patterns on surfaces such as walls or floors can provide a tactile experience and help individuals navigate spaces.
- Sound: Using materials that produce sound or incorporating sound systems in the architecture can help stimulate the auditory senses of visually impaired individuals.

3.4.3. ACOUSTIC SENSES

“The modern architect is designing for the deaf …. The study of sound enters modern architecture schools only as sound reduction, isolation, and absorption.”

Undoubtedly, how a room sounds is significant. After all, sounds might give hints as to a space's identity or dimensions, or even its function. Every structure or location, as noted by Pallasmaa, has a distinctive sound that might convey intimacy or monumentality, denial or invitation, welcome or antagonism. However, the topic of unwanted noise is one that is frequently brought up when talking about sound and architectural design. There is also a developing story about the negative impacts of loud background noise and the frequently positive benefits of music and soundscapes on patients' rehabilitation in the hospital/healthcare context. (Spence, 2020)

The use of natural noises, such as the sound of running water, to assist hide other people's disturbing discussions is being researched. The presence of a waterfall at the far end of the lot in this instance effectively masks the acoustic space- imagine just the noises, or better-termed cacophony, of the city. The lush vegetation that is along the side walls probably also contributes to the noise reduction. (Spence, 2020)

Think merely of the old Muzak to understand how crucial music is to experience the built environment. This is also true of the hotel experience for the visitor. Customers are greeted with the sound in the lobby. In order to pass the time between check-in and check-out, hotel lobby music is frequently determined by tedious, vacuous lounge muzak- a zombie-like drone of new jazz and polite house. Due to the loud music from the nightclub or bar, which is frequently a key component of the experience provided by these trendy venues, careful architectural planning is also necessary to prevent undesired noise from reverberating throughout the remainder of the structure. (Spence, 2020).

Stimulating acoustic senses in architecture is an important aspect of designing for visually impaired people. This can be achieved using various acoustic elements such as sound-absorbing materials, sound masking systems, and careful acoustic design.

For example, sound-absorbing materials can be used to reduce unwanted noise and echo in a space, creating a more comfortable and clearer auditory environment. Similarly, sound masking systems can be used to create a background sound that can help mask unwanted noise and provide a more consistent and pleasant auditory experience.

In addition, careful acoustic design can help ensure that important sounds, such as alarms and announcements, are easily heard and understood by visually impaired individuals. This can include the use of directional sound systems or other technologies that help direct sound to the appropriate location. Similarly, using materials that produce sound or incorporating sound systems in the architecture can help stimulate the auditory senses of visually impaired individuals.

3.4.4. OLFACTORY SENSES

"The strongest memory of a space is often its odor; I cannot remember the appearance of the door to my grandfather's farm-house from my early childhood, but I do remember the resistance of its weight, the patina of its wood surface scarred by a half century of use, and I recall especially the scent of a home that hit my face as an invisible wall behind the door."

Speaking of the architecture of taste or aroma, the two so-called chemical senses, may seem like going too far. Olfaction is more active in silence and lack of light. Unfortunately, and frequently, olfactory consideration in architectural design has been limited to the removal of offensive odors. This may not be a coincidence considering that unpleasant odors have been proven to be more efficient at immersing us in an experience than neutral or positive ones. In order to draw attention to the fact that too many locations appear to be purposefully created to have no scent and to leave no persistent olfactory imprint, Jim Drohnik coined the term "anosmic cube" to describe the notion of olfactory absence. It is evident that a space's aroma may also be quite evocative. The olfactory component of the design can be employed to favorably influence behavior modification. When there is a whiff of citrus in the air, people prefer to clean more. Researchers have previously shown that lavender and other aromas typically used in aromatherapy have positive impacts on those who are exposed to them. For example, the latter have a tendency to exhibit less stress, better sleep, and even improved recovery from disease (Spence, 2020).

Figure 23: Scenescape of Amsterdam

In designing for visually impaired people, architects can consider incorporating elements that stimulate the olfactory senses, such as fragrance gardens or scent diffusers strategically placed throughout a building. This can provide a unique and memorable experience for visually impaired people, enhancing their overall sensory experience.

It is important to note that care should be taken in selecting scents, as some people may have allergies or sensitivities. Additionally, the scent should complement the overall design and function of the space, rather than being overpowering or distracting.

3.4.5. GUSTATORY SENSES

"You may not literally taste the materials in a building, but the design of a restaurant can have an impact on your 'conditioned response' to the taste of the food."

- John Paul Eberhard

"Many years ago, when visiting the D. L. James Residence in Carmel, California, designed by Charles and Henry Greene, I felt compelled to kneel and touch the delicately shining white marble threshold of the front door with my tongue. The sensuous materials and skillfully crafted details of Carlo Scarpa's architecture as well as the sensuous colours of Luis Barragan's houses frequently evoke oral experiences. Deliciously coloured surfaces of stucco lustro, a highly polished colour or wood surfaces also present themselves to the appreciation of the tongue."

-Juhani Pallasmaa

"The suggestions that the sense of taste would have a role in the appreciation of architecture may sound preposterous. However, polished and coloured stone as well as colours in general, and finely crafted wood details, for instance, often evoke an awareness of mouth and taste. Carlo Scarpa's architectural details frequently evoke sensation of taste."

-Juhani Pallasmaa

All of these narrations point to the fact that the building secrete out certain taste that is mostly perceived physiologically or through memory. Taste of the space, is mostly related to those spaces with functions that are directly relevant to the tongue. The taste of the architectural space is felt due to the correlation with other sensory perception. Research shows that there is a "Crossmodal correspondences" between color and basic tastes i.e., Sharp red color represents Tang taste, Warm brown colors represent Sweetness, Yellow and orange represent Sourness, and Green with Bitterness and even sourness. Such correlation between colour and taste is mostly due to the memory. (Spence, 2020)

Stimulating gustatory senses in architecture for visually impaired people is not a common approach. However, it can be done by providing a space that encourages the sense of taste, such as a cafeteria or kitchen, which can be designed to include various textures, flavors, and aromas. For example, incorporating a garden that grows herbs or fruits can provide a stimulating and enjoyable experience for the visually impaired.

Furthermore, incorporating a tactile element to the food presentation, such as using textured plates or utensils, can also enhance the gustatory experience. However, it is important to note that gustatory senses should not be relied upon as the primary means of wayfinding or spatial orientation, as this can be unreliable and potentially dangerous.

3.4.6. BRINGING IT ALL TOGETHER

"The architect must act as a composer that orchestrates space into a synchronization for function and beauty through the senses – and how the human body engages space is of prime importance. As the human body moves, sees, smells, touches, hears and even tastes within a space – the architecture comes to life

The rhythm of an architecture can be felt by occupants as a result of the architect's composition – or arrangement of all the sensorial qualities of space. By arranging spatial sensorial features, an architect can lead occupants through the functional and aesthetic rhythms of a created place."

- Charles Spence

"Every significant experience of architecture is multi-sensory; qualities of matter, space and scale are measured by the eye, ear, nose, skin, tongue, skeleton and muscle."

-Juhani Pallasmaa

The aforementioned quotations infer that these multi-sensory experiences interact with one another to shape how we react to our surroundings, whether they be natural or manmade. What we see often influences what we hear and smell, as well as how we process the event. Despite the fact that we frequently are unaware of these cross-sensory interactions and impacts, the senses constantly communicate with and affect one another. (Spence, 2020)

Several studies have also demonstrated that odors that we are unconscious of- either because they are presented just below the perceptive threshold or because we have grown functionally anosmic to their persistent presence- can nonetheless have an impact on us. Therefore, this yet again implies that ambient sensory experiences need not be detectable in order to have an impact on us, whether positively or negatively (Spence, 2020). Thus, by exploring the ways to enhance these multi-sensory elements, the architectural spaces can be used to enhance the quality of life while at the same time also creating more immersive, engaging, and memorable multisensory experiences.

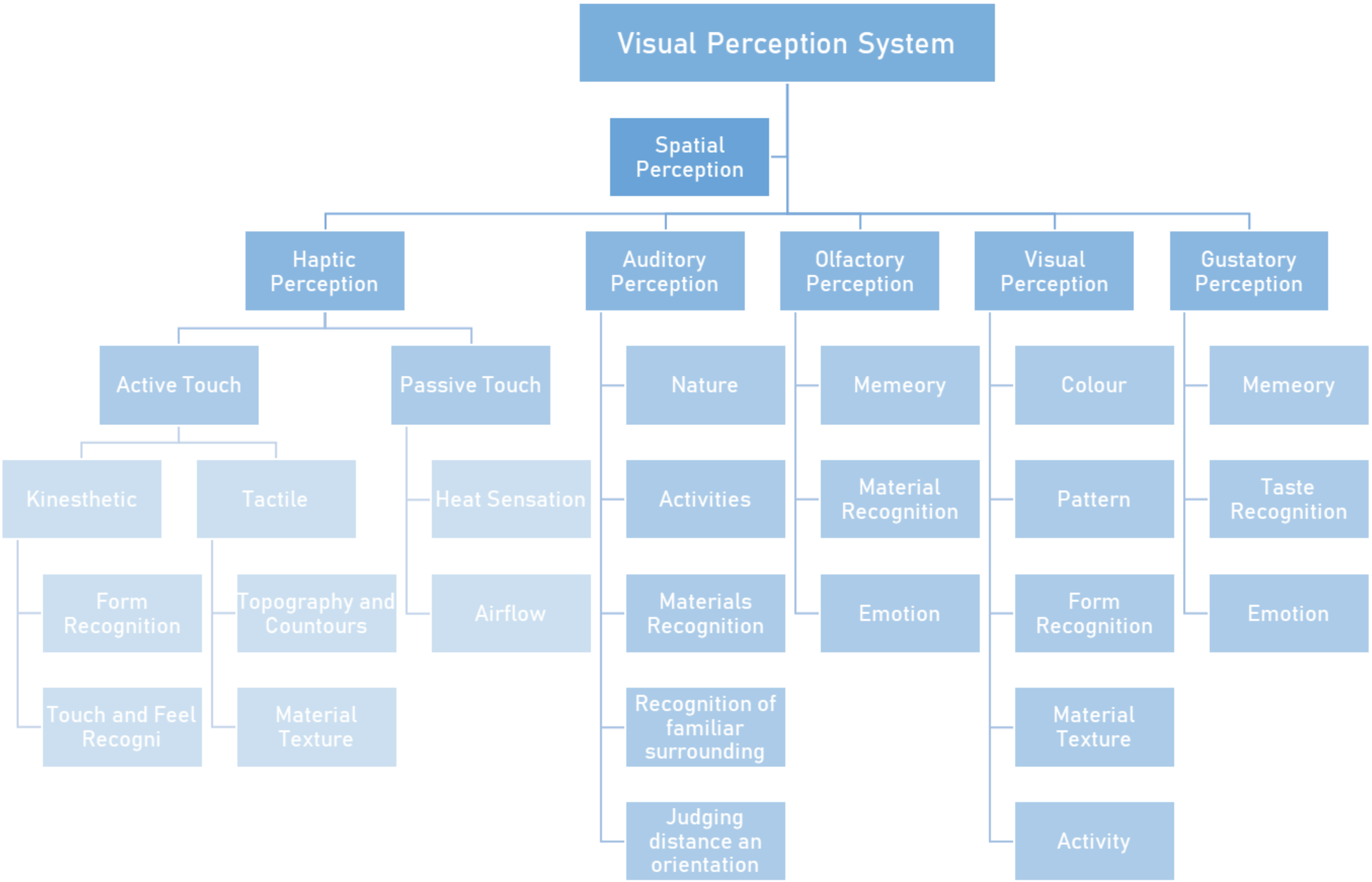


Figure 24: Visual Perception System

3.5. EMBODIED SPACE IN PERSPECTIVE

As previously mentioned, visually impaired persons experience difficulties and spatial obstacles in their everyday life as a result of the built environment frequently being planned with an intense concentration on the visual aspect, which is known as architectural visual bias or ocularcentrism. People with visual impairments prioritize and filter out tactile (active, passive, and dynamic touch), auditory, and olfactory spatial aspects when navigating their environment. Such inclusive spatial designs are necessary to develop surroundings suited for the blind, enabling them to lead autonomous, secure, and effective lives. As a result, VI individuals interact with their environment, live in it, and employ alternate skills, methods, and instruments to perceive what is outside of them. (Malekafzali, 2021)

3.5.1. Nature: The Finest Medium between Human Body and Surroundings

"Entering the park from the main street and feeling the sudden calmness, only hearing birds, water stream, air penetrating through grass and leaves while smelling plants and water. The sunlight warmth was the way we recognized the tree-shaded areas, the smell of greens, flowers, and water was strong, felt like the smell of freshness. The special smell of water stream blending in with the soil and rocks, splashing on the rocks then to our skin felt like a way of blending in with the natural elements in the park"

"Being totally blind, the only way that I could feel the light intensity in a space was feeling the sun heat on my skin, the sun heat and air flow approach me, made me understand the atmosphere surrounding me, effortlessly"

"Rain is considered a colored blanket that throws over previously invisible things, creating a continuous acoustic experience. Through the sound of splashing rain, I can interpret the contours of the lawn, which rises to the right in a little hill. The sound of the rain is different and shapes out the hill curvature for me, if only rain could fall inside a room, it would help me to understand where things are in that room, to give a sense of being in the room, instead of just sitting on a chair"

"The outside is so much more dynamic. There are breezes, there are the sounds of a breeze through the leaves in the tree, or birds off in the distance. I spend a lot of

time on the front porch of our house, enjoying the street life and all the sounds. There's a dynamic to the environment outside that is often excluded from the interior."

- (Oteifa, Sherif, & Mostafa, Understanding the Experience of the Visually Impaired towards a Multi-Sensorial Architectural Design, 2017)

Looking upon these comments from the interview with the visually impaired, the sun, water and air were repeated throughout the study. The perception of nature is mostly done through multiple senses such as sound, smell, etc. The perception of light intensity felt from the sun heat, the interpretation of contours of the lawn through acoustic experience during raining, the space perception through the acoustical experience such as sounds of a breeze through the leaves in the tree, or birds off in the distance, etc. shows how nature is embodied by the visually impaired people.

3.5.2. FEELING MATERIALS

"Here, the rain is striking the concrete, here it is splashing into the shallow pools which have already formed. The sound on the path is quite different from the sound of the rain drumming into the lawn on the right, and this is different again from the blanketed, heavy, sodden feel of the large bush on the left. Further out, the sounds are less detailed. I can hear the rain falling on the road, and the swish of the cars that pass up and down"

"The contrast between the rough asphalt and the smooth lawn was very recognized, then again from the smooth lawn to the concrete pavers at the city center"

- (Oteifa, Sherif, & Mostafa, Understanding the Experience of the Visually Impaired towards a Multi-Sensorial Architectural Design, 2017)

"Materials are felt," as stated above. Through touching, tapping, and listening to their echoes, they may be felt and heard. VI people were able to grasp the area they were standing on because to the different floor pavers installed beneath, which made it simple for them to determine their position and direction. They eventually had to sit down and recover from walking since rough pavers are tougher to navigate.

In order to identify objects on the floor and feel the various textures to know the precise location they are standing on, visually impaired children are taught to use their feet to feel the floor materials under them. Sometimes, however, they tend to stretch their legs. This is especially true if they are not close to walls. Using replicas of wood, metal, plastic, and concrete, kids also learn to differentiate between different materials by identifying them based on their weight, texture, and warmth as well as by pairing similar materials. They continue to touch, carry the objects, pair them, and then name them. (Oteifa, Sherif, & Mostafa, 2017)

3.5.3. UNDERSTANDING SPACE

"My first experience was going there without sight, and some things didn't quite come together, like the acoustics. I really wanted to hear what the vaults were like, and see if I could understand the form of those spaces through sound. And I couldn't; it was just completely dead…I was going all over trying to explore the architecture, tapping my cane, clapping my hands, snapping my fingers...Then at one point, I turned off the side of one of the galleries and into the long exterior vault. As soon as I opened the door and my cane hit the concrete floor, I could hear the architecture. I could hear the whole length extend out in either direction. I could also hear the delicate, crisp sound of people walking on crushed gravel pathways nearby and the sound of a fountain. It was hard to resist. You just wanted to go there, because it sounded like such a delightful space"

"Earlier this week, I traveled through some airports that are carpeted everywhere. It was dead and flat. You never heard footfalls or roller bags, you didn't hear the liveliness of the space. I think there are some great airport concourses, where there's excitement in the space. It's because you can hear the sound of travel, the sound of people moving around"

- Chris Downey

"Echo used to play a very important role in understanding the surrounding space, it made me understand the space wideness and how crowded it is, high echo means a space is wide and empty and vice versa. I usually prefer ceilings with intermediate heights, low ceilings result in high echoes, while high ceilings make it hard to track echo"

"To be able to identify and understand a place, I walk around, touch the surroundings with my cane, hands and feet, hit several objects while walking, clap to feel the echo, and thus, the wideness of space, and I smell the materials and this is how I develop a mental map of the surroundings, making it easier to understand the place when revisited."

- (Oteifa, Sherif, & Mostafa, Understanding the Experience of the Visually Impaired towards a Multi-Sensorial Architectural Design, 2017)

In order to grasp how the width of street changed, the changes in sound echo were noted. For example, with the increase of the width of the street, moving from the main street to tight lanes, the sound echo got higher. Some participants were able to identify the street only based on its auditory experience. Participants were able to recall individual locations by smelling fragrances, incense, bakeries, and coffee along the route. It was crucial to touch the nearby walls in order to recognize the area and the structures. Cognitive mapping and touching were used to find historical buildings. The warmth of the sunlight that entered through the windows was felt on the skin, making it simple to point out where the windows were without going close enough to touch them.

Children who are visually impaired learn to utilize their senses to recognize their surroundings. One of the exercises is referred to as "way finding," where children use their arms to establish a virtual personal space around them and a barrier between themselves and the items around them. Then, they use their feet and arms to identify walls, doors, seats, tables, and other objects. Another practice includes touching an obstruction and responding to it in order to learn how to recognize and avoid obstacles while walking. (Oteifa, Sherif, & Mostafa, 2017)

3.5.4. FEELING THE ATTRIBUTES AND PROPERTIES OF OBJECTS

“When I opened my eyes, and started seeing, I was amazed with colors, and ceilings, basically anything my hands couldn’t reach. I could feel the attributes of any object by touching and feeling it. When I saw the table, I knew that this was a table because I remember touching and feeling it, just like seeing it”.

“The children learn to understand that there are different forms of objects, like all children do, but unlike the other children who can simply see and learn the different forms, visually impaired children touch and feel the objects to be able to recognize them. They also need to learn that there is something called size and scale, what is it like to arrange from big to small or vice versa to have a full understanding of what sizes mean. We also train children to recognize weights.”

- (Oteifa, Sherif, & Mostafa, Understanding the Experience of the Visually Impaired towards a Multi-Sensorial Architectural Design, 2017)

Stereognosis is a technique that is used to teach vision impaired individuals to comprehend the size and form of objects using their hands. Children in uses play dough to understand the forms through the exercise where they mold play dough into spheres, cubes, and rods. After they've created the shape, they touch it and give it a name, which ensures that the item has a name. Another stereognosis exercise involves alternating several spheres and cubes on a rod. Typically, the exercise entails holding the spheres and properly putting them into each rod to fill it with the appropriate number of spheres. It helps one comprehend the various shapes and engages the tactile sense. Additionally, by touching rods of various weights and organizing them from longest to shortest, visually impaired individuals may learn about size and proportion. Another scale and proportion game involves arranging rings; the kids arrange the rings according to size, from the biggest to the smallest. (Oteifa, Sherif, & Mostafa, 2017)

3.6. NON-VISUAL PERCEPTION SYSTEM

As already stated above, the human's perceptual systems are classified into five groups namely: Gustatory Perception (Taste), Haptic Perception (Tactility/ Touch), Auditory Perception (Sound), Olfactory Perception (Taste), and Visual Perception (Eye-sight). These systems are ways of gathering information from the environment. They frequently overlap their actions, gather and evaluate the data with one another, and transmit the information. VI people are more dependent on other senses which gives the different image and cognitive map of the environment from what normal people see. Through these mapping, the VI individuals navigate around the environment.

Table 3: Non-Visual Perceptual Systems (Malekafzali, 2021)

Perception System	Receiving Organ	Organ's Function	Person's Function	Stimuli Factors of the Receiving Organ	Range
Navigation	Body and Head	Balance	Navigation	- Gravity - Sunlight - Sound	Far
Hearing	Ear	Hearing	Navigation and Recognition of the Environment	- Echo - Sound of: • Water Turbulence • Wind Blow • People's Conversation • Various Cultural Activities • Cane Hitting Different Surfaces	Far
Touch	Skin	Touching	Recognizing the Phenomenon	- Texture of Materials - Light and Shade Effects of Trees - Moisture - Sunlight	Near
Taste	Mouth	Tasting	Recognizing the Phenomenon	- Smell of Different Materials in The Air Create a Specific Taste - Smell of Grass and Moisture of the Grass	Far and Near
Smell	Nose	Smelling	Navigation	- Odor of Flowers, Grass, Various Industrial or Food Material and Soil	Far

3.7. EXPANDED CORE CURRICULUM

Since the inception of residential schools for the blind, early educators believed students with visual impairments should be educated on the basis of their individual interests and abilities, as well as in the general education curriculum. However, it was not until the 1990s that discipline-specific skills were fully documented and identified. The expanded core curriculum (ECC) was first articulated by a small group of professional educators, parents, and consumers concerned about the quality of educational services for students with visual impairments (Corn, Hatlen, Huebner, Ryan, & Siller, 1995; Corn & Huebner, 1998; Hatlen, 1996; Huebner, Merk-Adam, Stryker, & Wolffe, 2004). The ECC is defined as the body of knowledge and skills, beyond the core academic curriculum, that students with visual impairments need to learn in order to lead full, independent lives. The need for instruction in each area of the ECC is determined through assessment of individual students. The nine ECC areas include the following:

1. Compensatory skills: These are skills that compensate for the lack of visual information, such as braille reading and writing, tactile graphics, auditory skills, and orientation and mobility.
2. Orientation and mobility: This are the ability to travel independently and safely using a combination of sensory information and environmental cues. This includes the use of canes, GPS devices, and other orientation and mobility aids.
3. Independent living: This includes the skills necessary for daily living, such as personal hygiene, household management, and self-advocacy.
4. Recreation and leisure: This includes activities that promote physical fitness, socialization, and creative expression, such as sports, music, and art.
5. Assistive technology: This includes the use of technology to access information and complete tasks, such as screen readers, magnifiers, and braille displays.
6. Career education: This includes the skills necessary for employment, such as job seeking, workplace readiness, and vocational training.
7. Social skills: This includes the ability to interact with others and navigate social situations, including communication, relationship building, and conflict resolution.
8. Self-determination: This includes the ability to set goals, make decisions, and advocate for oneself.

9. Sensory efficiency: Sensory efficiency skills are essential for visually impaired children to be able to fully participate in the world around them. These skills involve using their remaining senses to gather information about their environment and to compensate for the lack of visual information.
    - Listening skills: Listening skills are important for visually impaired children to gather information about their surroundings like identifying sounds, locating the source of the sound, and interpreting the meaning of the sound.
    - Tactile skills: Tactile skills involve using touch to gather information about the environment by identifying textures, shapes, and objects through touch.
    - Olfactory skills: Olfactory skills involve using the sense of smell to gather information about the environment. This includes identifying scents and using scent to navigate the environment.
    - Gustatory skills: Gustatory skills involve using the sense of taste to gather information about the environment by identifying flavors.
    - Kinesthetic skills: Kinesthetic skills involve using the sense of touch and movement to gather information about the environment. This includes using body movement and positioning to understand the layout of a space.
    - Visual efficiency skills: Visual efficiency skills involve using the remaining vision effectively to gather information about the environment through lighting, contrast, and magnification to maximize visual input.

By incorporating these areas into the curriculum, visually impaired children can develop the skills and knowledge necessary to lead independent and fulfilling lives. It's important to provide a well-rounded education that addresses all aspects of a child's development, including academic, social, emotional, and physical.

3.8. FINDINGS AND ANALYSIS OF INTERVIEWS AND SURVEY

Case studies were conducted to gain detailed information retrieved from literature reviews, as well as to conduct a realistic assessment of the current situation based on the framework. A questionnaire was developed to understand their experience in the urban, individual context and the material properties to draw findings. Case studies were conducted in two schools in Nepal. In total, 30 students attending classes from 6 to 10 were interviewed and inferences were drawn.

3.8.1. IN URBAN CONTEXT

Among these students, 77.78% of children preferred private vehicles because they often face problems commuting alone in public vehicles due to inadequate public transportation services adapted to the requirements of people with visual impairment. Most of the candidates point out the fact that they don't like to travel in public vehicles because of crowds, lack of seating arrangements and unmanaged transportation systems. Such problems are faced almost daily. In the case of public spaces, it is hard to navigate new spaces without the help of a volunteer. In the context of sloped land, it is hard for the VI to interpret the surroundings while moving down the slope. New spaces generate a sense of uncertainty and discomfort in the unknown. The interviewees often encounter the obstacles such as trees, vehicles, poles, etc. while travelling. Similarly, the uneven surface generates a fear factor as it is hard to predict the depth of the finishes due to such irregularity.

3.8.2. IN INDIVIDUAL CONTEXT

In the context of the residence or the hostels provided, most of the children were able to navigate easily without any assistance. The children first look for the cues or landmarks such as pillars, walls, or any fixed built structures. Through this, they develop a cognitive mapping through the help of memories or experiences. In such cases, where they have been familiar with the surrounding the space requirements are as same as that for normal people. Most of the accidents occur in areas with few steps or pillars provided in the circulation areas. The interviewees were asked about their preference for a ramp or stairs. 56% of the children preferred ramps in the case of small level differences while 64.32% of the children preferred stairs in the case of vertical circulation from one floor to another. It is due to the fact that the stairs provided in the case of small level differences are hard to distinguish and unlike the visual senses, other senses are as accurate as the visual senses.

3.8.3. LIGHTING

Electric illumination should be consistent throughout the length of hallways. Pinpointing the room through the help of room numbers is made easier with the use of task lighting, such as that seen at room entrance doors. The pools of light should be avoided in otherwise dark areas. Glare and reflections from highly polished floor surfaces might be challenging for those with low vision, especially in rooms with floor-to-ceiling windows. Instead of polished flooring, it is advised that they have a matte surface with a textured covering. In general, high intensity downlighting may not be appropriate since the downlighting may cast unpleasant shadows on the reading material. Table lamps or similar task lighting offer more control and may be more appropriate. Lighting can also be used for wayfinding to help in navigation. Electric lighting of stairways must be designed to make the step edges clearly visible, especially in the direction of egress- usually in the downward direction. Uniform, diffused lighting which does not produce soft shadows on the treads is desirable. To avoid shadows and dark areas, ambient lighting for restrooms should cover all areas evenly, including toilet stalls and entrance vestibules. Shadows and dark areas often occur in the entrance area and create discomfort and confusion because of the decrease in visual functioning. Vanity lighting at mirrors should be selected to avoid glare while illuminating the vanity surface and the face of the user. Lighting should be placed on each side of the mirror in addition to ambient lighting from above. Lighting controls that react to fluctuations in daylight levels can be used in cases of functions which require a constant illumination level as it assists in maintaining comfortable lighting levels for general illumination while maximizing energy savings, but always of high enough illumination intensity to allow persons with low vision to clearly see their surroundings. For optimal positioning and flexibility, task lighting that is movable and adjustable in brightness is usually desirable.

3.8.4. SURFACE FINISHING

Glare and reflections from highly polished floor surfaces might be challenging for those with low vision, especially in rooms with floor-to-ceiling windows. Instead of polished flooring, it is advised that they have a matte surface with a textured covering. Refrain flooring patterns like stripes or geometric patterns that could be misconstrued for stairs or changes in the floor's surface. In particular, when the design is perpendicular to the direction of movement, these may be very misleading. These can be particularly dangerous in such staircase leading to changes in floor level. Vertical reflecting surfaces can also be perplexing for those with low vision; therefore "full-height" mirrors shouldn't be installed near the floor as the reflection can be misinterpreted for a doorway or an extension of the room. It's crucial to consider how to minimize the contrast between the colors and values of the wall finish and the surrounding windows. Increasing contrast can be beneficial to a person with low vision when it is necessary or crucial to differentiate one wall feature from another, such as door frames. In some buildings where corridor systems may be complex or potentially confusing to the user, it may be helpful to vary the wall treatments, colors, patterns, artwork, or materials to help orient the user. Matte finishes on architectural surfaces are preferable to highly polished ones. High gloss finishes should be avoided on horizontal and vertical surfaces to avoid reflected glare. Rugs and carpets may present tripping hazards unless well secured to the floor and with edges firmly attached to avoid entangling feet, cane or crutches. Floors and walls should be of contrasting colors or values so the person with low vision can know where the floor and wall meet. This may also be enhanced with a baseboard or border that contrasts with both surfaces. Ramps and steps are hazardous if they cannot be easily seen such as by change in color, value or texture, at the beginning and end of the ramp and by contrasting color and value between treads and risers. Patterns in the flooring material may obscure the edge of a step and are not recommended. Floor patterns in carpeting, tile, and other materials may be visually confusing to the person with low vision, and it may become especially difficult to retrieve dropped items. Solid colors may make this less of a challenge.

3.9. INFERENCES OF LITERATURE REVIEW

The ultimate solutions should be reflected in the design process for the building built for people with different physical abilities. As the architects are responsible for developing solutions and recommending materials in which users must live, knowledge about functional impairments is particularly important. The rushed and flawed decisions give birth to poor solutions which are often the result of time and money. The primary responsibilities of Architects are to visualize the consequences of the choices they make, regardless of developers’ requirements and reluctance to concentrate on availability and universal design. The innovative thinking, imagination, and visual expressiveness in design, color, and use of the material are crucial in achieving Universal design. Universal design should thus be an integral part of architectural education rather than a separate subject (Ahmer, 2014). To draw the implications of the Literature Review, the tables have been developed to brief these portions.

Table 4: The comparison of the features and qualities of five senses

Perceptual System	Sensory Organ (Receptor)	Receivable Information	Transfer Type	Affectivity of Sensory Member	Affectivity of Environment	Scope	Action Type	Depth And Direction of Space Perception	Perceiving Qualities Of Urban Space
Visual	Eye (Rod And Cone Photoreceptor)	Light, The Glistening of Colour	Media (Light)	Open And Close Pupil	Perceptive Definition	General	Controlled action	Directional View	Colour and form, volume and size, diversity, visual richness, visual coordination, imageability, visual personality, consistency with nature
Auditory	External And Internal Ear (Hair Cells)	Sound (Type, Direction, Distance, Source, Speech)	Media (Sound)	Stimulating Hearing Receptor	Echo	Public	Reaction	All Directional Hearing	Depth and distance, full and empty, quality of wall covering, social interaction, rush hour and traffic, vitality security, sounds and names, natural environment sound, vibrations, immediately
Olfactory	Nose (Olfactory Receptors)	Smell Direction	Media (Air)	Nose Mucous Stimulation	Smelling Field Definition	Semi-public	Reaction	All Directional Taste	The presence of natural, elements, freshness, environmental pollution and cleanliness, memory, and sense of place, spatial continuity
Gustatory	Tongue Surface And Oral Cavity (Taste Buds)	Taste And Flavour	Media (Mucus)	Stimulation Of Taste Buds	-	Personal	Action	Concentrated Tasting	Space taste, anchor points, identification of mental reference point
Tactile	Skin (Mechano-Receptors)	Temperature, Touch, Humidity, Pressure, Pain, Tenderness, Rapidness, Intensity, Speed	Direct	Deformation, Colour Change Of Skin, Physical And Chemical Changes Of Skin	Presence, Object Transferring	Fully personal	Action and reaction	All Directional Access	Environmental temperature and humidity wall material, total volume depth of the element, and details, passage of time, belonging feeling, restriction, surface flexibility, public arts, durability and stability, continuity of motion, hierarchy, climatic comfort, fourth dimensional perception

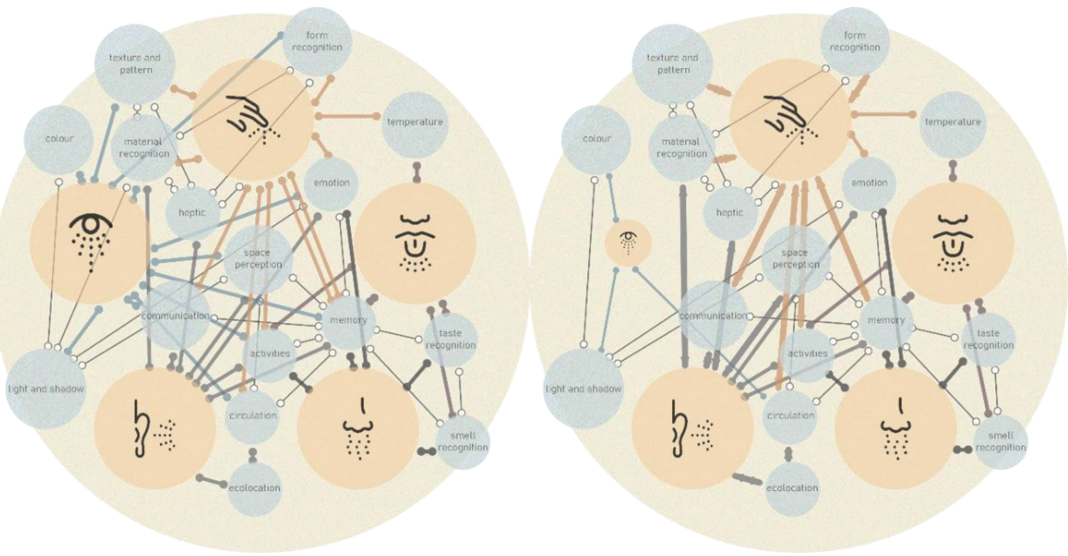
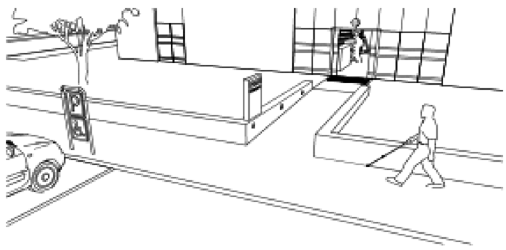
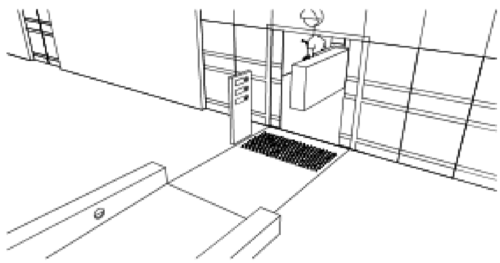
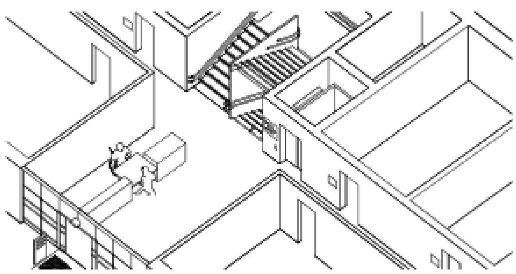
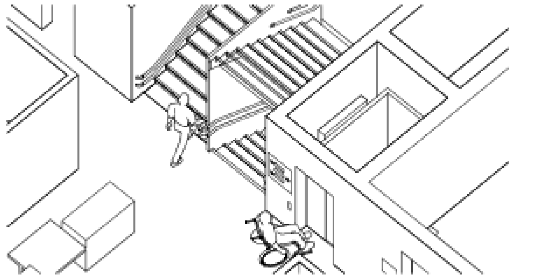
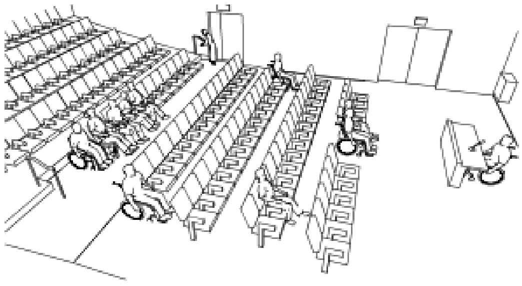
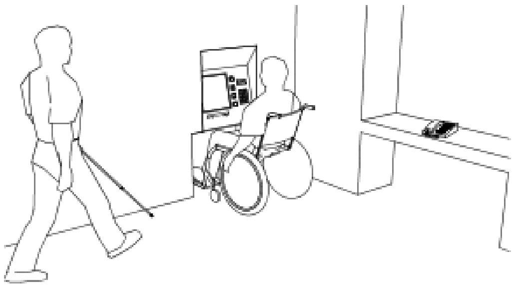
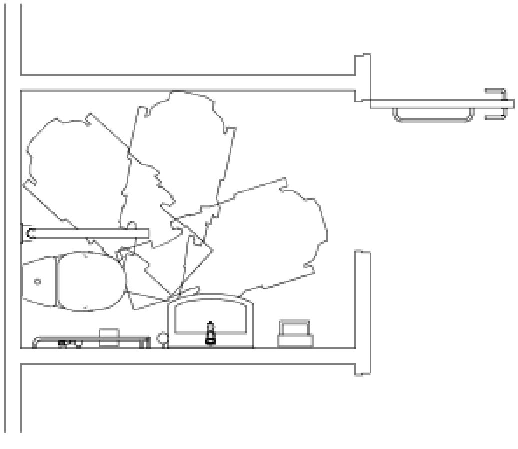


Figure 25: Comparison of Inter-relationship between Perception System in Sighted Individuals and Unsighted Individuals

Table 5: Examples of key accessibility issues in the early stages of planning

No.	Key accessibility issues	Example
1	Equitable approach to a building, e.g. designated parking, clear pedestrian routes separate from vehicles and cyclists, no steps or obstacles, short distances from parking and public transport, good signage, good lighting and good contrast.	
2	Equitable entry via the same entrances, e.g. easy to locate main entrances, no steps or obstacles, wide openings, adequate manoeuvring space in front of the door, low operating forces, good signage, good lighting and good visual contrast.	
3	Equitable use of the same paths in horizontal circulation, e.g. no steps or obstacles, adequate manoeuvring space, wide door openings, easy to operate doors, resting places, clear layout, good signage, good lighting and good visual contrast.	

No.	Key accessibility issues	Example
4	Equitable access to the same paths in vertical circulation, e.g. safe stairs, spacious lifts with easy operation, good signage, good lighting and good visual contrast.	
5	Equitable use of the same rooms, e.g. ample circulation space and different seating possibilities, good acoustics and hearing enhancement systems, good lighting and good visual contrast.	
6	Equitable use of the same equipment and facilities, e.g. easy to understand and operate, adequate manoeuvring space and operating height, information via two senses.	
7	Equitable use of toilet and sanitary facilities, e.g. good signage, adequate manoeuvring space, good transfer options, well-placed equipment, easy operation.	

CHAPTER 4: CASE STUDY

4.1. FRAMEWORK FOR CASE STUDY

General Objective	Specific Objective	Research Questions/ Variables	Data Collection
To understand how the spaces can be perceived through the multi-sensory experience	To review about the multi-sensory experience and its impact in architecture	Types of multi-sensory experience	Literature
		Theories behind multi-sensory experience	
		Types of multi-sensory experience	
		Importance of multi-sensory architecture	
	To understand how the spaces are perceived by Visually Impaired People through the multi-sensory experience	Perception of multi-sensory experiences in architecture	Literature Interview Case Study
		Importance of multi-sensory architecture	
		Interpreting and observing space by visually impaired individuals	
		Difficulties faced by visually impaired individuals in daily life	
		Comparison of sensory activity between visually impaired and normal individuals for guiding multisensory design.	
	To understand how the spaces are perceived by normal people through the multi-sensory experience	Navigation of spaces through non-visual senses	Literature Interview Case Study
		Determining the order of sensory dominance in navigation	
		Understanding how sighted individuals navigate in the absence of vision	
		Comparison of sensory activity between visually impaired and normal individuals for guiding multisensory design.	

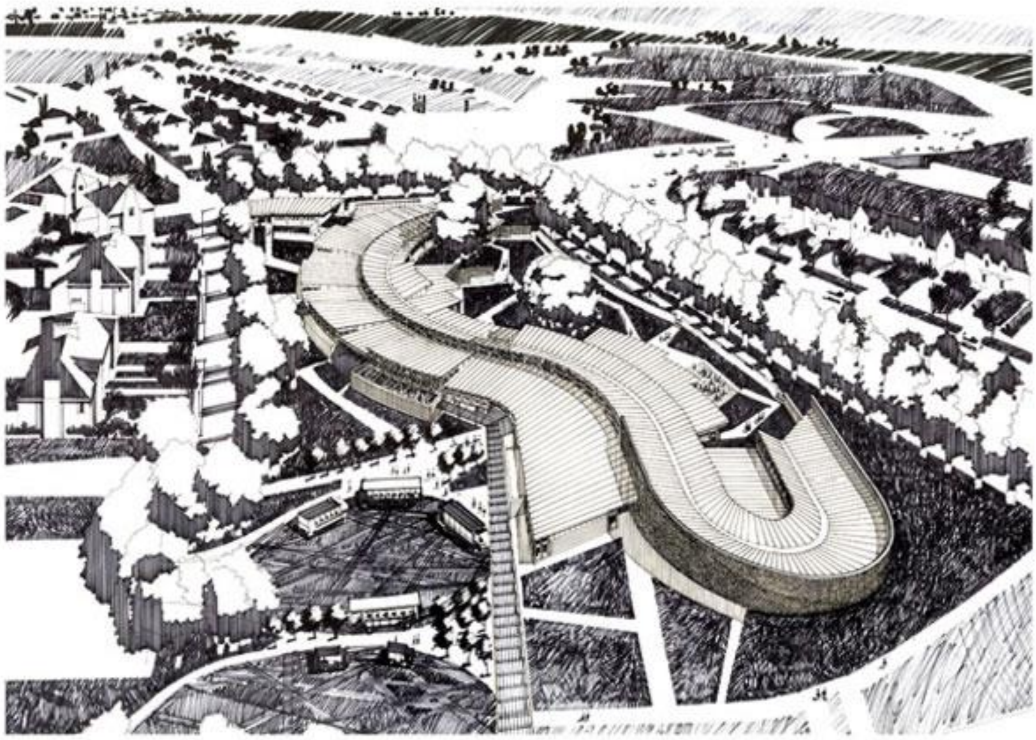
General Objective	Specific Objective	Research Questions/ Variables	Data Collection
To understand the principles of design and design strategies to cater to the visually impaired students and develop guidelines for the designs that enhance the experience for the visually impaired	To review the anthropological data, design strategies, and guidelines required for visually impaired	To review the anthropological data	Literature
		To review the design strategies adopted in other countries	
		To review the guidelines provided by governmental agencies	
		To review the principles of universal design	
	To determine if the anthropological data design strategies, and guidelines is applicable in context of Nepal	To conduct studies about anthropological data	Literature Interview Case Study
		To review the design strategies adopted in architects in Nepal	
		To review the guidelines provided by governmental agencies	
To study the characteristics of the material to know how the visually impaired people perceive the material	To review the characteristics of the material which helps in the navigation	Types of materials researched for navigation purposes	Literature
		The role of materials in aiding navigation	
		Characteristics that enhance material and color palette for navigation.	
	To understand how the visually impaired people perceive the material	Familiarity with materials among visually impaired individuals	Literature Interview Case Study
		Characteristics of materials under study	
		Perception of material transitions	
		Influence of external factors on the perception of materials	
	To understand how nature affects the surrounding and perception of materials	Perception of natural phenomena	Literature Interview Case Study
		Psychological and behavioral effects of natural phenomena	
		Designing architecture with nature and materials to enhance non-visual senses	

Table 6: Theoretical Framework for Case Study

4.2. INTERNATIONAL CASE STUDY

4.2.1. HAZELWOOD SCHOOL, GLASGOW, SCOTLAND

4.2.1.1. OVERVIEW OF THE CASE STUDY



Project Name:	Hazelwood School
Location:	Glasgow, Scotland
Building Type:	Education
Completed:	2007
Client:	Glasgow City Council
Architect:	GM + AD architects (Alan Dunlop, Gordon Murray)
Site Area:	3 Acres
Built-up Area:	2,668 m^2

4.2.1.2. INTRODUCTION

"The school has been designed to deal with very specific issues whilst ensuring an architectural quality. It is a building that will not only support the senses but act as an environment that stimulates the imagination. I was determined to create a school which would support the needs of the children and the aspirations of their parents, a place of safety and ambition that would free the teacher and inspire the child"

-Ar. Alan Dunlop

The Hazelwood school is located in the southern suburbs of Glasgow City, Scotland. The school was designed and built for an architectural entry into the competition to provide a facility for the young people aged between 2-18 who are deaf and blind in the year of 2007. Each student has a combination of two or more of the following impairments: sight, hearing, mobility or cognitive. The building was designed by Alan Dunlop architects. This facility had developed its own method of teaching for both deaf and visually challenged children. Hazelwood School caters for 60 students with multiple disabilities. The design focused on creating a safe, stimulating environment for pupils and staff. (Institute for Human Centered Design, n.d.) & (Petras, 2011)

The architects set out to eliminate any institutional feel and worked to avoid conventional/ standard details, creating a bespoke design that incorporates visual, sound and tactile clues. Hazelwood's educational staff aims to create and foster independence, aided by the architectural elements found in the building. Orientation within the building supports this independence. A sensory wall was developed in the circulation core as a navigational tool to allow the children to move around the school safely. (Institute for Human Centered Design, n.d.) & (Petras, 2011)

4.2.1.3. RATIONALE OF THE STUDY

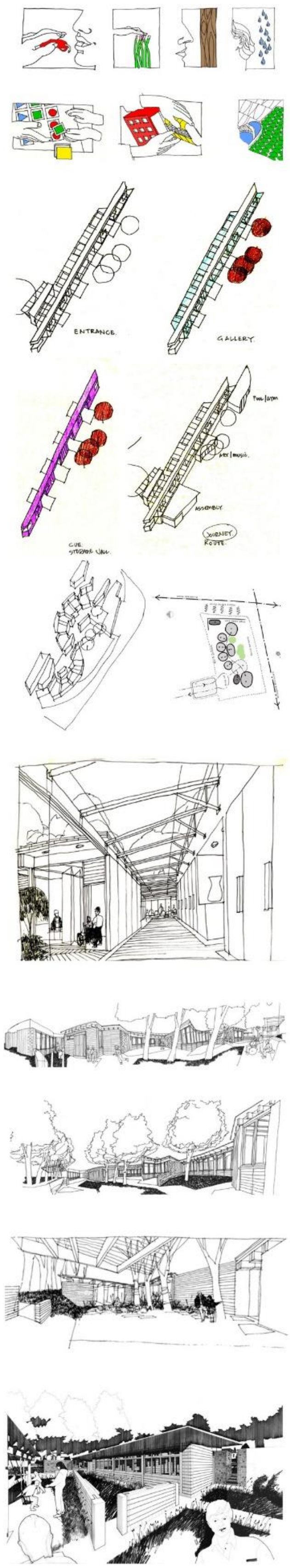
The reasoning for taking this case study are as follows: (Institute for Human Centered Design, n.d.) & (Petras, 2011)

- One of the first visually impaired school designed based on research
- Dedicated therapy areas related to nature
- Use of tactile clues, contrasting and neutral color as visual indicators
- Unique sensory trail wall weaves throughout the school and enables children to practice mobility and orientation skills

4.2.1.4. ZONING

Figure 26: Zoning and Master Plan of Hazelwood school (Institute for Human Centered Design, n.d.)

4.2.1.5. ARCHITECTURAL ANALYSIS



The design incorporates cork-clad walls and weaving walkways to help students find their way round, various sensory lighting is used to engage children with vision-related disabilities. Facilities including a hydrotherapy pool put the sensory stimulation aspect at the heart of the school. The Hazelwood school design focuses on creating a safe, stimulating environment for students and staff. I set out to eliminate any institutional feel and worked to avoid conventional thinking on school design. The aim was to create a bespoke building that designed out long dark corridors and maximised levels of natural light and incorporated visual, sound and tactile clues. This allowed the children to move around the school with a greater level of freedom and independence. (Institute for Human Centered Design, n.d.) & (Petras, 2011)

Each one of the external materials was selected for their sensory qualities. The natural larch weatherboarding develops a strong grain when exposed to the elements, offering a gently rippled tactile quality for 'trailing' (navigation using the sense of touch). High level clerestory glazing forms a substantial part of the façade of the north-facing classrooms, allowing for maximum daylight to penetrate deep into the spaces and ensuring even distribution of light. Storage boxes, two and a half metres tall, create a solid wall below the clearstory glazing; this reduces external visual distraction. (Institute for Human Centered Design, n.d.) & (Petras, 2011)

The school snakes through the parkland site, forming gentle curves around the existing mature trees. The single story, built in natural materials, creates a series of small garden spaces ideal for small class sizes and maximizes the potential for more intimate outdoor teaching and learning opportunities. The distinctive curving interior spine meets the complex demands for an intuitive wayfinding system as well as the substantial storage needs for a wide range of equipment used by children with a variety of disabilities. (Institute for Human Centered Design, n.d.) & (Petras, 2011). Some of the distinctive architectural features in the case study are as follows (Institute for Human Centered Design, n.d.) & (Petras, 2011):

- The unique sensory trail wall weaves throughout the school and enables children to practice mobility and orientation skills, which lead to increased confidence, sense of mastery, and self-esteem.
- The trail rail wall is clad in cork, which has a warm feel and provides signifiers or tactile cues to assist children with orientation and navigation through the school.
- Each bay of sensory trail wall is individually shaped. This helps children orient along the length of the circulation space in the school.
- Corridors are designed as streets, which also assist with orientation and mobility.
- Redundant signage throughout the school, in Braille and pictograph and Moon, caters for the diverse communication abilities of all the children.
- Large classrooms with ample storage space and adaptable areas between the classrooms.
- The focus-learning rooms offer viewing for staff and visitors without disturbing the children. These areas also offer quiet time as needed.
- The lack of clutter in the classrooms and on the walls generates a calming atmosphere without unnecessary visual confusion.
- The subtle color, contrast, and adaptable lighting elements maximize use of children’s residual vision.
- Use of contrasting and neutral color as visual indicators of transitional and storage spaces.
- Classrooms are oriented north facing to take advantage of a more even level of light and open onto the quietist part of the grounds, the classroom garden spaces.
- Storage ‘boxes’ to the rear of each classroom were designed to provide a solid wall and eliminate visual distraction for the children from outside.

- To reduce the effects of traffic noises proximal to Hazelwood, a majority of classroom spaces are located along the northern, quiet edge of the site and more transient spaces to the south. The ‘street’ links these areas and guides the building around the existing adjacent trees.
- The curved form means that both internally and externally the building is broken down into manageable spaces. The scale of these is then more appropriate for navigating and also minimizes any visual confusion by reducing the extent of the spaces.
- The building was developed as a series of space groupings for simple orientation.
- As the site is adjacent to a major traffic junction and in order to achieve the acoustic requirements of the teaching spaces, there are no operable windows within the classrooms. The building design was based on natural ventilation throughout. The depth of the storage boxes accommodates an attenuated acoustic fresh air plenum in lieu of opening windows.
- Acoustic ceilings are detailed into all teaching spaces to reduce higher volume reverberation.
- The overall roof form results in quiet, sheltered external teaching spaces shared between radial classrooms to the north.
- Naturally weathering larch boarding is used externally for the trail wall and stimulates the sense of smell as well as providing and appealing tactile surface.
- The transition between the ‘street’ and classrooms areas was designed to inform children of their location as well as school events. For instance, the roof over the street pitches to the north and clerestory glazing is incorporated. This is mirrored with glazing to the south, which floods the area with natural light. Through GM + AD’s research it became apparent that a good proportion of children who are blind can identify between natural and artificially lit environments.
- The transoms and sills are used for trailing and the sill doubles as a kerb which children may use to guide canes or the side of their feet along the street.

- All navigational devices, be it trail rails, window transoms or signage on doors, are set at a consistent height throughout the building so that they can be quickly located by the children.
- Differing tactile floor finishes serve as an alternative or enhancement to the trail walls for navigation and cuing in some locations inside the school.
- The design of the playground and playground equipment allows each child the freedom to play as much as possible at his or her own level.
- Design of the game's hall, trampoline area and hydrotherapy pool allow children the opportunity to explore, extend their skills, and gain confidence through engagement in relatively independent activity.
- A high slate exterior wall protects the site from the loud traffic noises.
- The external structure and the cladding were all considered in terms of sensory stimulation. The structural glulam* timber frame casts shadows within the building to establish a clear pattern along the internal street of the school. [By combining engineered strength with the warmth and beauty of wood, structural glued laminated timber (glulam) offers designers a multitude of options for large, open spaces with a minimum number of columns.]
- Roofing slates define areas outside, form a good trailing surface, and the tactile contrast to the timber clearly orients children as to location when outside. The slate also has the advantage on the south elevations of being a heat source for children to use as a navigation device.
- A network of paths around the school and the gardens varies in finish from bound gravel which crunches under foot to recycled bound rubber and timber decking. Each area is defined by separate finishes, which feel and sound different under foot.

4.2.1.6. INFERENCES

The Hazelwood School aids to achieve inclusive deign by using materials, acoustics, lighting, color, and natural elements. Its primary feature of the school is its curved singular spine of circulation that is accented by a cork textured wall that helps students recognizes circulation and transition spaces. This facility also uses outdoor areas while still providing architectural applications that are informative of space, boundaries, and activities.

Hazelwood School is a prime example of how innovative and thoughtful design can create a welcoming and supportive environment for children with visual impairments. The school’s unique architectural features are specifically designed to cater to the diverse communication abilities of all children and enhance their learning experience.

The school also acknowledges acoustic properties through the use of inclined ceilings and absorption ceiling assemblies. Even though the building references natural qualities, the design of the interior also uses the play of color and contrast to create a playful space for the children, but still be informative of thresholds and edges.

In conclusion, Hazelwood School’s unique architectural features are designed to create an inclusive and supportive learning environment for children with visual impairments. The school’s innovative design, featuring a sensory trail wall, corridors designed as streets, and large classrooms with ample storage space, adapts to the diverse communication abilities of all children. With its emphasis on sensory stimulation, careful attention to acoustics, and thoughtful design of playground and outdoor spaces, Hazelwood School is a model for inclusive and accessible education.

Figure 27: Inference of Architectural Analysis (Trevino, 2022)

4.2.2. CENTER FOR THE BLIND AND VISUALLY IMPAIRED, MEXICO CITY

4.2.2.1. OVERVIEW OF THE CASE STUDY

Project Name:	Center for the Blind and Visually Impaired
Location:	Mexico City, Mexico
Building Type:	Healthcare
Completed:	2001
Client:	Mexico City Government
Architect:	Taller de Arquitectura-Mauricio Rocha
Site Area:	14,000 m²
Built-up Area:	8,500 m²
Age Group:	Unrestricted
Designed for:	Blind and Visually Impaired People

4.2.2.1. INTRODUCTION

The Center for the Blind and Visually Impaired (CBVI) is located in Mexico City, Mexico in one of the most disadvantaged and highly-populated parts of the city. Iztapalapa is the district with the largest population of visually impaired individuals in Mexico City. The whole center, approximately 91,000 sq. ft., was designed to enhance spatial perception and use the five senses to supply a strengthened experience. “A water channel runs through the center of the plaza, so that the sound of the water guides users along their way.” Plants are also used in outlying gardens to orient users to different areas or zones of the complex.

A blind wall encircles the complex on its four sides and acts as an acoustic barrier as well as a retaining wall/blank to hold the earth moved from neighboring wasteland areas. In contrast to the abstract exterior, the internal facade of the boundary wall creates banks that change shape, height, and orientation, thus creating various courtyards. The floor plan, meanwhile, can be read as a series of filters which stretch out from the entrance in parallel strips. The first filter is the building that houses the administrative offices, cafeteria, and utility area. The second consists of two parallel lines of buildings organized symmetrically along a central plaza. These buildings contain a store, the "tifloteca-sonoteca" (a sound and touch gallery) and five arts and crafts workshops. The third filter has the classrooms facing the gardens and the most private courtyards. Perpendicular to the entrance, a series of double-height volumes house the library, gymnasium-auditorium, and swimming pool. The buildings are rectangular prisms, based on concrete frames and flat roofs. Each group explores different spatial and structural relationships, making each space identifiable for the user and varying size, light intensity and weight of materials: concrete, tepetate bricks, steel, and glass.

4.2.2.2. RATIONALE OF THE STUDY

The reasoning for taking this case study are as follows:

- Provides education, therapy, and services for varying levels of sensory, behavioral, physical, and cognitive abilities
- Dedicated therapy areas related to nature
- Use of tactile clues
- Use of contrasting and neutral color as visual indicators

4.2.2.3. ZONING

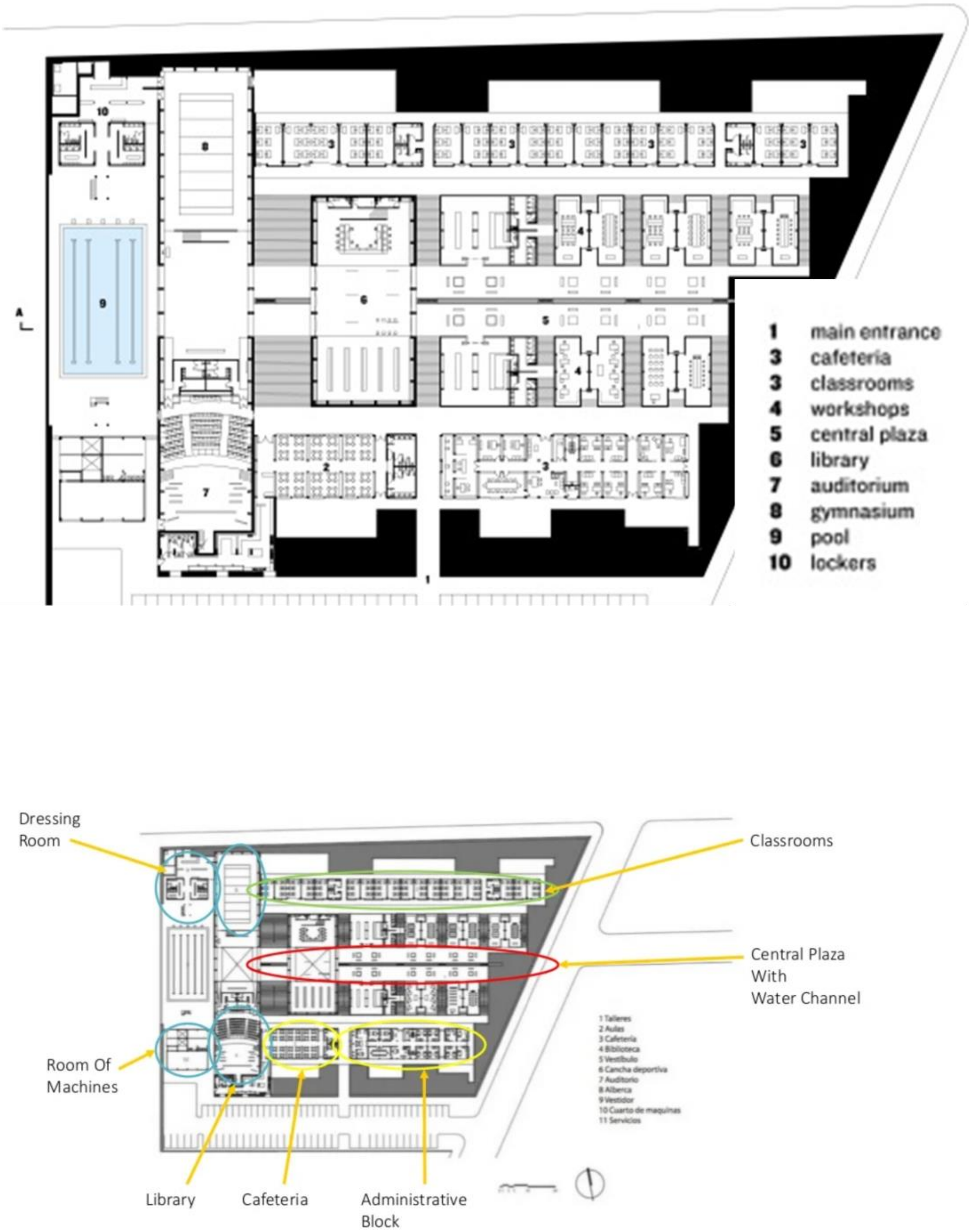
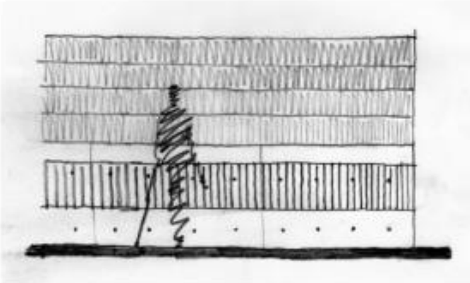
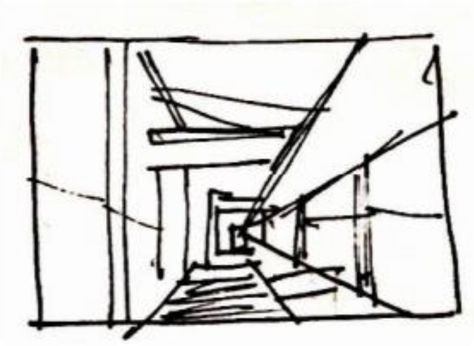
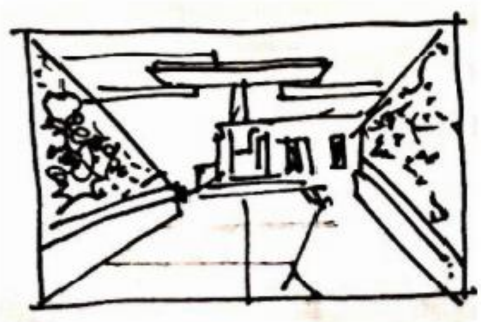


Figure 28: Zoning and Master Plan of Center for the Blind and Visually Impaired

4.2.2.4. ARCHITECTURAL ANALYSIS







The center's facade can be read as a series of horizontal and vertical lines formed into shapes which acts as tactile clues. Building forms, a kind of barrier from the outside world as seen the images. There are few fragrant plants planted along the corridor to help orient the blind and disabled students who visit the facility. The channel of water arranges visitors toward the principal line towards the gathering space. The water stream can be heard by a blind person and helps them walk along the pathway created. There is also a strip of stones next to the water channel introduced so that the blind could test with their cane or foot to know that there is a barrier and avoid falling into the water channel.

The design elements like the spatial experience through edge, transitions and landmarks can also be seen in this building. These design elements analyzed in this precedent study, are very much helpful in selecting the strategies for the project's design. The design process was well informed through analysis of the precedent. This is one of such examples where it was found interesting to see that the design is well informed with the choice of materials, design perspectives in spatial experience and also with the gist of introducing the elements of nature into the design. These concepts were useful and were considered as an inspiration for the project.

The Center for the Blind and Visually Impaired in Mexico City is designed with the needs of its users in mind. The center caters to individuals who are blind or visually impaired, and its design is geared towards ensuring that these individuals can easily navigate through the building without assistance. One of the unique features of the Center for the Blind and Visually Impaired is its use of materials that are designed to provide tactile and auditory feedback. The materials used throughout the building include textured surfaces, such as rough concrete, smooth marble, and rubber flooring. These materials are used to help individuals with visual impairments navigate through the building, and they also help to create a sense of orientation within the space. The center also utilizes acoustic design to aid in navigation. The design team carefully considered the use of sound to help individuals locate different areas of the building. Sound-absorbing materials were used where sound should be dampened, and other materials were selected to create an echo in areas where sound should be amplified.

Another key design feature of the Center for the Blind and Visually Impaired is its use of natural light. The building features large windows and skylights that allow for ample natural light to flood into the space. This helps to create a warm and welcoming environment for individuals with visual impairments. Additionally, the windows and skylights have been carefully positioned to ensure that there is no glare, which can be problematic for individuals with visual impairments. The use of natural light also helps to reduce energy costs, which is an important consideration for any building.

The layout of the building is also designed to aid in navigation for individuals with visual impairments. The building is organized around a central courtyard, which provides a clear point of reference for individuals as they move through the building. The courtyard is also a source of natural light and ventilation, which helps to create a comfortable environment within the building. The corridors and pathways within the building are wide and well-lit, with plenty of space for individuals to move around comfortably. The use of color and texture also helps to distinguish different areas within the building, which makes it easier for individuals to navigate.

The Center for the Blind and Visually Impaired also features a range of amenities designed to promote health and wellbeing. The building includes a gymnasium, a swimming pool, and a hydrotherapy pool, all of which are designed to promote physical fitness and relaxation. These amenities are accessible to individuals with visual impairments, and they have been carefully designed to ensure that they are safe and easy to use. The building also features a range of social spaces, including a cafeteria and a library, which are designed to promote social interaction and a sense of community.

The Center for the Blind and Visually Impaired is also designed to be sustainable. The building incorporates a range of sustainable features, including solar panels, rainwater harvesting, and energy-efficient lighting. These features help to reduce the building's environmental impact and contribute to the overall sustainability of the community.

4.2.2.5. INFERENCES

The Center for the Blind and Visually Impaired in Mexico City demonstrates a well execution of designing for the visually impaired strategically. The architects use natural elements for architectural applications that can enhance the mobility of the facilities occupants. (Trevino, 2022)

The facility uses natural lighting to create shading for directional cues, pathways, and thresholds. There is a water channel that is at the center of the facility that aids in acoustic qualities for the visitors to listen and follow along the path. The water channel is lined with pebbles that acts as a edge for the path of circulation. (Trevino, 2022)

The facility also taps into the sense of smell using the foliage that is used to aid along the main circulation path, as well as for land markers of program. The use of natural stone for tactile purposes and cues of transitions, edges, space are integrated into the design. (Trevino, 2022)

Figure 29: Inference of Architectural Analysis (Trevino, 2022)

4.3. NATIONAL CASE STUDY

4.3.1. SHREE PURWAANCHAL GYAN CHHAKCHU VIDYALAYA

4.3.1.1. OVERVIEW OF THE CASE STUDY

Project Name:	Shree Purwaanchal Gyan Chhakchu Vidyalaya
Location:	Bargachi, Dharan
Building Type:	Education
Completed:	2034 B.S.
Client:	Government of Nepal
Architect:	-
Site Area:	3 Bigha – 0 Katha – 0 Dhur (20,317.89 Sq. m.)
Built-up Area:	-

4.3.1.2. INTRODUCTION

Shree Purwaanchal Gyan Chhakchu Vidyalaya is located in Bargarchi, Dharan. The school was built as a special school provide a facility for the young people aged between 2-18 who are especially blind in 2034 B.S. The school was constructed under the grant "The Gurkha Welfare Scheme". The school was built as a residential school for children from class 1 to 10 students with the maximum students of about 10 per classroom. Currently, the school 58 students of whom, 21 are girls and 37 are boy. About 7 students has a combination of two or more of the following impairments: sight, hearing, mobility or cognitive. The school provides the Hostel facilities for students and Quarter for Teachers. The school has also given the employment opportunities to the Visually Impaired people. The school has 20 teachers, of whom 3 are Visually Impaired, and 10 staff.

This facility has been developing its own ways to improve the wayfinding method and providing the required training for teaching visually challenged children and help them in navigation through Extra Curricular Activities. The design focused on creating a safe, and easy method for navigation. The designer seems to set out to eliminate any difficulties in navigation through hit and trial method rather than looking into the conventional/ standard details. The goal of the school is to create and foster independence, aided by the architectural elements found in the building. Orientation within the building supports this independence.

4.3.1.3. RATIONALE OF THE STUDY

The reasoning for taking this case study are as follows:

- Gives insight into the present context of Nepal
- Recognize the problems existing in the current design
- Understand the movement of the Visually impaired
- Only special school for Visually Impaired
- To understand the working modules of special school such as the educational processes, Curriculum that is being followed, and compare it with integrated school.

4.3.1.4. INTERVIEWS

The interviews were conducted with the teachers and the students to better understand the working of the school and understand how the visually impaired interpreted the spaces around them. Two of the senior teachers were interviewed to get insight about the functioning of the school. These questionnaires were prepared based on the theoretical frameworks:

Name: Bidhya Shakya | Subject: Nepali

Years of Experience: 31 years | Work Basis: Permanent Basis

Q.1. What types of formal training did you have?

Ans: Self-Taught, Braille Learning, Mobility Training for 1 week, and Low-Vision Training for 2 days

Q.2. How are new Visually Impaired Children enrolled?

Ans: The new children are firstly taught to understand and read Braille. The learning time of Braille depends upon the skill of the children. After the children have the grasp of Braille, the they are enrolled to the classes based on their strength.

Q.3. Is the curriculum different from normal ones?

Ans: Same Curriculum as that for normal children is followed. The curriculum is not flexible. There is no additional curriculum that helps the VI children enhance their senses.

Q.4. Which subjects are hard to get the grasp of?

Ans: The subjects having a drawings or sketches. These drawings needs to be explained to the student to understand.

Q.5. Is there any other extracurricular activities not included into the curriculum that is being taught?

Ans: Students are taught special skills like, mobility, orientation, music, and computer skills

Q.6. Which subjects are easiest to teach?

Ans: Computer, G.K., and Music are easiest to teach.

Q.7. Are the spaces provided enough for the visually impaired student?

Ans: The toilets provided are sufficient. After the covid, the normal classes were changed into computer-oriented classes, thus making the classes small.

Q.8. Where is the most injury prone spaces in the building?

Ans: Most of the injuries occur in the poles in middle of the circulation areas between hostel area and academic block which supports the trusses provided to reduce sun glare. Similarly, the windows provided for the ventilation opens outward disturbing the circulation within the corridor.

Q.9. Where do the students spend most of their leisure time?

Ans: Most of the students spend their leisure time at the play area for children.

Q.10. How long does it take for the Visually Impaired to get used to the surrounding?

Ans: It also depends upon the skill of the VI children. In most of the cases, the low-vision students get hang of the spaces within 2 to 4 days and Blind students get hang of the spaces within 10 to 15 days. Within the one month of time, they can fully navigate in and around the surrounding without the help of others.

Q.11. What architectural features are applied in the buildings?

Ans: The stairs are coloured to help the children with low vision to navigate.

Name: Sandip Pradhan

Subject: Music, History and Social Studies

Years of Experience: 22 years

Work Basis: Permanent Basis

Q.1. What types of formal training did you have?

Ans: Self-Taught, Braille Learning, and Low-Vision Training for 2 days. Gives training other teacher.

Q.2. How are new Visually Impaired Children enrolled?

Ans: The new children are firstly taught to grasp their tactile senses. They are taught to differentiate between smooth surface, rough surface, touch sensory with the help of mustard seeds to understand the concept. Through this they are slowly taught to read Braille. They are trained to understand through tactile senses rather than sound. The learning time of Braille depends upon the skill of the children. After the children have the grasp of Braille, the they are enrolled to the classes based on their strength.

Q.3. Is the curriculum different from normal ones?

Ans: Same Curriculum as that for normal children is followed. The curriculum is not flexible. There is no additional curriculum that helps the VI children enhance their senses.

Q.4. Which subjects are hard to get the grasp of?

Ans: The subjects having a drawings or sketches such as math, science, etc. are hard as the solution to the math problem needs to know the preceding steps to move further. Similarly, the geometry needs to be explained to the student to understand.

Q.5. Is there any other extracurricular activities not included into the curriculum that is being taught?

Ans: Students are taught special skills like, mobility, orientation, music, and computer skills. Multisensory room are also provided which provides different indoor sports such as chess, carrom, sound table tennis, snake and ladder. Outdoor sports such as cricket, football and running areas are also provided to enhance their skills.

Q.6. Which subjects are easiest to teach?

Ans: Nepali, G.K., and Music are easiest to teach.

Q.7. Are the spaces provided enough for the visually impaired student?

Ans: The toilets provided are sufficient. The classroom are also enough. After the covid, the normal classes were changed into computer-oriented classes. These classes now look into each other rather than focusing towards teacher. This makes the teacher hard to take care of every students together.

Q.8. Where is the most injury prone spaces in the building?

Ans: Most of the injuries occur in the poles in middle of the circulation areas between hostel area and academic block which supports the trusses provided to reduce sun glare. Similarly, the windows provided for the ventilation opens outward disturbing the circulation within the corridor. Similarly the mats provided in the doorways are prone to slipping. Tactile tiles needs to be used.

Q.9. Where do the students spend most of their leisure time?

Ans: Most of the students spend their leisure time at the play area for children.

Q.10. How long does it take for the Visually Impaired to get used to the surrounding?

Ans: It also depends upon the skill of the VI children. In most of the cases, the low-vision students get hang of the spaces within 2 to 4 days and Blind students get hang of the spaces within 10 to 15 days. Within the one month of time, they can fully navigate in and around the surrounding without the help of others.

Q.11. What architectural features are applied in the buildings?

Ans: The stairs are coloured to help the children with low vision to navigate. The colours are not studied and used.

4.3.1.5. ZONING

Staff Quarter
1. Quarter
2. Amenities
3. Washroom
4. Store room

Vocational Block
5. Indoor Sports
6. Nursery
7. Audio Room
8. Vocational room
9. Multi-purpose Room
10. Music Room

Hostel Block
11. Boy's Washroom
12. Boy's Hostel
13. Warden's Quarter
14. Girl's Hostel
15. Girl's Washroom

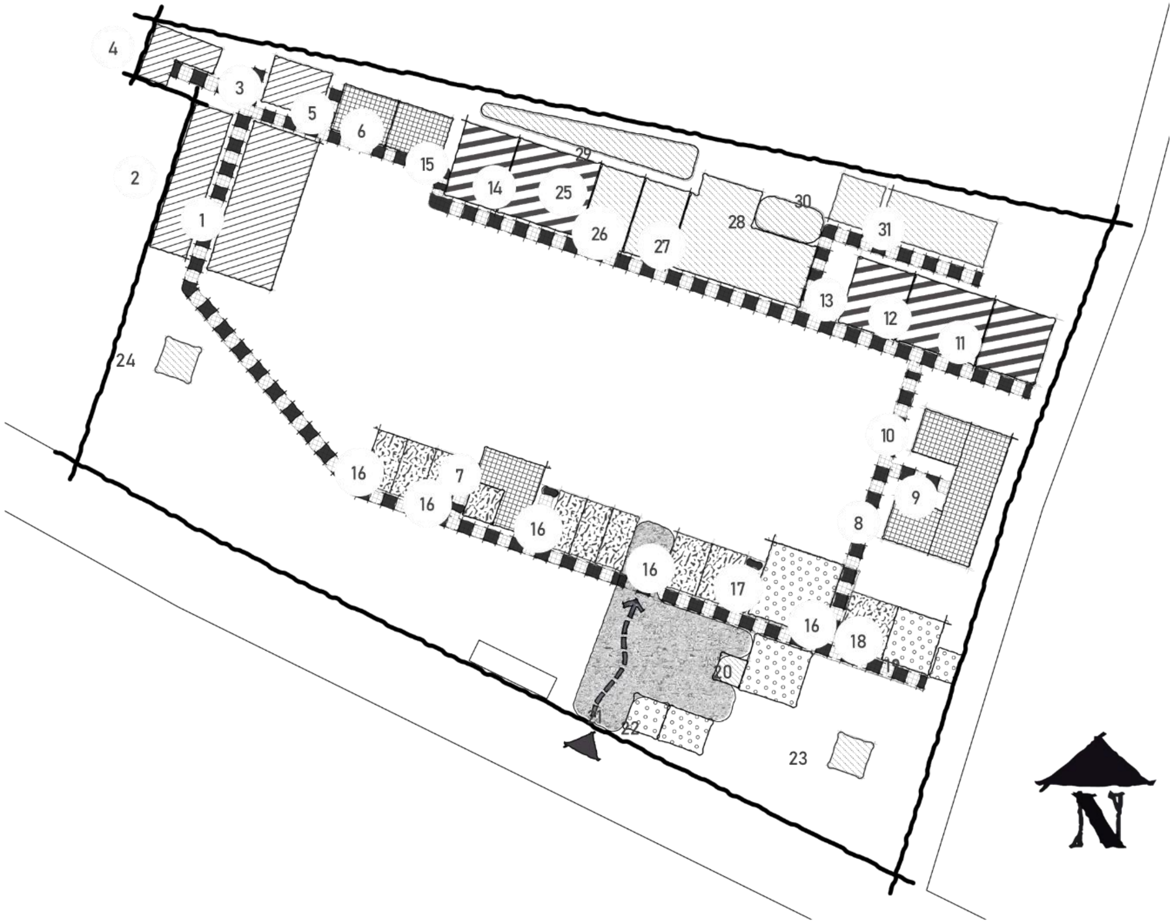
Hostel Block
11. Boy's Washroom
12. Boy's Hostel
13. Warden's Quarter
14. Girl's Hostel
15. Girl's Washroom

Classroom
16. Class 1 to 10

Administrative Block
17. Principal's office
18. Staff Room
19. Staff Toilet
20. Account's Section
21. Guard Room
22. Waiting Area

Administrative Block
17. Principal's office
18. Staff Room
19. Staff Toilet
20. Account's Section
21. Guard Room
22. Waiting Area

Other Amenities
23. Boy's Cloth Washing
24. Girl's Cloth Washing
25. Study Room
26. Infirmary
27. Kitchen and Dining Area
28. Drinking Water
29. Girl's Clothes Drying Area
30. Kitchen
31. Staff Quarter



4.3.1.6. PROGRAM FORMULATION

As mentioned in the legend, school complex has been divided into many blocks based on the functions that is conducted in the block. The blocks are divided into Administrative Block, Vocational Block, Hostel Block, Staff Quarter, Academic Block and Other Amenities. The Administrative Block and Academic Block are in front of the school premise whereas the more private space such as hostel blocks, dining hall, staff and guest quarter are located in the rare of the land. The division of private and public space can be seen in the building. A huge green grass field is situated in the middle of the private and public space, similarly the vocational training block can also be seen adjacent to the field creating a transition from one type space to another. A buffer space of play area and green space can also be seen between the Main Entrance, Administrative Block and Academic Block. Small patches of green areas are introduced in the pocket spaces in between kitchen and Hostel blocks, in front of Vocational Blocks, at the rear ends of the land and the blocks.

a. Academic Block

This block is single storied building that houses classroom for student from Nursery to 6, each of size 20’ x 17’, and an audio library. Audio library with the size 24’-7” x 10’ has two room. The room at the front of the entrance has chairs and table where the students can learn. It is well ventilated and has enough natural light. The room at the back is a record room. This room has proper sound insulation. it is used to record sound, nursery rhymes, and also used by the students of grade 9 and 10 to learn about the school curriculum by recording books.

b. Academic Block and Administrative Block

This block also contains 4 classrooms from class 7 to 10, each of size 20’ x 17’, principal’s office, accounts office, staff room, staff toilet, store room, and braille printing room. Bifurcated stairs lead up to the first floor where a multipurpose room is present along with that braille or tactile library and, resource room.

c. Vocational Block

Multi-Purpose Room located in the 1st floor is a large hall appropriate for indoor gaming activities like table tennis and gathering space. It also contains a temporary stage that enable the room to conduct various small-scale programs. As we pass by the multi-purpose hall, we arrive to the resource room. In this room children are taught about various thing using tactile materials. This is located beyond the multipurpose room. Various tactile toys like snakes and ladder, chess, stuffed animals were stacked in this room so that children could learn through the tactile senses. The room also contained tactile globe, maps for teaching geographical materials. Located behind the resource room was braille library. Many braille books were available in this room along with the braille tactile machine with which the books are translated into braille.

As, we move from administrative block to the accommodation block through the covered pathway, we pass by another vocational block. The U-shaped single story building houses a music room, multipurpose room and Science laboratory. This lab contains many tactile biological instruments like tactile biological human pictures that helped students to learn. Also, equipment of chemistry was available to learn various chemical reaction. Mainly the student was taught about the chemicals through their sense of smell.

d. Hostel Block

As we pass by the Vocational Block, we arrive towards the hostel block. The hostel blocks are divided into Girl's hostel and Boy's hostel with its amenities provided in between these two blocks. The block of size 57'- 6" X 21'- 6" each, housed 20 girls and 37 girls where the individuals would get a bed of size 2'- 6" X 6'- 00" with 2'- 00" between two consecutive beds, a wooden cupboard and a steel box.

e. Other Amenities.

In between the hostel block, amenities such as Reading room, Canteen, Warden's room and Adjacent Services required for the canteen are provided. The L - shaped single story canteen houses a dining area of size 53'- 6" X 18' - 6" with the kitchen area of size 18' - 6" X 17' - 00" which can cater to 66 students at a time. Reading room of size 22' - 00" X 18' - 6" is provided for class 10 students. A space is also provided for drinking water facilities, infirmary, warden's room, and dish washing area in between.

At the extreme ends of two hostel block, the restroom for each hostel block is provided with shower of 2' - 6" X 2' - 6" and w/c of size 4' - 6" X 2' - 00". A laundry area are provided in the front of academic block and clothes drying area behind the hostel block.

4.3.1.7. ARCHITECTURAL ANALYSIS

One of the most significant features of the school is the use of different colors to aid in navigation. Visually impaired students often face challenges in moving around spaces they are unfamiliar with. However, by using different colors on the floors, walls, and ceilings of the school, students can easily differentiate between different areas of the building, making it easier for them to navigate the space independently.

Additionally, the classrooms are north-facing to take advantage of even levels of natural light and open onto the quietest part of the grounds, the classroom garden spaces. This orientation allows for more natural light to filter into the classrooms, providing a more comfortable and conducive learning environment. Furthermore, the quiet classroom garden spaces provide students with a place to relax and take a break from academic activities, reducing stress levels.

Shades have been thoughtfully provided throughout the school to reduce glare. Excessive glare can be a significant problem for visually impaired students, making it difficult for them to see properly. By providing shades in key areas of the building, architects have significantly reduced the glare and made the learning environment more comfortable for students.

Another impressive feature of the school is the colorful staircase, which helps students easily identify the next step. The staircase is a key area of any building, and by incorporating different colors and textures, visually impaired students can more easily navigate the stairs and feel more confident moving around the building.

The punctures in walls are provided to let in indirect lighting, which helps reduce glare. Excessive glare can be a significant problem for visually impaired students, making it difficult for them to see properly. By providing punctures in walls in key areas of the building, architects have significantly reduced the glare and made the learning environment more comfortable for students.

Dharan is a relatively hot area, and so they have incorporated ventilation systems throughout the building. They have also tried to reduce the amount of southern light that enters the building, which can cause discomfort and distract students during learning activities.

Furthermore, they have included ramps in the building to accommodate small height differences. This feature ensures that visually impaired students can move around the building independently, without having to rely on others for assistance.

Finally, most of the functions in the school are on the ground floor level. This design ensures that students can move around the building independently and safely without having to navigate stairs.

4.3.1.8. Inferences

Shree Purwaanchal Gyan Chhakchu Vidyalaya is a special school located in Bargarchi, Dharan, built under the grant of "The Gurkha Welfare Scheme" to provide facilities for visually impaired children aged between 2-18. The school has 58 students, including 21 girls and 37 boys, with some students having multiple impairments. The school provides hostel facilities for students and quarters for teachers and employs visually impaired people. The school has 20 teachers, of whom 3 are visually impaired, and 10 staff members.

The school focuses on creating a safe and easy method for navigation and fostering independence aided by architectural elements found in the building. The school has used different colors on the floors, walls, and ceilings to aid in navigation, classrooms are north-facing to take advantage of natural light, and shades have been provided throughout the school to reduce glare. A colorful staircase, punctures in walls for indirect lighting, and ramps to accommodate small height differences are some other features of the school.

The school complex is divided into several blocks, including an administrative block, a vocational block, a hostel block, staff quarters, academic blocks, and other amenities. The academic block houses classrooms for students from nursery to grade 6, while the academic and administrative block contains classrooms for students from grades 7 to 10, a principal's office, accounts office, staff room, staff toilet, store room, and braille printing room. The vocational block contains a multi-purpose room, resource room, and braille library, as well as a music room, science laboratory, and multipurpose room. Finally, the hostel block is divided into a girl’s hostel and boy's hostel with amenities provided in between.

The report on the Shree Purwaanchal Gyan Chhakchu Vidyalaya school for the visually impaired highlights several design features that aid in navigation and improve the learning environment. However, it also identifies some drawbacks in the design that may pose safety hazards to students. One of these is the sharp columns used in the corridor, which can cause injuries to visually impaired students who may not see them. Additionally, the absence of tactile warning signs in stairs and hazardous spaces poses a risk to students. The lack of a change in flooring material when transitioning from the corridor to the classroom may also lead to confusion for visually impaired students. Furthermore, the windows that open outside in the corridor may cause injury if students accidentally bump into them, and the floor mats provided are not sunken inside, which increases the risk of tripping and falling. These drawbacks need to be addressed to ensure the safety and well-being of the visually impaired students at the school. The study aims to provide insight into the present context of Nepal, recognize existing design problems, understand the movement of the visually impaired, and compare the educational processes and curriculum of special and integrated schools.

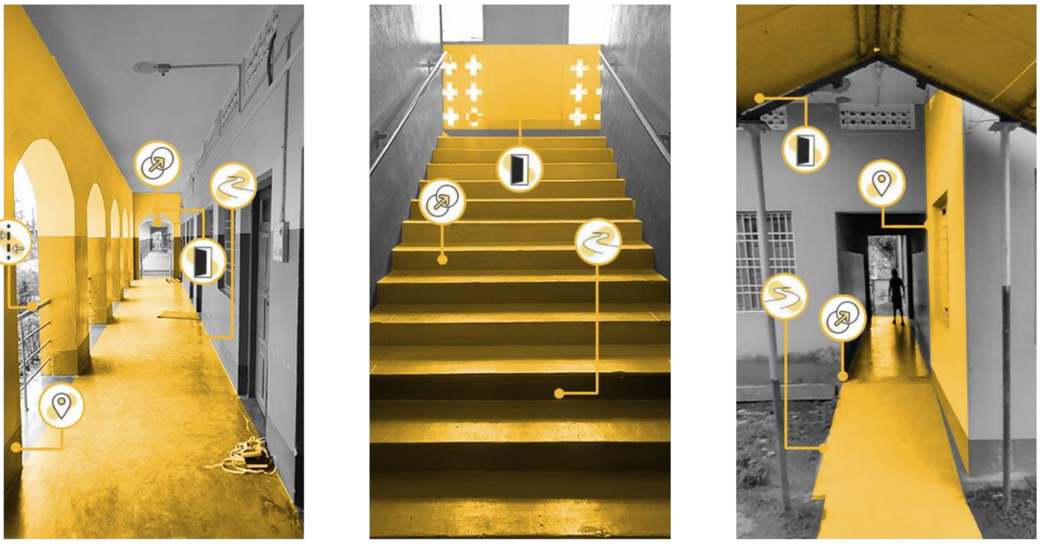


Figure 30: Inference of Architectural Analysis

4.3.2. NAMUNA MACHHINDRA SCHOOL

4.3.2.1. OVERVIEW OF THE CASE STUDY

Project Name:	Namuna Machhindra School
Location:	Lagankhel, Lalitpur
Building Type:	Education
Completed:	2021 A.D.
Client:	Government of Nepal
Architect:	JICA
Site Area:	1,621 m²
Built-up Area:	-

4.3.2.2. INTRODUCTION

Namuna Machhindra School is located in Lagankhel, Lalitpur. The school was re-constructed as an inclusive school which provides facility for the young people aged between 2-18 who are especially blind in 2021 A.D. The secondary school was founded in 2008 BS (1952 AD) and today has over 500 pupils from ECD to grade 10, including 37 students with visual impairments. The reconstruction of the facilities initiated in November 2019 under the Emergency School Reconstruction Project (ESRP) supported by JICA after the 2015 Gorkha earthquake. The new buildings were reconstructed with multi-hazard resilient structures which are environment, child, and gender and disable friendly to provide improved learning environment for the students based on the concept of Build Back Better (BBB) which increases resilience not only physically but also socially. The reconstructed buildings were also designed to be a “complete school” which provides all the necessary facilities for the education to the students. In the new school, there are classrooms with furniture for Early Childhood Development (ECD) to grade 10, science laboratories, a resource classroom, separate hostel rooms for boys and girls, kitchen and dining hall for the students with visual impairment, office rooms for head teacher and teachers, separate toilets for girls and boys with water supply in each floor of the academic and hostel block, also handwashing facilities, tactile pavement, and handrails are set in the hostel block.

This facility has been developing its own ways to improve the wayfinding method and providing the required training for teaching visually challenged children, and help them in navigation through Extra Curricular Activities. The design focused on creating a safe, and easy method for navigation.

4.3.2.3. RATIONALE OF THE STUDY

The reasoning for taking this case study are as follows:

- Gives insight into the present context of Nepal
- Recognize the problems existing in the current design
- Concept of inclusive education and "Child, Gender and Disabled (CGD) Friendly.“
- Recently constructed school which complies with the Universal Design Principle

4.3.2.4. ZONING

Staff Quarter

1. Quarter (1st Floor)

Vocational Block

2. Resource Room

Hostel Block

3. Boy's Washroom
4. Boy's Hostel
5. Girl's Hostel (Upper Level)
6. Girl's Washroom (Upper Level)

Classroom

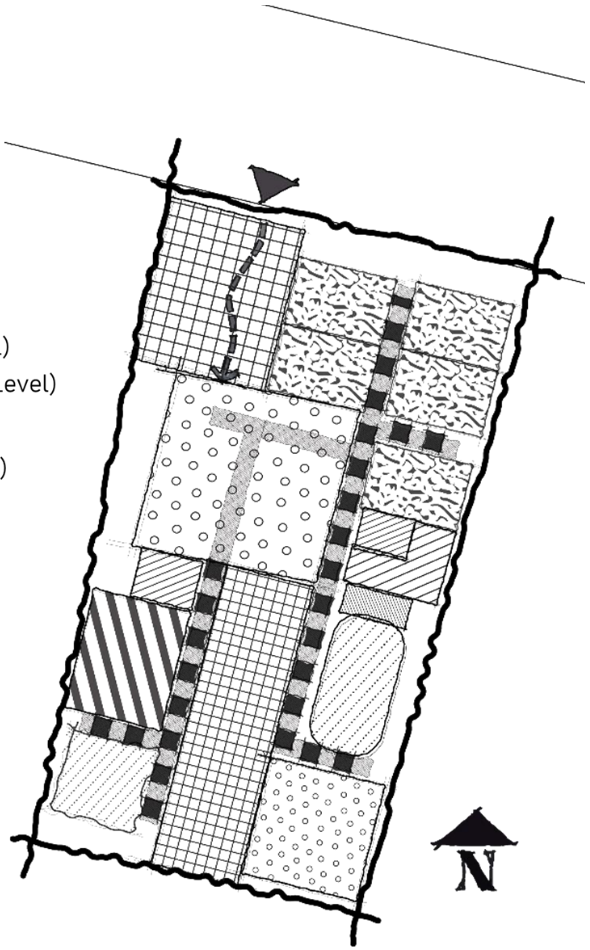
7. ECD Room (Ground Floor)
8. Class
9. Washroom
10. Laboratory

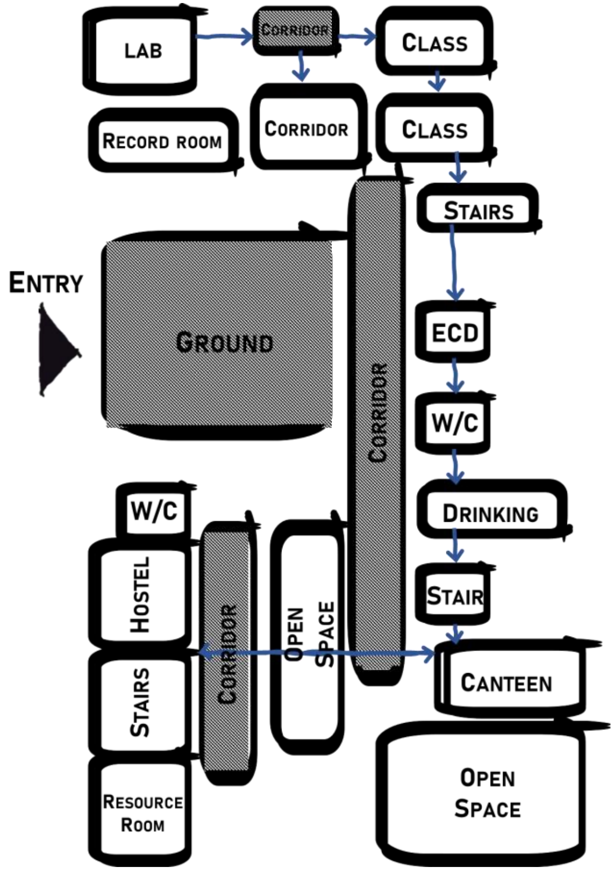
Administrative Block

11. Principal's office
12. Staff Room
13. Staff Toilet
14. Guard Room

Other Amenities

15. Infirmary
16. Kitchen and Dining Area
17. Drinking Water





4.3.2.5. Architectural Analysis

Architecture plays a significant role in creating an inclusive and accessible environment for all individuals, especially those with disabilities. When it comes to this school, the emphasis is on creating a "Child, Gender, and Disabled (CGD) Friendly" environment that provides them with the opportunity to learn, grow, and thrive. The school has been reconstructed with the hope that it would be comfortable for differently abled students. To make it easy for visually impaired students to navigate around the school building and dormitory, the new design incorporates reduced steps, braille blocks, and handrails. These features allow visually impaired students to move around the school independently and with confidence. Additionally, the design ensures that there are no sharp edges or protrusions that may pose a risk of injury to the students.

The dormitory for visually impaired students has a motif of cherry blossoms, which reflects friendship and goodwill. This motif has been incorporated into the design of the dormitory to create a warm and welcoming atmosphere for the students. The dormitory is designed to provide the students with a sense of community and belonging, and the cherry blossom motif serves to reinforce this feeling.

Another important feature of the school is the use of shades to reduce glare. Visually impaired students are sensitive to bright light, which can cause discomfort and make it difficult for them to see. The use of shades in the school helps to reduce the glare and create a more comfortable environment for the students. The shades have been strategically placed to allow natural light into the classrooms while minimizing the amount of glare.

Finally, ramps have been provided in small height differences to make the school more accessible for students with mobility impairments. The ramps have been designed with a gentle slope to allow students to move around the school easily and without the need for assistance. The ramps have also been placed in strategic locations to ensure that students can access all areas of the school.

In conclusion, the design of a school for visually impaired students must prioritize creating a " CGD Friendly" environment that provides them with the opportunity to learn and grow. The unique architectural features highlighted in this essay, including reduced steps, braille blocks, and handrails, cherry blossom motifs, shades, and ramps, are all designed to create an inclusive and accessible environment for visually impaired students. By incorporating these features, the school can provide visually impaired students with an environment that allows them to learn and thrive alongside their non-disabled peers.

4.3.2.6. Inferences

Namuna Machhindra School in Lalitpur, Nepal, was re-constructed as an inclusive school under the Emergency School Reconstruction Project in 2019, after the 2015 Gorkha earthquake. The new multi-hazard resilient buildings are designed to be "CGD Friendly" and cater to the needs of visually impaired students. The new design incorporates reduced steps, braille blocks, handrails, and shades to make it easy for visually impaired students to navigate independently. The dormitory for visually impaired students has a cherry blossom motif to create a warm and welcoming atmosphere. Ramps have been provided in small height differences to make the school more accessible for students with mobility impairments. These unique architectural features prioritize creating an inclusive and accessible environment for all students, allowing visually impaired students to learn and thrive alongside their non-disabled peers.

Figure 31: Inference of Architectural Analysis

The drawbacks of a school for visually impaired students can pose significant challenges to their learning and safety. One issue is the presence of lighting poles in the circulation areas, which can obstruct their movement and pose a risk of injury. Additionally, there is no covering above the circulation space connecting the academic block with the accommodation block, leaving students exposed to harsh weather conditions. The slippery flooring on the ground floor can increase the risk of injuries, particularly during the rainy season when flooding might occur. The classrooms can also be congested, making it challenging for visually impaired students to navigate the space. The absence of a braille library and audio library can further limit their access to learning materials. Finally, the staircases are not designed according to guidelines, making them difficult to navigate for visually impaired students. These challenges highlight the need for continued efforts to create inclusive environments that are safe and accessible for all students, regardless of their abilities.

4.3.3. INFERENCES

The international case studies of Hazelwood School in Glasgow and the Center for the Blind and Visually Impaired in Mexico City provide examples of how thoughtful design can create safe, stimulating, and welcoming environments for individuals with disabilities. Both buildings are designed to cater to the unique needs of their users, with a focus on sensory clues, tactile cues, and other features that aid in navigation and provide a sense of orientation within the space. Additionally, both buildings utilize natural elements, such as plants and natural light, to create a calming and welcoming atmosphere.

The design of these buildings shows that careful consideration and research can lead to innovative solutions that improve the quality of life for individuals with disabilities. In particular, the use of tactile clues and other sensory features can help individuals navigate the space with greater independence and confidence, leading to increased self-esteem and a greater sense of mastery. The buildings also demonstrate the importance of natural elements and acoustic design in creating spaces that are both functional and welcoming.

Overall, the case studies of Hazelwood School and the Center for the Blind and Visually Impaired highlight the importance of inclusive design that considers the needs of all individuals, regardless of their abilities. By prioritizing accessibility and inclusivity in design, architects can create buildings that are not only functional but also inspiring and transformative for their users.

The national case studies of Shree Purwaanchal Gyan Chhakchu Vidyalaya, a special school for visually impaired children, and Namuna Machhindra School, a reconstructed inclusive school that caters to young people aged between 2-18, particularly those who are blind were conducted. Both schools have unique architectural features to aid in navigation and make them more accessible for visually impaired students. However, both the case studies highlight some design drawbacks that may pose safety hazards to students, which need to be addressed to ensure the safety and well-being of the visually impaired students. The challenges faced by visually impaired students in schools can have significant consequences on their safety and learning. These challenges may include physical obstacles such as lighting poles, slippery floors, and poorly designed staircases, as well as environmental challenges such as exposure to harsh weather conditions. Additionally, the absence of important resources such as braille and audio libraries can further limit their access to learning materials. These challenges underscore the need for creating inclusive environments that are safe and accessible to all students, irrespective of their abilities. Thus, efforts must be made to address these challenges and ensure that visually impaired students have equal access to education, resources, and opportunities. The case studies provide insight into the present context of Nepal, recognize existing design problems, understand the movement of the visually impaired, and compare the educational processes and curriculum.

In conclusion, the case studies of Hazelwood School and the Center for the Blind and Visually Impaired demonstrate how thoughtful design can create safe, stimulating, and welcoming environments for individuals with disabilities, while the national case studies of Shree Purwaanchal Gyan Chhakchu Vidyalaya and Namuna Machhindra School highlight the challenges faced by visually impaired students in schools and the need for creating inclusive environments that are safe and accessible to all students. The case studies provide valuable insights into the importance of inclusive design, the use of sensory and tactile cues, and the challenges posed by physical obstacles and environmental factors. By addressing these challenges, architects can create buildings that improve the quality of life for individuals with disabilities and promote equality and accessibility in education.

CHAPTER 5: PROGRAM FORMULATION

Total number of Students:
Grades: 1 to 12
Classroom per Grade: 2
Students per Classroom: 18
Total number of Students; 12 * 2 * 18 = 432

Total number of Teachers
Based on the case studies, teacher to student ratio= 1:9
Total number of Teacher = 50
Support Personnel = 20
Total number of Staff = 70

S.N.	Program	Capacity per unit area	Number of Units	Unit Area (Sq. m.)	(per person or per unit)	Total Area	Unit	Remarks
A.	Administrative Block							
1	Principal's Office		1	35	sq.m./unit	35	sq. m.	
2	Vice Principal's Office		1	35	sq.m./unit	35	sq. m.	
3	Account Office		1	25	sq.m./unit	25	sq. m.	
4	Reception		1	10	sq.m./unit	10	sq. m.	
5	Waiting Area		1	20	sq.m./unit	20	sq. m.	
6	Lobby Area with Vestibules		1	10	sq.m./unit	10	sq. m.	
7	Conference Area	120	1	1.875	sq.m./p	225	sq. m.	
8	Meeting Room	18	1	3	sq.m./p	55	sq. m.	
9	Store Room + File Room		1	10	sq.m./unit	10	sq. m.	
10	Computer Desk		1	10.75	sq.m./unit	10.75	sq. m.	
11	Pantry		1	12	sq.m./unit	12	sq. m.	
12	Medical Room	4	1	15	sq.m./p	60	sq. m.	
13	Counselling Room		1	15	sq.m./unit	15	sq. m.	
14	Common W/C		2	6.25	sq.m./unit	12.5	sq. m.	
					Sub Total:	535.25	sq. m.	
					Net Unassigned Footage (Circulation, Walls, Mechanical, Janitors Closet):	214.1	sq. m.	40% of Total
					Total:	749.35	sq. m.	

S.N.	Program	Capacity per unit area	Number of Units	Unit Area (Sq. m.)	(per person or per unit)	Total Area	Unit	Remarks
B.	Academic Block							
1	Classroom	18	12	3.25	sq.m./p	702	sq. m.	
2	Teacher's Lounge	25	1	5	sq.m./p	125	sq. m.	
3	Teacher's Kitchenette	8	1	2.75	sq.m./p	22	sq. m.	
4	Multi-Purpose Classroom	18	1	3.25	sq.m./p	58.5	sq. m.	
5	Common W/C		4	50	sq.m./unit	200	sq. m.	
					Sub Total:	1007.5	sq. m.	
	Net Unassigned Footage (Circulation, Walls, Mechanical, Janitors Closet):					403	sq. m.	40% of Total
					Total:	1410.5	sq. m.	
C.	Skill Training Block							
1	Orientation and Mobility Training		1	1000	sq.m./unit	1000	sq.m.	
2	Basic Communication		2	95	sq.m./unit	190	sq.m.	
3	Practical Braille Skills		2	95	sq.m./unit	190	sq.m.	
4	Essential Living Skills		2	95	sq.m./unit	190	sq.m.	
5	Art and Craft		1	100	sq.m./unit	100	sq.m.	
6	Dance Studio		1	120	sq.m./unit	120	sq.m.	
7	Music Studio		1	270	sq.m./unit	270	sq.m.	
8	Computer Class		1	115	sq.m./unit	115	sq.m.	
9	Laboratory		5	115	sq.m./unit	575	sq.m.	
10	Gymnasium		1	365	sq.m./unit	365	sq.m.	
11	Indoor Sports		1	1300	sq.m./unit	1300	sq.m.	
12	Swimming Pool		1	1030	sq.m./unit	1030	sq.m.	
13	Adjacent Sports Amenities		1	115	sq.m./unit	115	sq.m.	
14	Common W/C		2	50	sq.m./unit	100	sq.m.	
					Sub Total:	5660	sq.m.	
	Net Unassigned Footage (Circulation, Walls, Mechanical, Janitors Closet):					2264	sq.m.	40% of Total
					Total:	7924	sq.m.	

S.N.	Program	Capacity per unit area	Number of Units	Unit Area (Sq. m.)	(per person or per unit)	Total Area	Unit	Remarks
D.	Amenities							
1	Tactile Library		1	100	sq.m./unit	100		sq. m.
2	Braille Printing Office		1	30	sq.m./unit	30		sq. m.
3	Audio Visual Library		1	50	sq.m./unit	50		sq. m.
4	Café		2	300	sq.m./unit	600		sq. m.
5	Common W/C		1	50	sq.m./unit	50		sq. m.
					Sub Total:	855	sq.m.	
					Net Unassigned Footage (Circulation, Walls, Mechanical, Janitors Closet):	342	sq.m.	40% of Total
					Total:	1197	sq.m.	
E.	Accommodation Block							
1	Girl's Hostel	6	3	15	sq.m./p	270	sq. m.	Future Expansion
2	Boy's Hostel	6	3	15	sq.m./p	270	sq. m.	Future Expansion
3	Common Space	50	1	3	sq.m./p	150	sq. m.	Future Expansion
4	Common W/C	5	1	15	sq.m./p	75	sq. m.	Future Expansion
					Sub Total:	765	sq.m.	
					Net Unassigned Footage (Circulation, Walls, Mechanical, Janitors Closet):	306	sq.m.	40% of Total
					Total:	1071	sq.m.	
					Grand Total:	12316.85	sq.m.	
					Ground Coverage Ratio:	13,885.66	sq.m.	40% of Total Site
					Permissible Built Area:	20,828.49	sq.m.	
					Parking	5,207.124	sq.m.	

Table 7: Program Formulation

CHAPTER 6: SITE SELECTION AND ANALYSIS

6.1. SITE OVERVIEW

Location:	Khari Bot, Nagarjun
Site Area:	34,714.16 sq. m. 68 Ropani - 3 Aana
Zone:	Residential Zone
Lowest Contour Level:	1311 m.
Highest Contour Level:	1334 m.
Latitude:	27°43'56.78"N
Longitude:	85°17'50.71"E
Total Height Difference:	23 m.
Built-up Area:	2,668 m^2

1| BALAJU PARK.

2| KHARI BOT MICRO STAND.

6.2. SITE NARRATIVE

Away from the busting street of Ring Road, at around 1 km. in, one reaches a residential zone surrounded by lush greenery. The site conveys the sense of calmness and solitude. The site is fairly steep and facing the east. The steep contour can be used to play with the wind and manipulate it to develop the multisensory experiences within the structure. The site is accessible from three sides i.e., East, South, and West. This rather abrupt change in elevation, coupled with the fact that the site faces the west can be problematic. Through the challenges, the project can be developed to help in utilizing the natural light and the potential to utilize the sun for both light and energy. The transmission pole runs along the western road through which the public vehicle moves along. A graveled road moves across the site which leads to the community forest.

6.3. SITE ANALYSIS

6.3.1. SITE JUSTIFICATION

According to the census data of 2011, Kathmandu District has 3,703 number of Visually Impaired and Blind People. The World Health Organization (2010) estimates that 6.67% of visually impaired are under 15 years of age. Comparing the data (on the right) of Bagmati Province, the top 10 municipalities having higher population density of visually impaired children below the age of 15 years are within the Kathmandu Valley (Kathmandu, Lalitpur and Bhaktapur) which is shown in Figure 32. Similarly, the site is located within the periphery of Kathmandu. The required infrastructure facilities such as commute, road, and other factors are also within the site. Thus, the initial tentative site location for project is assumed to be within the Nagarjun Municipality.

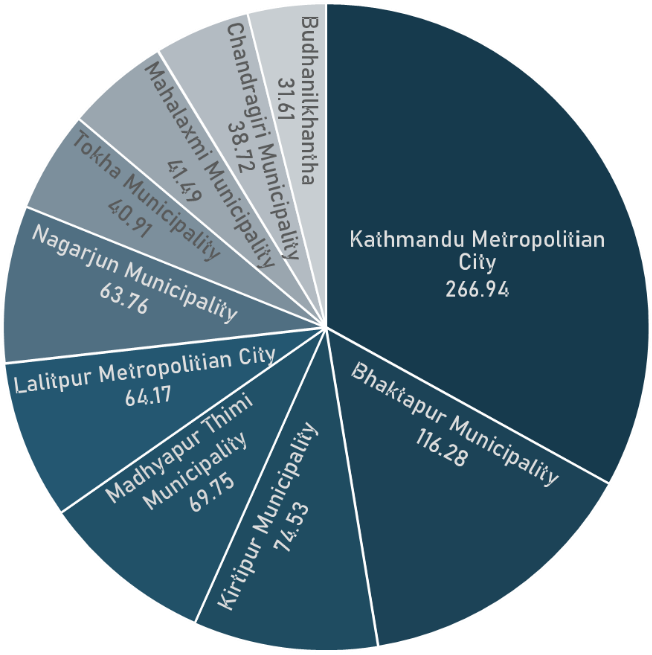


Figure 32: Population Density of Visually Impaired People

6.3.2. CLIMATIC CONDITION

6.3.2.1. CHARACTERISTICS OF CLIMATE

- Warm temperate climate
- Hot arid climate during October to December
- Warm humid climate lasting from June to August
- Cool climate lasting from November to December
- Monsoon season lasting from May to August
- Favorable season lasting from January to March
- No overheated period

- Under heated period during Nighttime of November
- Annual range of temperature is 12.36667 °C
- High humidity during July to October months and low in February
- Maximum rainfall of 266.1 mm during August and no rainfall during February, October, November, and December
- Sky condition: Mostly Cloudy in monsoon, Partly Cloudy in winter and clear in summer
- Vegetation grows quickly due to climatic actions

6.3.2.2. ANNUAL RAINFALL

MONTH	1	2	3	4	5	6	7	8	9	10	11	12
RAIN.	14.8	0	47.4	87.6	149	169	216	266	103	1.1	0.3	0

Figure 33: Annual Rainfall Graph of Nagarjun (Source: Meteorological Department)

From the Graph,

Annual Rainfall	=	1053.9 mm
Maximum Rainfall	=	266.1 mm during August
Minimum Rainfall	=	No rainfall during February, December
Average Rainfall	=	87.825 mm

6.3.2.3. Annual Temperature Graph:

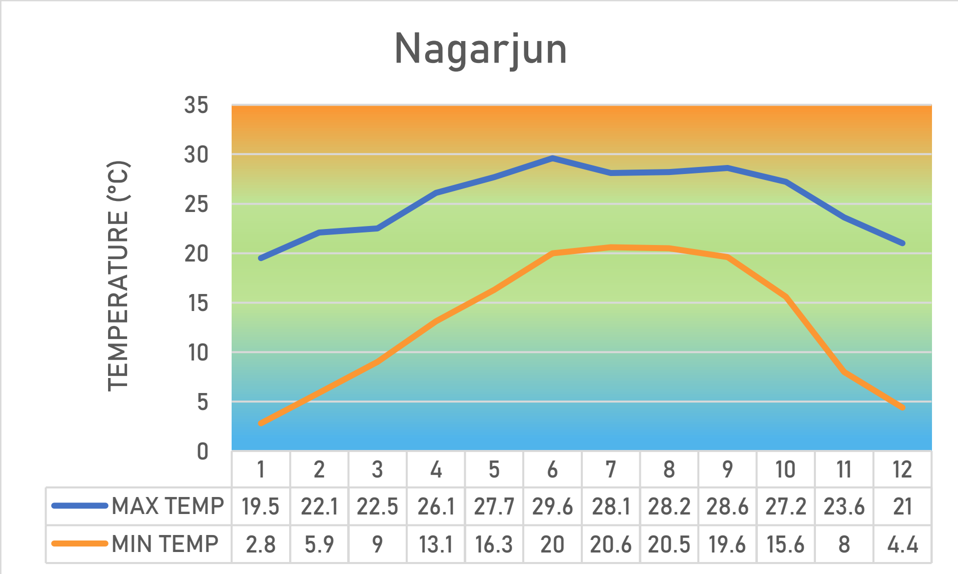


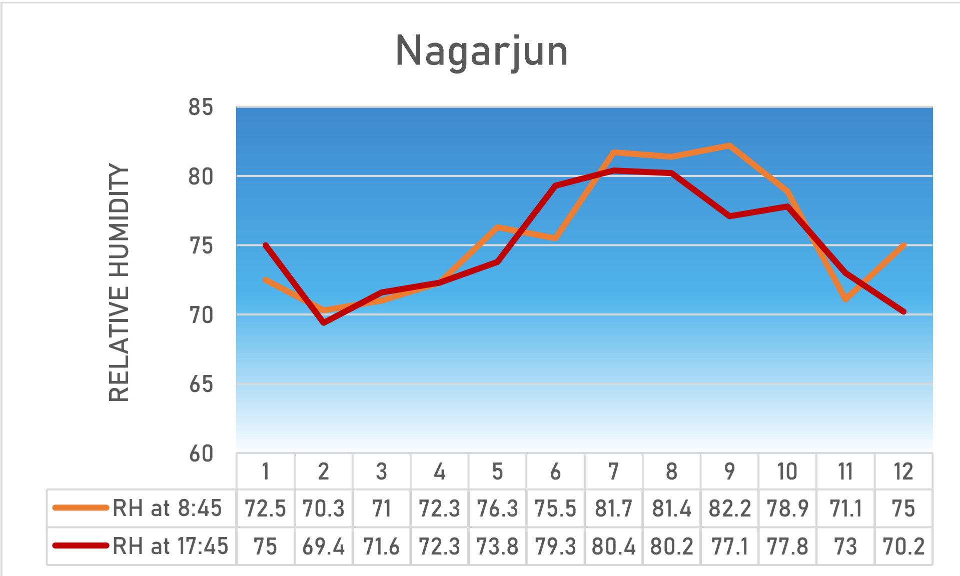
Figure 34: Annual Temperature of Nagarjun (Source: Meteorological Department)

From the Graph,

Mean Max. Temp.	=	25.35°C
Mean Min. Temp.	=	12.98333°C
Max. Temp.	=	29.6°C
Min. Temp.	=	2.8°C
Annual Range	=	Mean Max. Temp. – Mean Min. Temp.
	=	25.35°C-12.98333°C
	=	12.36667°C

Comfort Range (15°-26°C)	During Day Time:	January, February, March, April, November, December
	During Night Time:	May, June, July, August, September, October
Overheated period (Over 30°C)	During Day Time:	None
	During Night Time:	None
Under Heated Period (Below 10°C)	During Day Time:	January
	During Night Time:	January, February, March, November

6.3.2.4. Annual Humidity Graph:



	1	2	3	4	5	6	7	8	9	10	11	12
RH at 8:45	72.5	70.3	71	72.3	76.3	75.5	81.7	81.4	82.2	78.9	71.1	75
RH at 17:45	75	69.4	71.6	72.3	73.8	79.3	80.4	80.2	77.1	77.8	73	70.2

Figure 35: Annual Humidity Graph of Nagarjun (Source: Meteorological Department)

From the Graph,

Humidity at 8:45	Max. Humidity:	82.2% at September
	Min. Humidity:	70.3% at February
Humidity at 17:45	Max. Humidity:	80.4% at July
	Min. Humidity:	69.4% at February

6.3.2.5. Wind Flow

Looking into the wind rose diagram of the site as provided in figure, the wind blows from Eastern side to the site in about average speed of 2 to 4.9 mph in higher frequency. Similar pattern can be seen from West and South-West Direction

The wind rose shows the annual wind direction and speed. The spoke the wind rose shows the direction the winds blew from and the length of each spoke around the circle shows how often the wind blew from that direction. The different colors of each spoke provide details on the speed, in knots (1 knot=1.15 mph), of the wind from each direction. Looking into the wind rose diagram, the wind blew from the east at about 4.9% of the time, from the west at 5% of the time and the southwest 4.95% of the time. Similarly, the wind speed and wind intensity at the site can easily be construed.

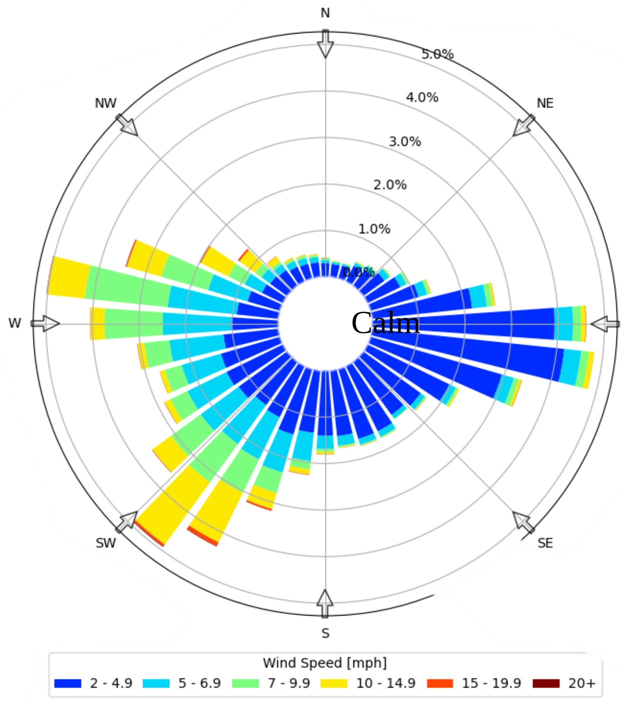


Figure 36: Annual Wind Rose Diagram of Nagarjun

6.3.2.6. SWOT Analysis

Strengths:

- Proper air circulation in the school will ensure that students are in a healthy and comfortable environment.
- The school is located in a residential area, which may offer a quieter and safer environment for the students.
- The site is easily accessible, which makes it convenient for students, staff, and visitors to reach the school.
- Accessible infrastructural resources such as electricity, water, and sewage will help the school to function efficiently.
- The location of the site may reduce disturbance from traffic or other sources of noise pollution.

Weaknesses:

- There is no footpath, which may make it difficult for visually impaired students to navigate the area safely.
- The steep contour of the site may make it challenging for students with mobility issues to move around.
- The road leading to the school is only 20 ft wide, which may create congestion and pose a safety risk for students and visitors.
- Rapid urbanization in the area may lead to increased traffic, noise pollution, and other environmental challenges.

Opportunities:

- The school can become a focal landmark in the area, which can help to raise awareness about the needs of visually impaired students.
- The school can optimize natural lighting, vantage points, and ventilation to create a more comfortable and conducive learning environment for the students.

Threats:

- The weak soil condition of the site may pose a risk of erosion or drainage problems, which can impact the safety and stability of the school buildings and surrounding area.

6.3.2.7. COMPREHENSIVE SITE ANALYSIS:

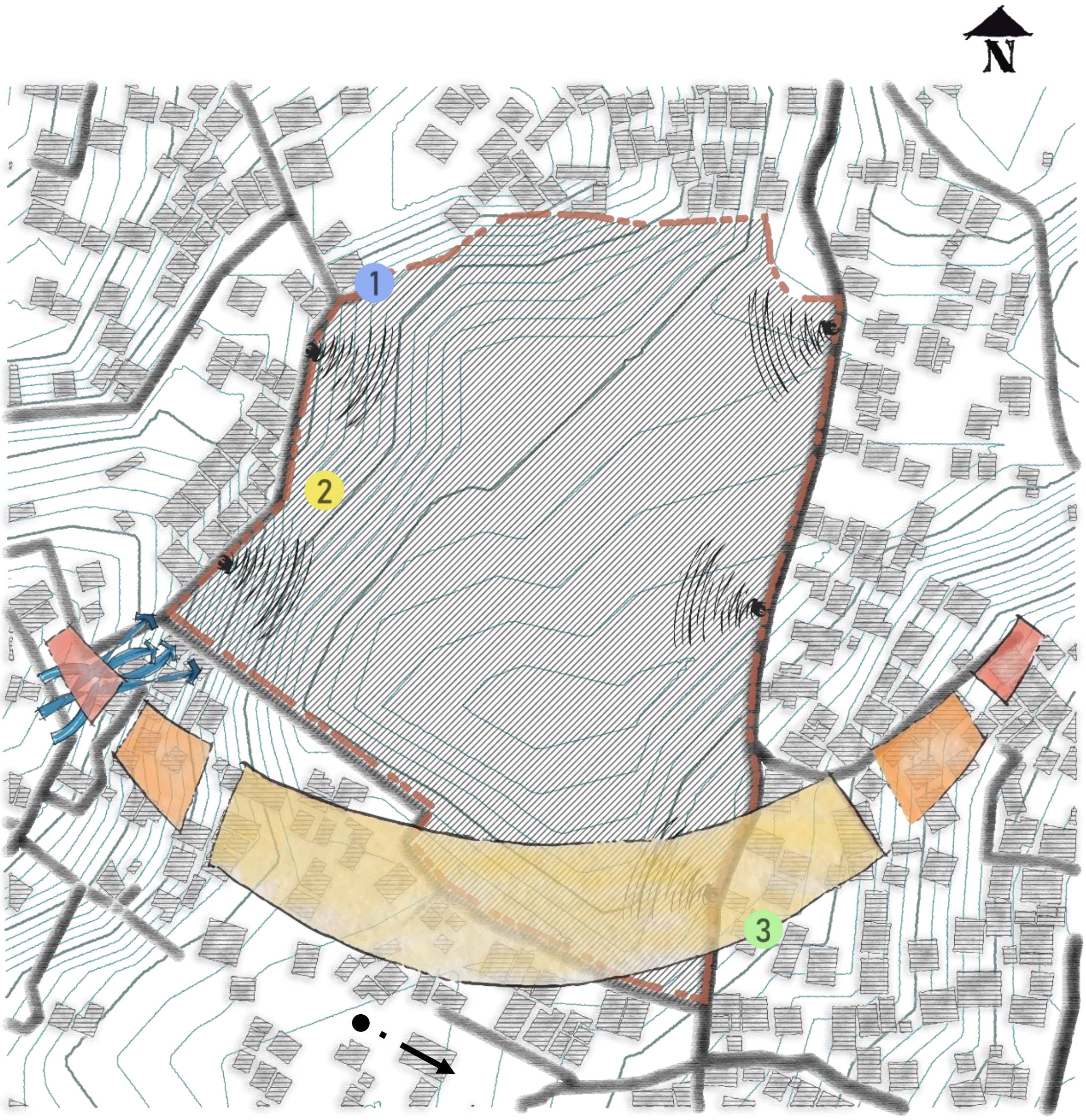


Figure 37: Sun path Diagram and Wind Direction along with Views

CHAPTER 7: DESIGN CONCEPTUAL DEVELOPMENT

7.1. NARRATIVE FOR CONCEPT DEVELOPMENT

The pitter-patter of raindrops echoed through the empty streets as the sky above grew darker by the minute. A gust of wind picked up and the flowers swayed wildly in the garden, bending and bowing under the pressure. The butterflies and birds scattered, seeking shelter from the oncoming storm. As people around the city rushed for cover, one man was seen running towards the hospital. His face was a mix of excitement and fear, his eyes darting left and right as he searched for a taxi. He had just received a call from his mother that his wife's water had broken, weeks before the expected delivery date. His heart raced as he thought of what could happen. Would everything be alright? Would the baby be healthy? He tried to push these thoughts aside and focused on finding a taxi. Finally, one pulled up and he jumped in, hastily giving the address of the hospital. The ride was a blur, as the rain pounded the roof of the taxi and the wind howled around them. The man's emotions were a roller coaster, shifting from excitement to fear and back again. He clutched his phone tightly, waiting for any updates on his wife's condition. As they arrived at the hospital, he leaped out of the taxi and sprinted inside, his heart pounding in his chest. He raced up to the maternity ward, where he was met with the sight of his wife, lying on a hospital bed, breathing heavily. The baby was on its way. The man's emotions overflowed as he held his wife's hand and urged her to push. Minutes later, a tiny baby girl was born, crying softly in the arms of the nurse. The man couldn't help but cry tears of joy and relief, his fears melting away as he held his newborn daughter in his arms. As the rain continued to fall outside, the man and his wife basked in the joy of the moment, grateful for the safe arrival of their baby girl. They knew that their lives would never be the same again, but they were ready to face the challenges and joys of parenthood together.

With the passing days, the parents took care of their little baby girl. The small bundle of joy grew quickly, and before they knew it, she was already a few weeks old. The child's little giggles filled the room, and she was always seen playing with her own hands. The parents, filled with the joy of being new parents, started to let their childish personalities show. They made silly sounds with their fingers and tongue, trying to get their baby's attention. The child would always look up with a bright smile, trying to figure out where the sound came from. However, as they played with their child, the parents started to notice something concerning. Their child didn't seem to react the same way when given visual stimulation. They tried everything, but their baby girl wouldn't respond to the toys or the bright colors they showed her. Worried and confused, they took their daughter to the doctor for a check-up. After a series of tests, the doctor's diagnosis was heartbreaking. The child had a genetic eye problem that left her visually impaired. The news hit the parents like a ton of bricks. All the joy and excitement of being new parents vanished, replaced with worry and sadness. They couldn't believe that their little girl would never be able to see the world like other children could.

Days turned into weeks, and the weight of the news still hung heavy on their hearts. The parents struggled to come to terms with the reality of their daughter's condition. They were scared and didn't know what the future held for their child. However, with time, they started to see their daughter in a new light. Even though she couldn't see, she had an incredible sense of touch, hearing, and smell. She could recognize her parents' voices and the smell of their skin. The parents realized that their daughter might be visually impaired, but that didn't make her any less special. They were determined to give her the best life possible, filled with love, care, and endless opportunities to learn and grow. With time, the weight of the diagnosis lifted, replaced with a newfound determination to support, and nurture their precious daughter. They knew that the road ahead might be difficult, but they were ready to face it together, as a family.

Education is an essential step towards independence, and so they began their search for a school that could provide the necessary skills to transform their weaknesses into strengths. Eventually, they came across the "Swawolambi| School for Visually Impaired" and decided to pay a visit to enquire about the institution. At first, they felt lost and unsure if this was the right choice, but as they entered the school's lush, verdant surroundings, they began to feel a sense of indulgence and wonder. The greenery enveloped them like a loving mother, comforting and reassuring them. Stepping out of their vehicle at the designated drop-off zone, the playful wind tickled their skin, encouraging them to follow its direction towards the entrance plaza to the administrative building. As they walked, the wind continued to lead them, and they arrived at the reception desk, where a friendly staff member greeted and guided them. While waiting for their turn in the lounge, they caught a glimpse of the open courtyard, radiating with the warm glow of sunlight, and their eyes lit up with awe. Approaching the courtyard, they were greeted by the melodious sounds of musical instruments being played by the students, and they couldn't help but feel deeply moved and impressed. The passage of time slipped their minds as they became lost in the spellbinding melodies. Eventually, they were called into the admission office, where a teacher requested them to feel the school's environment by getting blindfolded and experiencing it as a visually impaired person would.

As they lost their most dominant sense, visual sense, they started to feel disoriented and helpless. Slowly taking each step, they became accustomed to their new reality and allowed their other senses to take over. The gentle wind guided them towards the corridor, and the railing provided a sense of safety as they navigated the staircase. The changes in floor texture helped them feel their way down the steps, and as they became more confident, they walked normally with the help of the railing.

Entering the corridor, they noticed the different flooring materials and the way they affected the acoustics. The coarser and hollower texture of the flooring on the left side helped them stay on course, and they moved towards the center of the corridor, where the flooring was smoother and more solid. As they walked, they felt the warmth of the sun on their skin and the scent of flowers in the air, indicating the presence of breakout spaces. The wind flowing through the pockets guided them forward, and the shape of the roofing enhanced the acoustics of the nodes.

Turning towards the smell of food, they honed their new senses and felt a mix of excitement and fatigue from the experience. They took shelter in the provided pocket spaces and removed their blindfolds, feeling amazed by the flashes of light that surrounded them. Looking ahead, they saw a large open space where children were playing and challenging themselves to strive towards independence through real-life scenarios.

As the tour came to an end, the parents were convinced that this was the right school for their child. They felt grateful and hopeful, knowing that their child's future was in good hands and that education was the first step towards independence. They left the school feeling confident that their child would grow up to be a strong and independent individual, despite her visual impairment.

7.2. FUNDAMENTAL CONCEPT

In the egoistic and conservative society, visually impaired individuals are often relegated to a position of weakness or inferiority due to their lack of visual senses. This perception has been deeply ingrained in society and perpetuated a sense of imbalance and discrimination. It seemed that their lack of visual senses made them the weaker side in the world considered “Yin”.

The principles of “Yin Yang” emphasize on the importance of recognizing and respecting differences while striving for balance and harmony. This approach recognized that every individual has unique abilities and challenges, and that these differences should be celebrated rather than stigmatized. In this way, Yin Yang offers a path towards a more inclusive and harmonious society. Thus, the concept for a school for visually impaired individuals will be centered around the principles of Yin Yang. The school will strive to create an inclusive and supportive environment where visually impaired students can flourish and develop their unique abilities. The school will seek to challenge the perception that visually impaired individuals are weaker or inferior by emphasizing the strengths and capabilities of these students.

Yin, representing the dark and passive aspects of a space, can be incorporated using soft textures, dark colors, and quiet spaces for rest and relaxation. This can be achieved by designing quiet areas for students to rest and recover from the sensory stimulation of their day, using soft materials such as carpet or cork flooring, and incorporating sound-absorbing materials in the ceiling and walls to reduce noise levels.

On the other hand, Yang, representing the light and active aspects of a space, can be incorporated using bright colors, strong contrasts, and active spaces for movement and play. This can be achieved by designing spaces for physical activity, such as gymnasiums or outdoor play areas, and incorporating bright colors and high contrast materials, such as bold striped flooring, to help guide visually impaired students.

Balancing these two principles in the design of the school can create a supportive and inclusive environment that considers the unique needs of visually impaired students. It can also promote a sense of well-being and balance in the students, helping to improve their overall quality of life.

7.3. DESIGN DRIVER

The design driver for the school for visually impaired should be centered around creating a space that promotes inclusion, accessibility, and a sense of balance and harmony. The design should focus on creating an environment that is not only functional but also aesthetically pleasing and emotionally supportive, allowing visually impaired students to feel empowered and confident in their abilities. The use of tactile and auditory cues, as well as visual cues that can be detected through other senses, should be incorporated into the design to make the space accessible to all students. In addition, the design should prioritize the creation of community and social connections among students, staff, and visitors, promoting a sense of belonging and fostering a supportive and collaborative learning environment. Designing a school for visually impaired individuals requires a focus on accessibility, safety, and inclusivity. Here are some design drivers to consider:

- **Accessibility**: The design of the school should prioritize accessibility for visually impaired students. This includes features such as wheelchair accessibility, Braille signage, audio cues, and tactile maps.
- **Multi-sensory Experience**: The school should provide a multi-sensory learning experience that engages all senses, including touch, smell, and sound, in addition to sight. This can be achieved through the use of tactile surfaces, scented classrooms, and soundscapes that provide students with a more immersive learning experience.
- **Lighting**: Lighting is crucial for visually impaired students, as it affects their ability to navigate and read. The school should have sufficient natural lighting and bright, consistent artificial lighting.
- **Acoustics**: Acoustics play an important role in the learning environment for visually impaired students. The school should be designed to minimize noise and echoes, which can affect their ability to hear and communicate.
- **Color Contrast**: Color contrast is important for visually impaired students, as it helps them distinguish between different objects and areas. The school should use high-contrast colors for walls, floors, and furniture.

- **Safety**: Safety is a top priority for any school, but it is especially important for visually impaired students. The design of the school should include features such as handrails, non-slip flooring, and audible alarms.
- **Inclusivity**: The design of the school should promote inclusivity for all students, regardless of their abilities. This includes features such as adjustable desks and chairs, sensory rooms, and assistive technology.
- **Wayfinding**: Wayfinding is crucial for visually impaired students, as they rely on clear and consistent paths to navigate the school. The design of the school should include clear signage, tactile maps, and audible cues to help students find their way.

By considering these design drivers, a school for visually impaired students can provide a safe, accessible, and inclusive learning environment that supports their unique needs and abilities.

7.4. ZONING

The main objective of the project is to provide a safe, stimulating environment for students and staff. By dividing the site into Public, Semi-Public, and Private zones, the different areas of the school can be used for their intended purposes and privacy can be maintained where necessary.

Figure -38: Site Zoning

The entrance of the school is located on the eastern side of the site, where the primary access road is situated. This strategic placement ensures that visitors can easily locate the school and access it without difficulty. The site slopes down from the east to the western side, and this has been utilized in the zoning plan to create another buffer between the school and the outside world. The public zone is located at the top of the contour level, which serves as a natural buffer and gradually introduces the privateness of the spaces as one moves down the slope.

The Public zone comprises the administrative block and amenities, such as the library, cafeteria, and assembly hall. This zone is accessible to visitors and serves as the face of the school. The Semi-Public zone houses the academic block and skill training block. This zone is designed to cater to the specific learning needs of visually impaired students, providing them with a conducive environment to learn and develop their skills. The Private space comprises the accommodation block, where students can rest and recharge after a long day of learning.

The public zone, located at the top of the contour level, is open and accessible, providing an inviting and welcoming environment. The Semi-Public and Private zones are located further down the slope, which gradually increases privacy as one moves down. This zoning plan ensures that visually impaired students and staff have a safe and secure environment to learn, work and live.

Figure 39: Functional Zoning

7.5. DESIGN DEVELOPMENT

7.5.1. ADJACENCY MATRIX

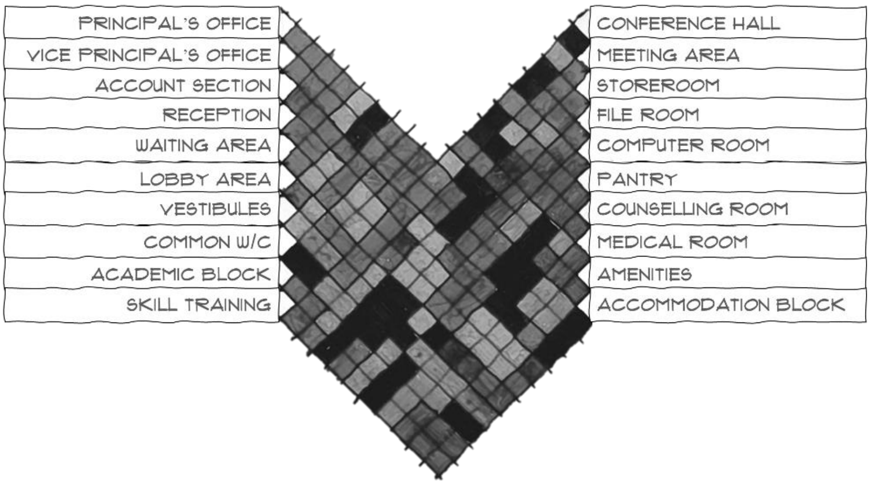


Figure 40: Adjacency Matrix of Administrative Block

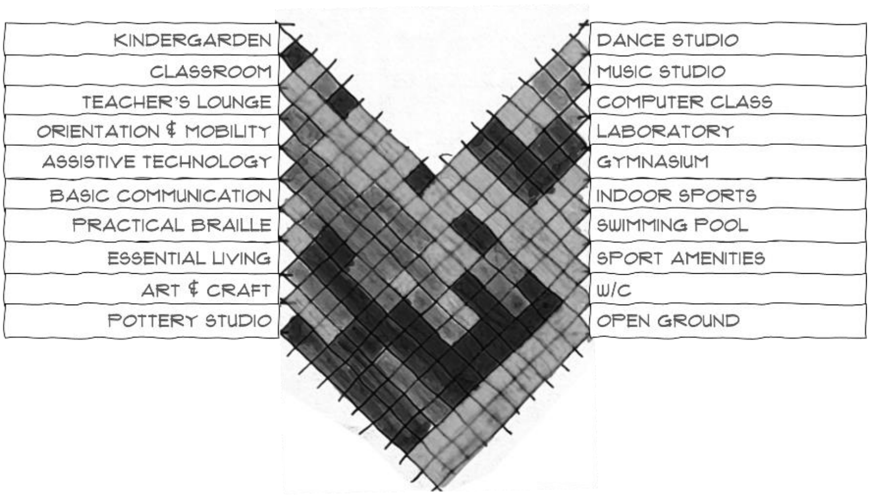


Figure 41: Adjacency Matrix of Academic Block

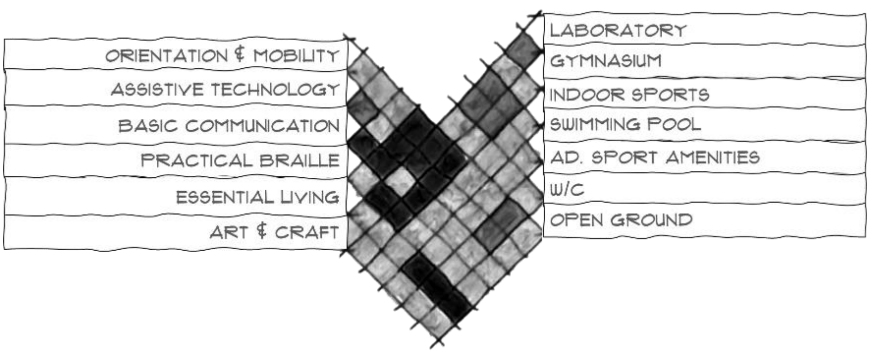


Figure 42: Adjacency Matrix of Amenities Block

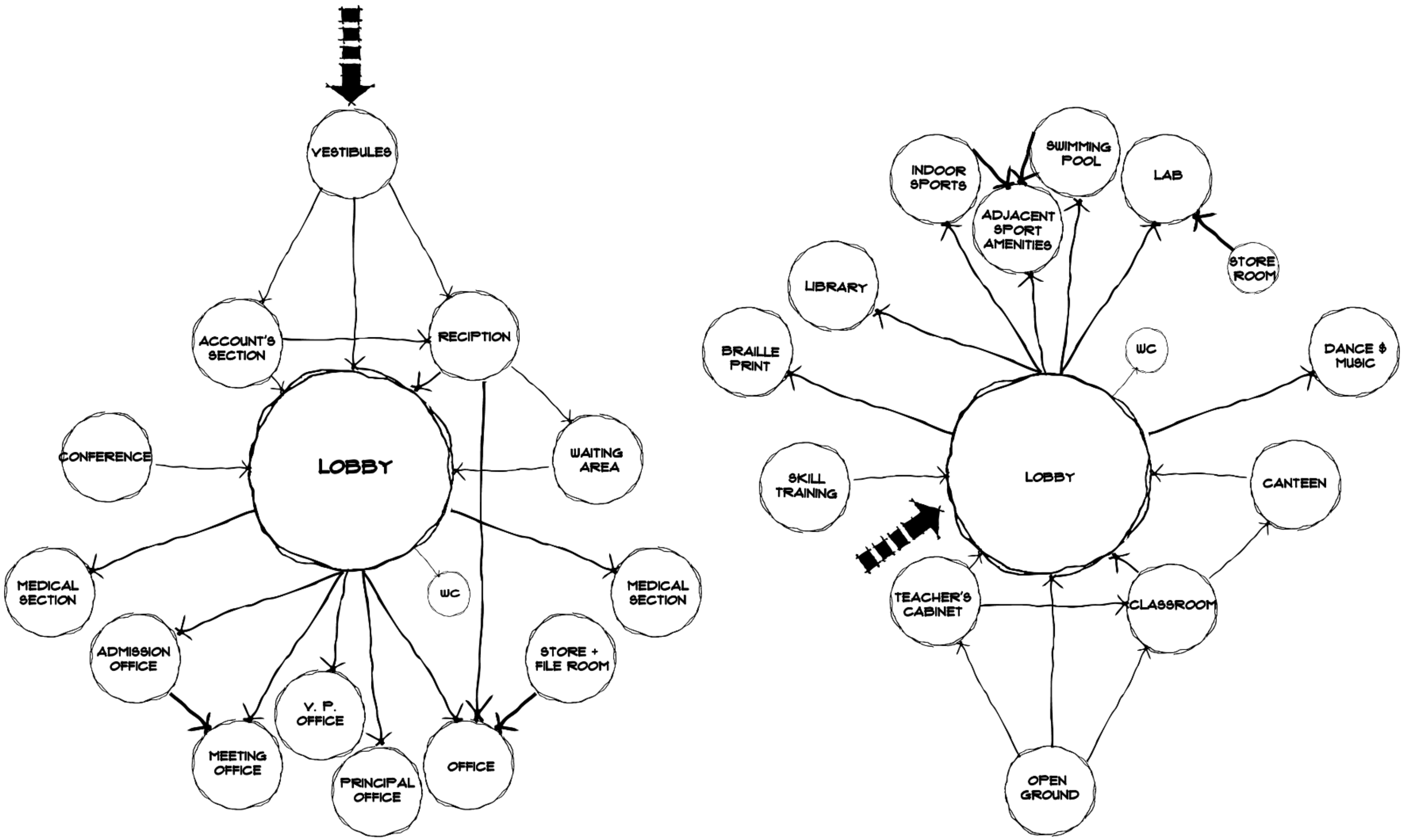


Figure 43: Functional Bubble Diagram

7.5.2. CONTOUR MANIPULATION

The site design for the school presents unique challenges that require careful consideration and planning. One of the most critical aspects of site design is contour manipulation, which involves shaping the site to create flat areas that can accommodate important functions such as classrooms, playgrounds, and communal spaces. The contour is steep. Steep slopes can create safety hazards, especially for visually impaired students, who may have difficulty navigating uneven terrain. By manipulating the contours, the design can maintain relatively flat spaces between amenities or functions, which can help to reduce the risk of accidents and create a more accessible learning environment.

Another consideration is the cost-effectiveness of the project. To keep the project within budget, it is essential to limit the use of retaining walls. Retaining walls are often necessary to manage steep slopes, but they can be expensive to construct. To achieve cost-effectiveness, the maximum height of the retaining walls should not be above 3m. Thus, the contours must be manipulated to achieve this goal.

Figure 44: Contour Manipulation

The primary focus of this project should be on safety and easy accessibility. Since it is challenging for visually impaired students to navigate spaces that require vertical circulation, the design should aim to reduce the number of vertical circulation elements such as stairs, ramps, and elevators. Instead, the design should optimize horizontal circulation to simplify navigation for visually impaired students.

To achieve these goals, the contours of the site have been manipulated to create flat areas that can accommodate functions and its support while reducing the need for vertical circulation. By shaping the site to create flat areas and reducing the need for vertical circulation, the design can create a safe and accessible learning environment that meets the unique needs of visually impaired students. The project was designed with cost-effectiveness in mind, limiting the use of retaining walls while maintaining the necessary level changes. By considering these factors, the site was optimized to achieve the best possible outcomes for the school and its students.

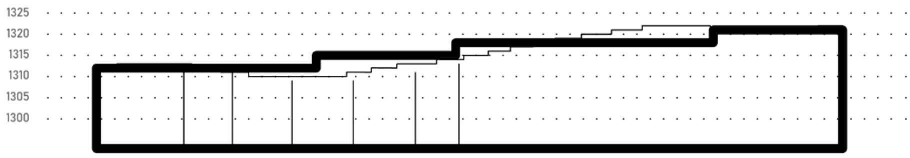


Figure 45: Section along A-A

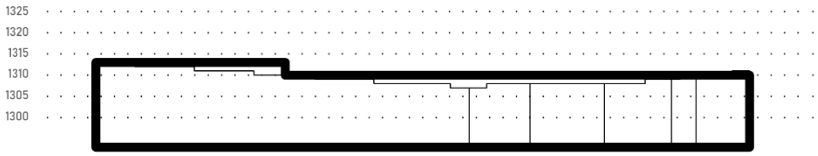


Figure 46: Section along B-B

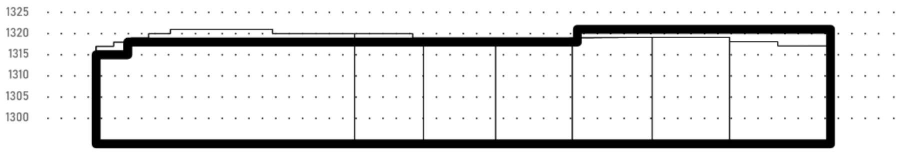


Figure 47: Section along C-C

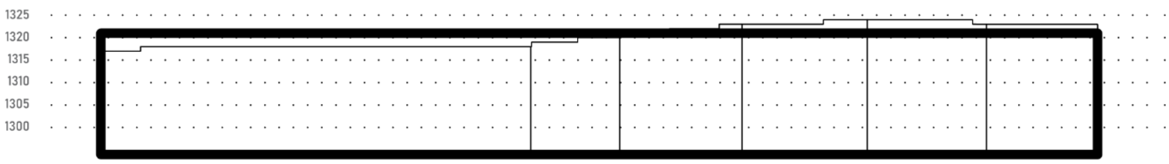


Figure 48: Section along D-D

7.5.3. PLAN DEVELOPMENT

PHASE I: DISTINCTIVE RECTILINEAR PATHWAY

Based on the design driver, the focus should be providing rectilinear pathway. The site divided into 4 sections through 5 vertical lines progressing in geometric sequence to represent the character development. These lines distinctly defined the spaces. Similarly, the same lines were rotated 90 degrees to create the zonings. This gave birth to the spaces. The initial zoning was added alongside the pathways resulting in a layout and zoning that is both functional and visually appealing.

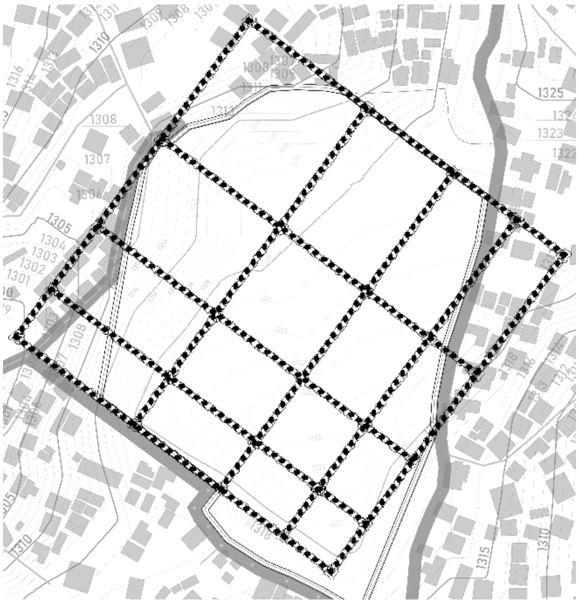


Figure 49: Grid for Pathways

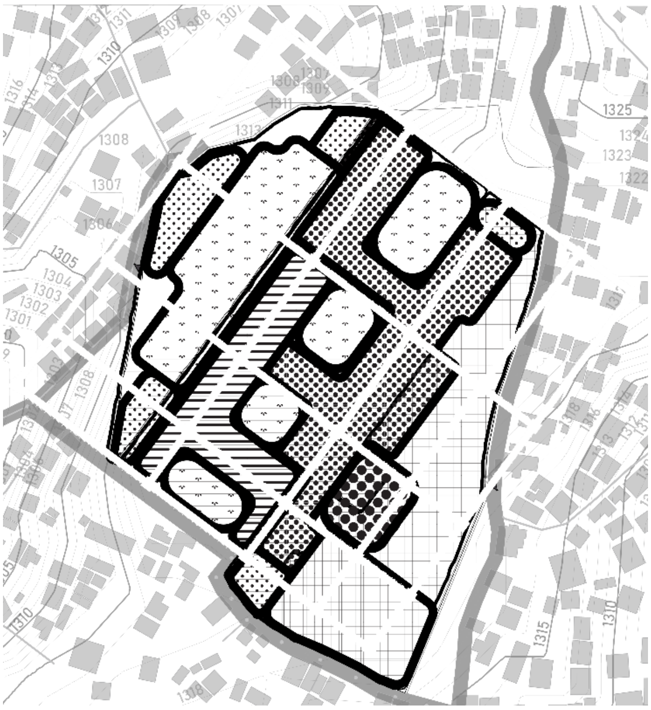


Figure 50: Initial Zoning alongside the Pathways

PHASE II: FIGURE-GROUND COMPOSITION

The main concept defines the next step. The achieved Initial Zoning alongside the Pathway composed to balance out the mass and void with each space connected to the courtyard. This gave birth to pocket spaces which helps the children to socialize through leisure activities. Similarly, these spaces were used to make children have multisensory experiences. A figure-ground composition was composed, and functions were designated to each mass. The use of pocket spaces and multisensory experiences further enhances the design, providing opportunities for the children to socialize and engage in meaningful activities. The figure-ground composition ensures that each space is well-defined and serves its intended purpose, resulting in a cohesive and well-organized design.

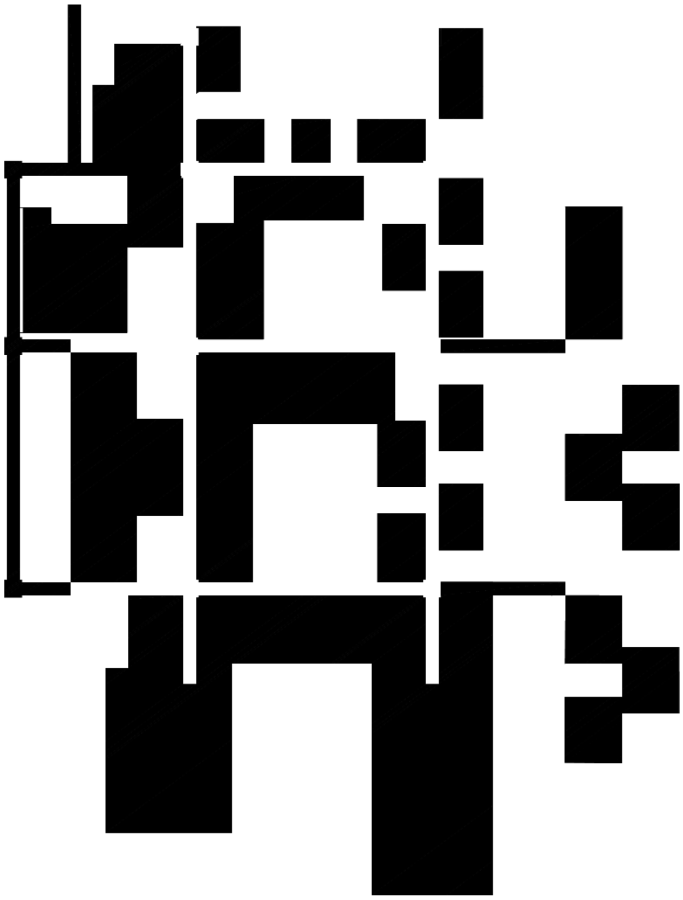


Figure 51: Figure-Ground Composition

Figure 52: Master Plan Render

Phase III: Sensory Experiences

A. Smellscape

i. Entrance

As we enter the site of the school for visually impaired students, the design aims to create a welcoming atmosphere that engages our senses, particularly through the implementation of the smellscape and passive heating techniques. These elements work together to guide us towards the building while providing a pleasant and comfortable experience.

To achieve a welcoming feeling, aromatic crawler plants are strategically placed along the pathways leading towards the entrance. These plants release pleasant scents, enhancing the olfactory experience as we approach the building. The fragrant aromas create a positive and inviting ambiance, stimulating our senses and creating a sense of anticipation and curiosity. In addition to the smellscape, passive heating techniques are employed to enhance the thermal comfort of the outdoor spaces which will be talked about after. (See Figure 68: Conceptual Sketches)

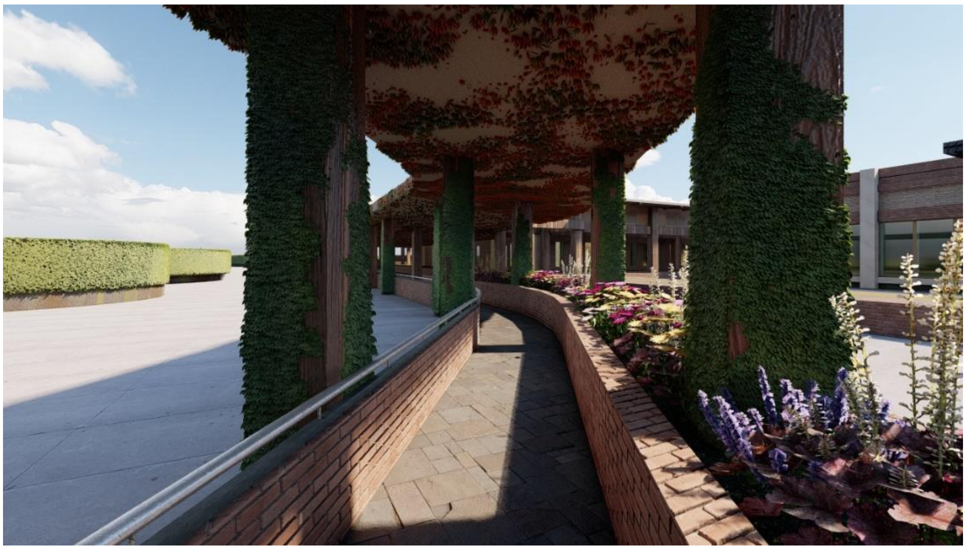


Figure 53: Entrance Corridor

ii. Staircase

The design of the school for visually impaired students incorporates the concept of the smellscape by creating pocket spaces with aromatic elements within the area surrounding the single flight staircase and the three landings in between. To ensure accessibility for all students, a ramp is provided across the staircase, allowing for seamless movement between levels. The space created between the ramp runs is utilized as pocket spaces, enhancing the sensory experience through the introduction of aromatic elements.

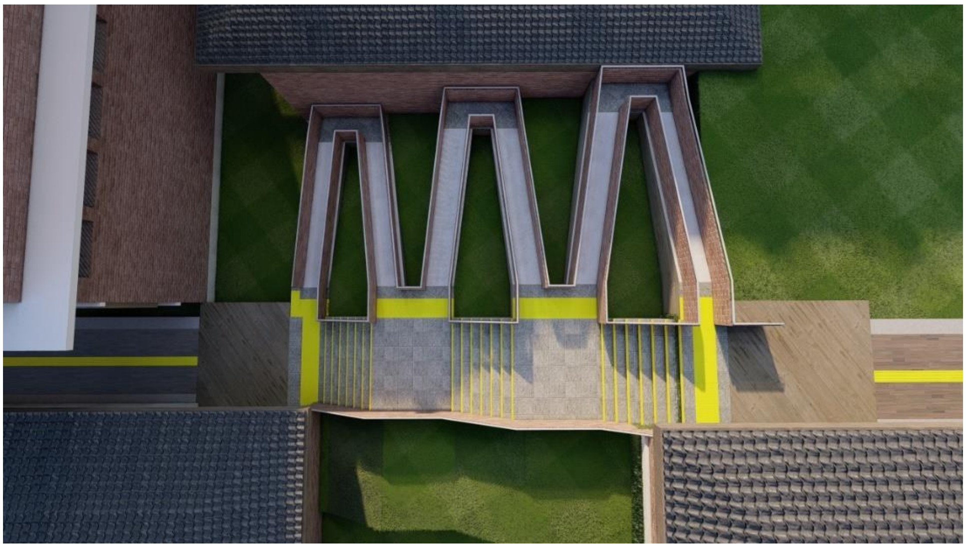


Figure 54: Staircase with Ramp

These pocket spaces serve as designated areas where students can pause, rest, and engage with their senses. By incorporating aromatic elements within these spaces, such as fragrant plants, essential oils, or other scent-emitting objects, the design creates an enriched sensory experience for the students as they navigate the staircase and the landings. The scents emanating from these elements are strategically chosen to provide a pleasant and engaging olfactory experience.

Figure 55: Smellscape across the Staircase

The presence of aromatic elements within the pocket spaces offers a range of benefits. Firstly, it contributes to the overall ambiance of the school environment, creating a more inviting and pleasant atmosphere for students and staff. Certain scents, such as lavender or eucalyptus, have calming properties and can help reduce stress levels, providing a more conducive learning and working environment.

Figure 56: Staircase Render

iii. Circulation

The design of the school for visually impaired students places a strong emphasis on the smellscape, recognizing the powerful impact that scents can have on the sensory experience and overall well-being of individuals. The breathing spaces, which were introduced alongside the pathway, serve as pocket spaces that offer a range of benefits, including opportunities for socialization, seating areas for rest, and most importantly, sensory experiences.

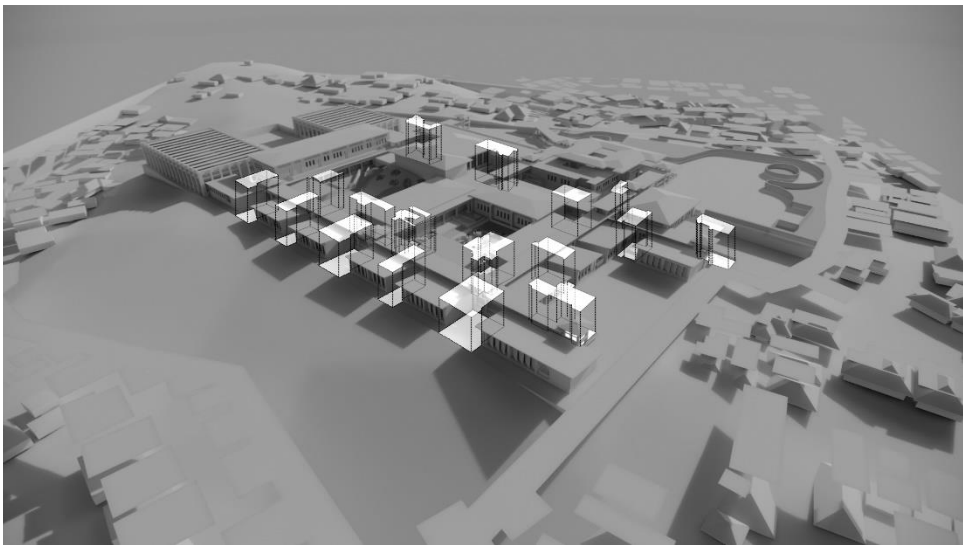


Figure 57: Pocket Spaces

By strategically locating these pocket spaces at the western end of the site, where the prevailing wind direction is from west to east, the design takes advantage of the wind flow to enhance the aromatic experience of the school environment. The positioning allows for fragrant scents to be carried by the wind from specific areas, such as surrounding vegetation or fragrant elements incorporated within the pocket spaces, towards the students as they navigate along the pathway.

The intentional introduction of pleasant and captivating scents serves several purposes. Firstly, it helps to create a more engaging and immersive environment for the visually impaired students. By stimulating their sense of smell, the design contributes to a multisensory experience that enhances their overall perception and understanding of their surroundings. This incorporation of olfactory stimulation alongside other sensory inputs such as touch and sound enrich their learning experiences and promotes a holistic engagement with the environment.

Figure 58: Aromatic elements in Pocket Spaces

Figure 59: Pocket Spaces used as Seating Space

Furthermore, the aromatic elements within the pocket spaces also have the potential to positively impact the emotional well-being of the students and staff. Certain scents, such as lavender or citrus, are known for their calming and uplifting properties. By introducing these scents into the environment, the design seeks to create a more serene and pleasant atmosphere, promoting relaxation and reducing stress levels among the school's occupants.

iv. Sensory Garden

In order to provide an enriching sensory experience for the children, a Sensory Garden has been incorporated into the design of the school. This garden serves as a dedicated space where students can engage and hone their senses. At the center of the sensory garden lies a unique feature known as the mist cave. The mist cave is designed to produce a fine mist that gently envelops the surrounding area. This mist serves multiple purposes within the sensory garden. To complement the mist cave, aromatic crawler plants are planted along the cave itself. These crawlers not only add visual appeal but also contribute to the overall aromatic experience. The combination of the mist and the crawlers creates a captivating and immersive sensory environment, encouraging the students to explore and engage with their sense of smell.

Firstly, it enhances the scent of the flowers planted throughout the garden. As the mist interacts with the flower blossoms, it releases their natural fragrances, intensifying the olfactory experience for the students. The mist creates a delicate and captivating ambiance, inviting the students to explore and appreciate the various scents present in the garden.

Moreover, the mist cave acts as a focal point or node within the site, drawing attention and serving as a landmark. Its unique design and the mist it produces make it easily identifiable, guiding visually impaired students and providing them with a reference point within the sensory garden.

Figure 60: Mist Cave

B. Acoustics Senses

i. Staircase

In the design of the school staircase for the visually impaired, the variation in ceiling height is utilized as an acoustic cue to aid echolocation. By incorporating differences in ceiling height, the sound waves generated by the students' vocalizations or by tapping on surfaces will bounce back and create distinct echoes. These echoes provide valuable information about the vertical position and spatial layout of the staircase.

To further enhance the echolocation experience, specific acoustical materials are chosen for the staircase flooring. These materials are selected for their ability to produce audible sounds when interacted with, such as footsteps or cane taps. The choice of acoustical flooring materials ensures that the students can effectively utilize echolocation to gauge their position on the staircase and navigate safely. In addition, sound reflectors are placed on the ceiling of the staircase. These reflectors are designed to optimize sound reflection and direct the echoes towards the students.

Furthermore, the use of sound-absorbing materials in other areas surrounding the staircase, such as adjacent walls or corridors, helps minimize background noise and reverberation. This ensures that the echoes produced within the staircase are distinct and easier to interpret, allowing the students to focus on the acoustic cues specific to the staircase environment.

By intentionally designing the staircase with acoustics in mind, the space becomes a valuable tool for echolocation and orientation for visually impaired students. The combination of varying ceiling heights, acoustical flooring materials, and strategically placed sound reflectors creates an environment where the students can confidently navigate the staircase using auditory cues.

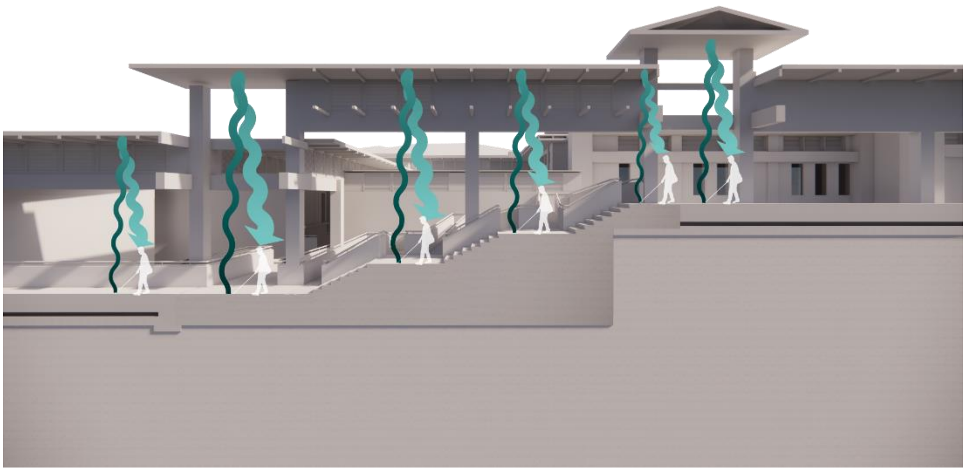


Figure 61: Echolocation in various height of staircase

ii. Circulation

Like the design of the staircase as above mentioned, the variation in ceiling height is employed as a means of echolocation. By incorporating differences in ceiling height when attending towards the node/ intersection, the sound waves generated by the students' vocalizations or by tapping on surfaces will bounce back and create distinct echoes. These echoes serve as important auditory cues, allowing the students to orient themselves within the corridor and perceive the spatial layout. To provide the unique auditory cues across the cross-section of the corridor, the voids are introduced. The depth of the voids is varied across the cross-section. This generates the distinctive auditory cues along the longitude section. As the visually impaired children diverse out of the straight line, the change in sound forces them to re-orient themselves back to the original pathway.

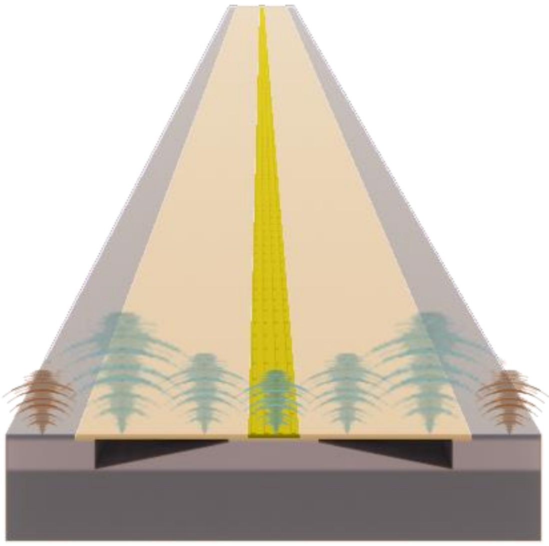


Figure 62: Cross-section of the Corridor giving the distinctive audible sound cues

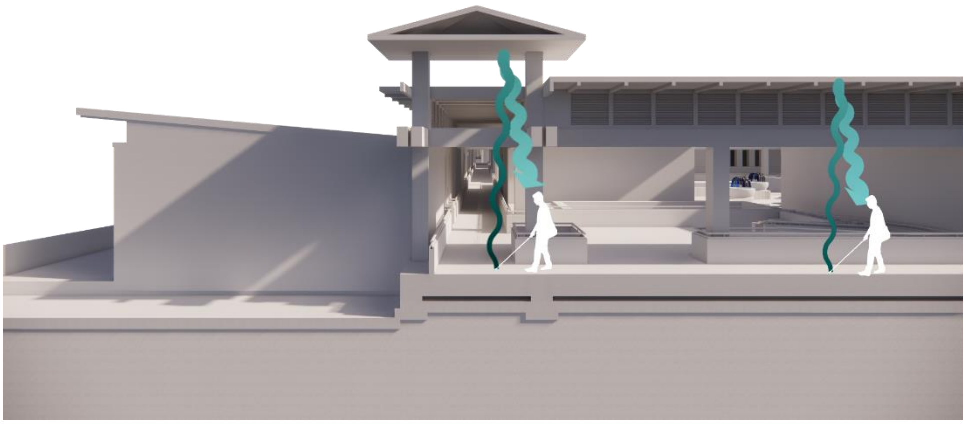


Figure 63: Echolocation in Corridor

To enhance the echolocation experience, specific acoustical materials are chosen for the corridor flooring. The wooden flooring is used. This material is selected for their ability to produce audible sounds when interacted with, such as footsteps or cane taps. Furthermore, sound reflectors are placed on the corridor ceiling.

In addition to the use of acoustical materials and sound reflectors, the design should consider other factors to create an inclusive and accessible corridor environment. This includes appropriate lighting levels and color contrast to assist those with partial vision, tactile indicators, or floor markings to provide tactile guidance, and clear signage with raised lettering or Braille for wayfinding purposes.

C. Haptic Sense

In the design of pathways within the school, a clear distinction is made between risk zones and safe zones to enhance safety and navigation for visually impaired individuals. The differentiation in flooring materials and textures helps convey this distinction.

In the safe zones of corridors, smooth wooden flooring materials are used. This material provides a smooth and consistent surface, allowing for easy and uninterrupted movement. The clear flooring helps visually impaired students navigate without obstacles or unexpected changes in texture.

Figure 64: Staircase Render

Conversely, stone pavements with coarser finishes are utilized to indicate the risk zones to create a noticeable transition. The coarser finishes alert users to be more conscious of their surroundings and potential risks. This includes areas where there may be steps, intersections, at the extremities of corridors, or other potential obstacles. By providing coarser textures, visually impaired individuals can detect the change in surface and be alerted to the need for increased awareness and attention. At the entrance of rooms, the wooden flooring is intentionally made slightly coarser. This serves as a tactile cue to indicate the transition from a common circulation space to a specific room, alerting individuals to the change in environment.

Figure 65: Example of Braille Handrails (Pigneto Metro Station, n.d.)

Tactile indicators play a crucial role in guiding visually impaired students along the pathways. These indicators are typically placed at the center of the circulation space, providing a tactile reference point to help maintain direction and orientation. Additionally, railings are installed at the extremities of the pathways to provide physical support and serve as a boundary marker, giving users a clear sense of the path's limits. The Braille Handrails are also provided before and after each transition spaces such as classroom, staircases, etc.

Figure 66: Corridor Render

By incorporating these design elements, the pathways within the school effectively communicate the differentiation between risk zones and safe zones, providing visually impaired students with clear cues for navigation and safety. The strategic use of flooring materials, tactile indicators, and railings helps ensure a secure and accessible environment, empowering visually impaired individuals to confidently navigate the school's spaces.

D. Other Senses

In addition to the use of acoustical and olfactory sense, the design should consider other factors to create an inclusive and accessible corridor environment. This includes appropriate lighting levels and color contrast to assist those with partial vision, tactile indicators, or floor markings to provide tactile guidance, and clear signage with raised lettering or Braille for wayfinding purposes. These are provided using materials having LRV value more than 30. The flooring materials contrasts themselves acoustically, visually, and haptically.

Figure 67: Cave Render

The inclusion of a cave feature in the design of the school serves as an orientation and mobility aid for visually impaired children. Within the cave, the interplay of light and shadows becomes a key element for the children to navigate and move freely. The strategic positioning of light source creates dynamic lighting conditions that cast varying shadows throughout the space. By encouraging the children to explore and interact with the cave, they are challenged to use their remaining visual cues to understand the spatial layout and navigate within the environment. The changing patterns of light and shadows can help them gauge distances, identify obstacles, and establish mental maps of the cave's configuration.

E. Passive Heating Techniques

i. Entrance

The design incorporates a concrete slab positioned above the pathways, acting as a thermal mass. This slab absorbs and retains heat from the sun, creating a greenhouse effect. As the slab heats up, the surrounding air is warmed, providing a comfortable environment for those walking along the pathways.

The glass membrane, which encloses the pathways, plays a crucial role in trapping and harnessing the transferred heat. As the hot air rises due to convection, it escapes out of the top portion of the glass membrane, creating a natural ventilation system. This movement of hot air creates a continuous cycle, with cool air replacing the hot air as it rises. This passive heating technique ensures that the pathways remain comfortably warm, even during cooler periods, further enhancing the sensory experience and providing comfort for those with visual impairments.

By combining the smellscape with passive heating techniques, the design not only creates a welcoming environment but also guides visually impaired individuals towards the building. The aromatic scents from the crawler plants attract attention and serve as a directional cue, while the warm and comfortable pathways encourage exploration and ease of navigation.

Figure 68: Conceptual Sketches

ii. Circulation

Expanding on the aforementioned design approach, the inclusion of a concrete slab positioned above the pathways continues to serve as a thermal mass, absorbing and retaining heat from the sun to create a greenhouse effect. As the slab heats up, it warms the surrounding air, initiating a process of convection where the hot air rises in an attempt to escape. To regulate this airflow and maintain thermal comfort, a series of mechanically controlled louver windows are integrated below the slab.

During the summer season, when cooling is desired, these louver windows are opened to facilitate a natural ventilation system. The hot air, rising due to convection, is directed towards the nodes situated at each intersection. These nodes are designed with roofs that are higher than the concrete slab and fully opened, creating an outlet for the hot air to escape. The hot air is guided towards these nodes through the pathways, aiding in the ventilation process and ensuring a more comfortable environment within the school.

Conversely, in winter when heat retention is prioritized, the louver windows are closed off. This prevents the warm air from escaping, effectively trapping the heat within the space and maintaining a cozy indoor temperature. By adjusting the position of the louvers, the design allows for flexibility in controlling the ventilation and temperature regulation throughout the year.

The incorporation of the nodes with roofs that are higher than the slab and fully opened serves multiple purposes. Firstly, they provide an outlet for the hot air to escape, effectively dissipating the excess heat and preventing it from accumulating within the pathways. Secondly, these nodes act as distinctive landmarks and guideposts for visually impaired individuals, helping them navigate the school with ease. By recognizing the unique design of these nodes, visually impaired students and staff can orient themselves within the space and confidently move towards their desired locations.

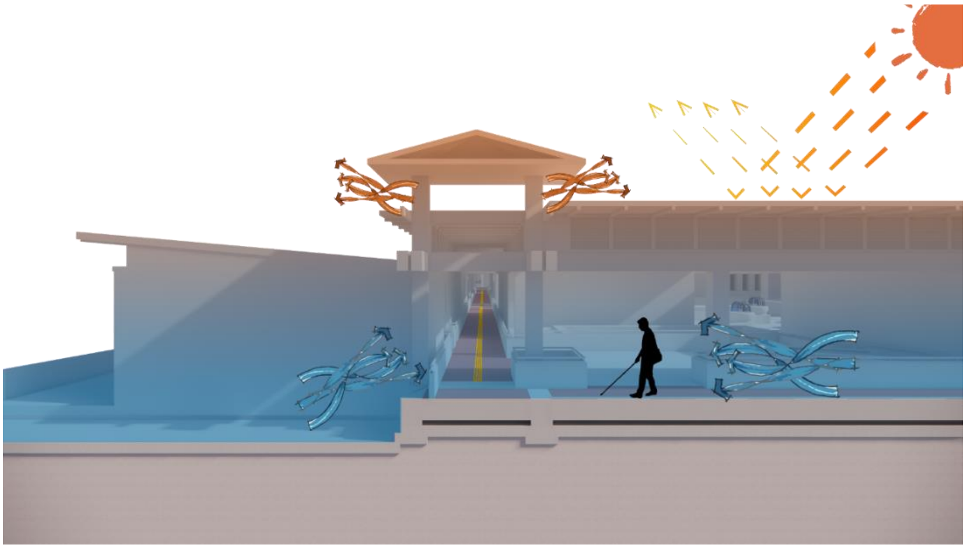


Figure 69: Wind Circulation through Passive Heating Technology

7.6. 3D VISUALIZATION

Figure 70: Cave

Figure 71: Sensory Garden

Figure 72: Bird's Eye View

7.7. ARCHITECTURAL MODEL

Figure 73: Actual Site Context

Figure 74: Site Model (Scale: 1:500)

Figure 75: Cross-section of Corridor (Scale: 1:50)

Figure 76: Back View of Classroom (Scale: 1:100)

Figure 77: Front View of Classroom (Scale: 1:100)

Figure 78: Front View of Canteen Block (Scale: 1:100)

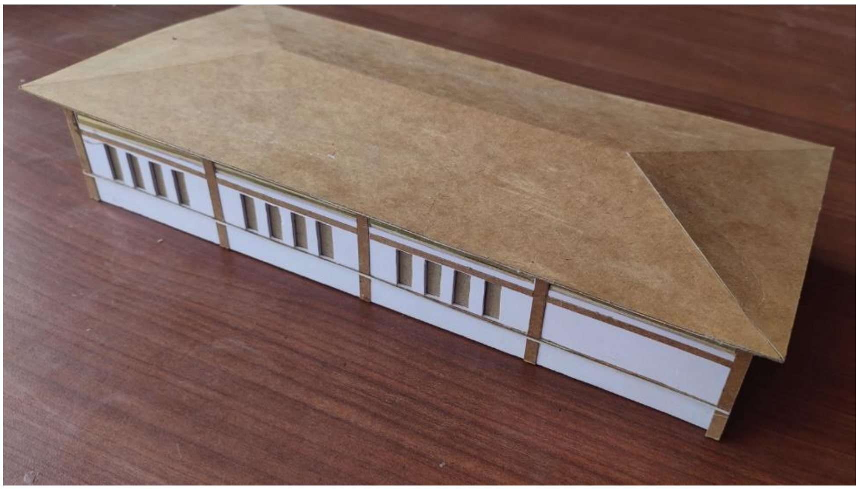


Figure 79: Back View of Canteen Block (Scale: 1:100)

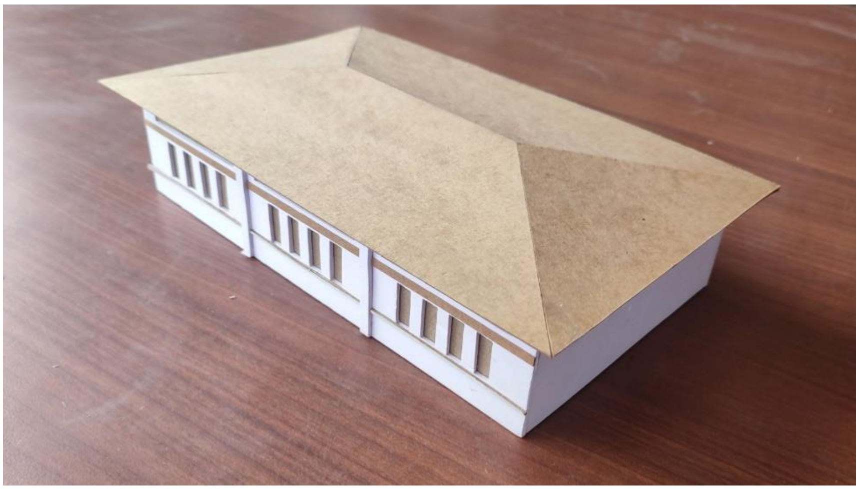


Figure 80: Back View of Library Block (Scale: 1:100)

Figure 81: Front View of Library Block (Scale: 1: 100)

7.8. STRUCTURAL CONSIDERATION:

Soil Type:	Firm Soil
Floor Height:	3 – 4 m per storey
Storey:	Mostly single storey
Span	5 – 7.5 m

The fact that the building is mostly single storey with a floor height of 3-4 meters per storey and a span of 5 - 7.5 meters further support the use of a load-bearing structure. The load-bearing walls can provide the necessary support for the building without the need for additional columns or pillars. This can be more cost-effective than a pillar structure, which would require more columns or pillars to support the same span, resulting in increased material and construction costs.

Using a truss system to support the roof is a suitable choice since it efficiently transfers the weight of the roof to the load-bearing walls. This reduces the need for additional support structures, further decreasing construction costs.

The building being spread out and not following a grid pattern suggests that each structure should be constructed as a separate independent unit. This can be beneficial as it eliminates the need for connecting beams or columns between the structures, which can be expensive to construct. Additionally, this can allow for more flexible use of space and easier modification or expansion of individual units in the future.

In conclusion, based on the given data, a load-bearing structure with a truss system to support the roof can be a cost-effective option for a single storey building with a span of 5 - 7.5 meters and a firm soil condition. However, it is important to conduct a thorough analysis of the site conditions and work with a structural engineer to determine the appropriate structural system for the specific project.

7.9. SERVICES AND UTILITIES:

7.9.1. WATER SUPPLY

The site's water supply is currently sourced from a KUKL deep bore in Samarpan Chowk, which provides water for three hours per day, twice a week. However, there are concerns that this supply may not be sufficient to meet the project's water demands. As a result, alternative options such as additional deep boring or contracting a private water company may be necessary to meet the additional water requirements.

Based on NBC – 208: 2003, the water supply requirement for the project is calculated:

S. No.	Description	Consumption per Day		No. of Users	Liter per day
1	Administrative Block	45	lpcd	50	2250
2	Academic Block	15	lpcd	432	6480
3	Accommodation Block	100	lpcd	56	5600
				Total Water Consumption per day:	14330

Total Water Consumption per Day = 14330 liter/ day = 14.330 m^3 per day

Since, the water is supplied twice a week, the total tank capacity should be:

$$= 14.330 \times \frac{7}{2}$$

$$= 50.15 \text{ m}^3$$

According to NBC – 208: 2003, minimum overhead storage in areas of chronic shortage or intermittent supply shall be:

S. No.	Description	Unit Storage (Lit)	Unit	No. of Users	Liter
1	Administrative Block	50	Head	50	2500
2	Academic Block	12	Head	432	5184
3	Accommodation Block	360	Resident	56	20160
				Total Water Consumption per day:	27844

Minimum overhead storage = 27844 liter = 27.844 m^3

= 30 m^3 (Say)

Underground Storage Tank Capacity = 50.15 m^3

Provide underground storage tank of size 4m X 4m X 3m and overhead tank of 5 m (minimum) diameter and height 2.5 m, 5m above the ground level.

Water Demand for Fire Fighting = 20 % of 14330 l = 2866 l = 2.866 m^3

7.9.2. SANITATION

Calculation of Septic Tank and Soak Pit Capacity:

- Capacity of Sedimentation Tank for Academic Block and Administrative Block,

= 2250 + 6480 l

= 8730 l

Sludge in four years (Assuming sludge removal period = 4 years),

= 482 X 15 X 4

= 14460 l

Total Tank Capacity = 14460 + 8730 l

= 23190 l

= 24000 l

Assume depth of tank 2m,

Area of Cross-Section of tank = 12 m^2

If the ratio of length to width is depth 3:1,

L = 6 m, B = 2 m and H = 2 m

- Capacity of Sedimentation Tank for Accommodation Block,

= 5600 l

Sludge in four years (Assuming sludge removal period = 4 years),

= 56 X 15 X 4

= 3360 l

Total Tank Capacity = 5600 + 3600 l

= 9200 l

=9500 l

Assume depth of tank 1.5 m,

Area of Cross-Section of tank = 6.33 m^2

If the ratio of length to width is depth 3:1,

L = 4.5 m, B = 1.5 m, and H = 1.5 m

- Design of Soak Pit:

Let absorption value of the soil be 1500 l / m^3,

Volume of Soak Pit	= 24000/1500
	= 16 m^3

Let the depth of soak pit be 4m,

Area	= 4 m^2
Diameter of soak pit	= 1.75 m
	= 2 m

Provide Soak pit of diameter 2m and height of 4 m.

7.9.3. RAINWATER HARVESTING:

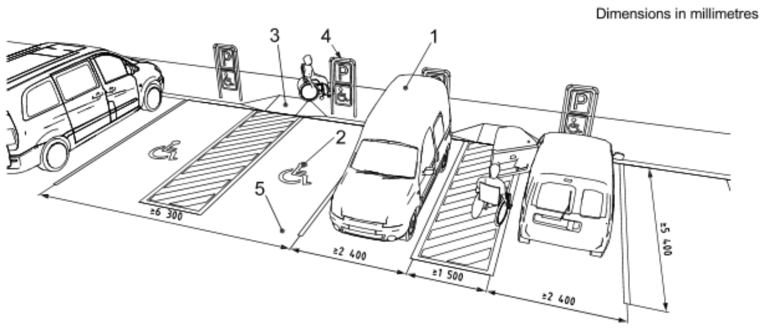
Average annual rainfall	= 1053.9 mm
Total Catchment area	= 9319.31 m^2
Run-off coefficient for roof	= 0.85
Volume of rainwater collected	= 0.85 x 1.0539 x 9319.31
	= 8348.37 m^3

CHAPTER 8: DESIGN GUIDELINES FOR VISUALLY IMPAIRED PEOPLE

This guideline was compiled from guidelines developed by the Low Vision Design Committee of the National Institute of Building Sciences (NIBS), McGill Standards developed by Office for Students with Disabilities (OSD) and the Office of Physical Resources (OPR), and International Standard (ISO 21542:2011(E)) and summarized to focus on the design requirements based on the scope of the report:

8.1. ACCESSIBILITY DESIGN GUIDELINES FOR VI PEOPLE

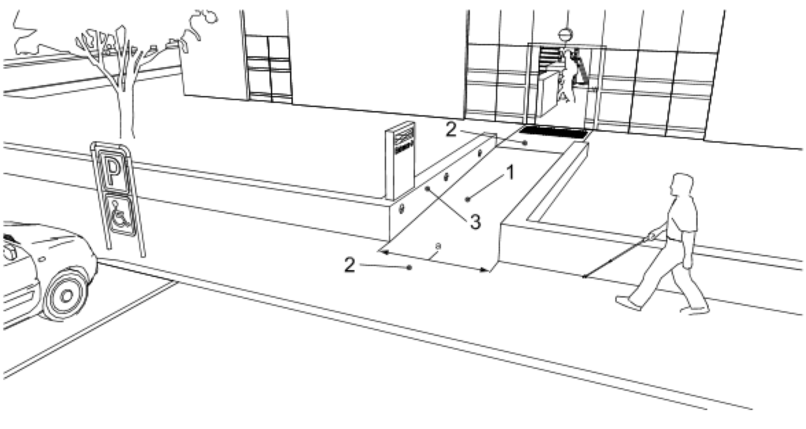
8.1.1. BUILDING ENTRANCES



Key

1 minimum unobstructed height for vans 2 600 mm
2 symbol of access
3 kerb ramp
4 signage, including symbol of access
5 firm ground

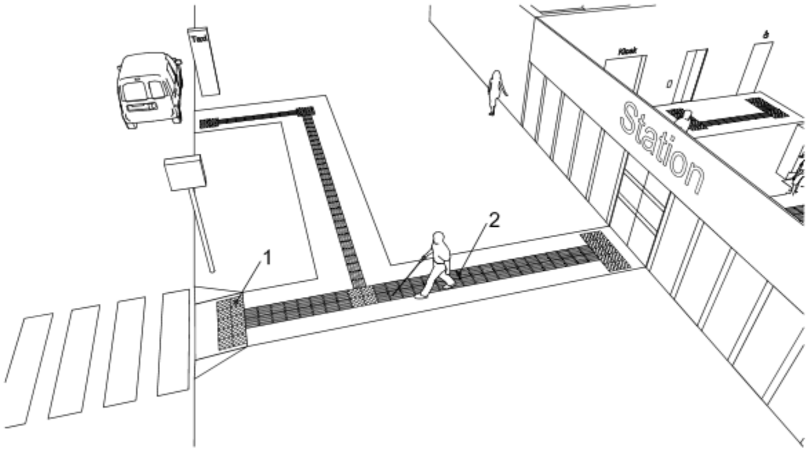
Figure 82: Designated parking spaces (ISO, 2011)



Key

1 sloping path (when the slope is steeper than 1:20 (5 %) the path shall be constructed as a ramp)
2 horizontal landing at both ends of sloping path, intermediate landings spaced according to Table 2
3 wall as tactile clue on direction
a Width of sloping path min. 1 200 mm.

Figure 83: Sloped Pathway to the Building (ISO, 2011)

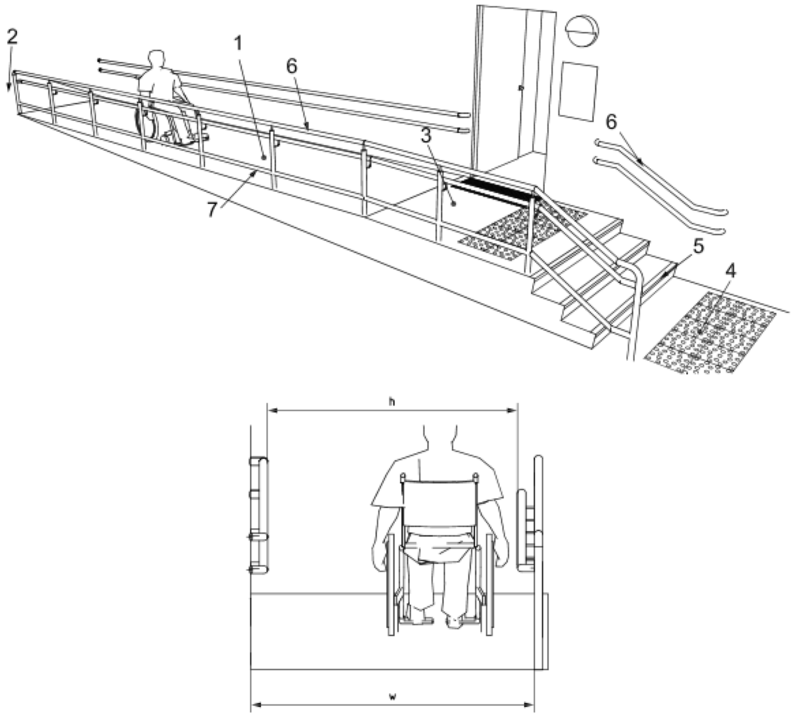


Key

1 tactile walking surface indicator as attention pattern for decision points or hazards

2 tactile walking surface indicator as guiding pattern

Figure 84: Tactile Walking Surface Indicators outside the Building (ISO, 2011)



Key

1 ramp surface (see Table 2 for maximum slope and length)

2 horizontal landing

3 horizontal landing

4 tactile walking surface indicator in front of stairs

5 complementary stairs with markings

6 handrails on both sides of ramp and stairs

7 upstand, min. 150 mm

h width between handrails

w width of ramp surface

Figure 85: Example of Building Entrance with Ramps (ISO, 2011)

8.1.2. DOORS

- Handrails and nosings should be constructed to contrast in color and value with treads and risers on all staircases and steps leading to building entrances. When feasible, guide people toward the whole step and riser area of the stair or steps by avoiding tapering or using handrails with high contrast.
- Public entrances must be clearly identifiable from the outside by their layout, architectural context, and placement on the building front, or signage must be placed on the sidewalk to point visitors in the right direction. Other doors, such those with restricted access for workers only and egress-only doors, might be mistaken for entrances by the careless unless they are positioned in less obvious places, have a less imposing style, or have large-print signage to warn oncoming people.
- To minimize confusion to approaching users, doors must be visually identifiable from sidelights and other nearby elements, such as mirrored panels. The simplest way to do this is to create stiles and rails that distinguish transparent sections from neighboring sidelights.
- Power-operated and power-assisted doors should be clearly marked visually, such as with stickers on the doors, high-contrast push plates, or other operational switches positioned and illuminated to be seen on the approach. Swinging doors should be replaced by power sliding doors. To minimize accidents between door swings and entering users, power-operated out swinging doors should be equipped with sensors on the approach side that are sufficiently far from the door.
- Decorative features such as signs, logos, or symbols should be placed at eye level (between 1400 and 1600 mm (54 and 62 in.) above floor level) and replicated at a lower level (one meter) on glazed doors and side panels (39 in.). The features' sizes must be larger than 150 mm (6 in.) and they must be visible from both inside and outside the structure.
- Consideration should be given to providing at least one door that is spacious enough for two people to pass through, such as one that is 1200 mm (48 inches) since some people with severe sight impairments may need to be guided by another person. (National Institute of Building Sciences, May 2015)

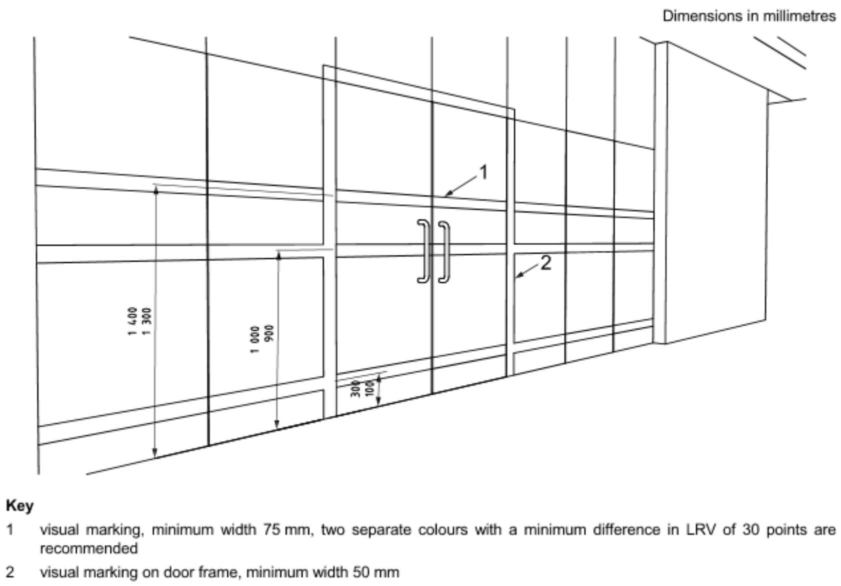


Figure 86: Markings on glazed doors (ISO, 2011)

8.1.3. VESTIBULES

- The distance between any stairs or stairways and any entrance doors should not be less than one meter. All outside entrances should include vestibules, particularly the main entry for the general public. In order to provide visitors enough space to halt and adjust their vision to the changing light between the two sets of doors without blocking the door swings, the vestibule should have a minimum distance of 2,400 mm (96 in.) between the doors. For power-operated out swinging doors with approach sensors, greater distances can be required.
- If floor mats, gratings, and thresholds are not made to be flush with the surrounding floor finishes, they might turn into tripping hazards.
- Surface treatments that are extremely reflective should be avoided in vestibules since they are

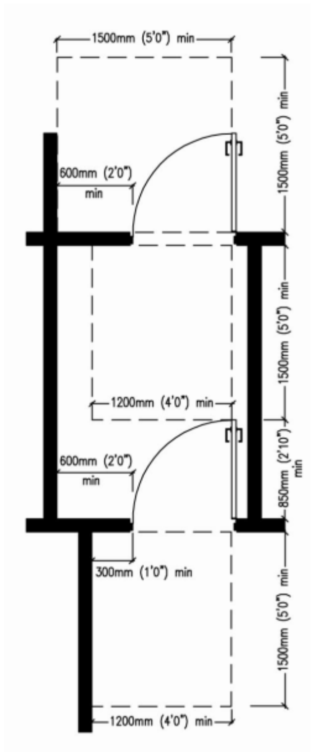


Figure 87: Vestibules (Office for Students with Disabilities University Planning Office, June, 2004)

relatively small areas and can be visually disorienting.

- Transparent door spaces are preferred so users can see visitors coming from the other side. Smaller glazed portions are preferred to fully glass ones because the reflections of approaching people in fully glazed doors may mislead certain people. Large, transparent door portions can lead to unexpected accidents if they are not divided by mullions or other barriers. Glazed sidelights need to be protected in a similar manner.
- The vestibule can act as a transitional space between the levels of interior and outdoor illumination. To prevent backlighting, provisions should be developed for altering the illumination to meet varying day and night lighting situations. There should be a provision for seating space in the vestibule that is aside from the walkway so that users' eyes can adapt to the transition between light intensity from the interior to the outdoors. (National Institute of Building Sciences, May 2015)

8.1.4. LOBBIES

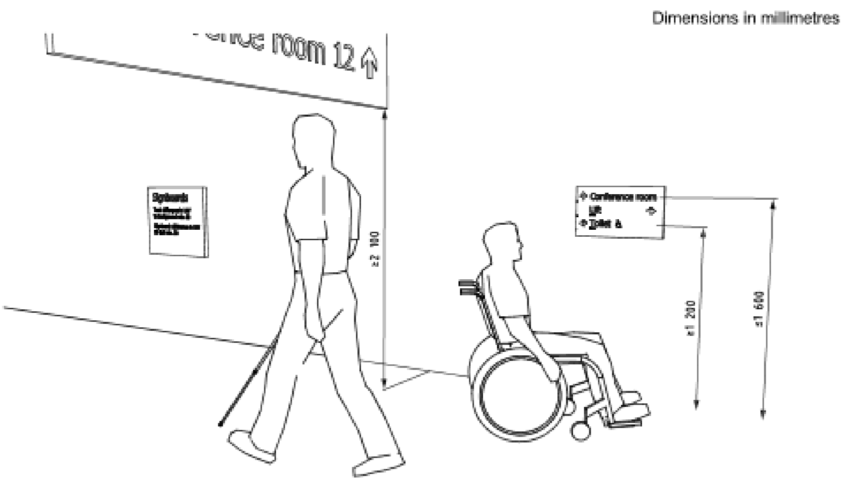


Figure 88: Helping in Wayfinding (Office for Students with Disabilities University Planning Office, June, 2004)

- The entry area should be planned to accommodate first-time visitors, who visit the building without a guide, might require help locating information on exploring the facility. This can imply positioning receptionists as near to and clearly visible from the point of the entrance as is practical.

- Building wayfinding information has to be enhanced with, if possible sound, written in fonts and pictures that people with limited vision can perceive. The information should be placed such that it can be seen readily from the entrance door, and if technology, it should be clear how to activate the screen, such as by pressing a big, apparent button. For Braille users, dynamic tactile systems- electro-mechanical arrays for movable braille characters- might be placed next to the touch screens. Place the touchscreen such that persons sitting and standing won't be bothered by glare. The audible announcement systems are useful for emergency announcements. All graphics must be adequately illuminated at all hours and should have high-contrasts between figures or text and background field.
- Personal audio aid receivers that can be activated by key fobs, smartphones, or other similar handheld gadgets may be helpful for groups who often use facilities like schools and workplaces where the system may be personalized to that group and devices can be made available for routine usage. (National Institute of Building Sciences, May 2015)

8.1.4.1. Atriums

- Atrium areas can be utilized as lobbies or as inner courtyards for a variety of activities, including gathering, dining, and movement. Because of the quantity of daylight that is brought into these spaces by wall glazing and skylights, as well as the fact that they are close to the interior, electrically illuminated rooms, hallways, and other locations, these spaces are frequently difficult for those with impaired vision. To allow for adjustments to variations in illumination intensity, transitional areas between the atrium and adjacent hallways, elevator lobbies, and other circulation spaces are highly advised. There shouldn't be any abrupt changes in the lighting levels at the floor, such when accent downlighting is employed.
- Critical areas like emergency exits, information/ registration desks, elevators, etc. may be accessible in through the atrium which can be further enhanced through high-contrast signage, tactile flooring, changes in lighting levels, and visual contrasts in the floor surfaces. (National Institute of Building Sciences, May 2015)

8.1.4.2. RECEPTION

- If a lobby reception is provided, seats should be provided if of the guests who are asked to wait to be led by facility personnel. In order to reduce the danger of unintentional accidents and falls, furniture needs to be placed away from walkways and be color/ value contrast with their surroundings, making the furniture easy to see by those with limited vision. There should be the armrests on the chairs. (National Institute of Building Sciences, May 2015)

8.1.4.3. VERTICAL CIRCULATION

- As with any other stairs, staircases in lobby spaces should be constructed with contrasts between the treads and risers (see below). For stairs that aren't enclosed, the design must prevent accidents from happening by using methods that don't also provide a risk of tripping or collision (such as curbs or low planters).
- Escalators and moving walkways should be designed with the following requirement:
  - Tread nosing edges in yellow or other highly visible color with permanent solid materials rather than painted.
  - Underside protections as recommended for monumental freestanding stairs above.
- To make the access noticeable and safe, demarcation lights and yellow combs should be provided at the entrance and departure from the escalator.
- Elevators should be designed with the following requirement:
  - Elevators have to be positioned in distinct areas away from the major lobbies that are clearly labeled by lighting and other visual cues.
  - Elevators with dim interior lighting should open to a lobby instead of an atrium that day lit.
  - Elevator buttons need to feature internal lighting which contrasting and have easy-to-read fonts for improved visibility. (National Institute of Building Sciences, May 2015)

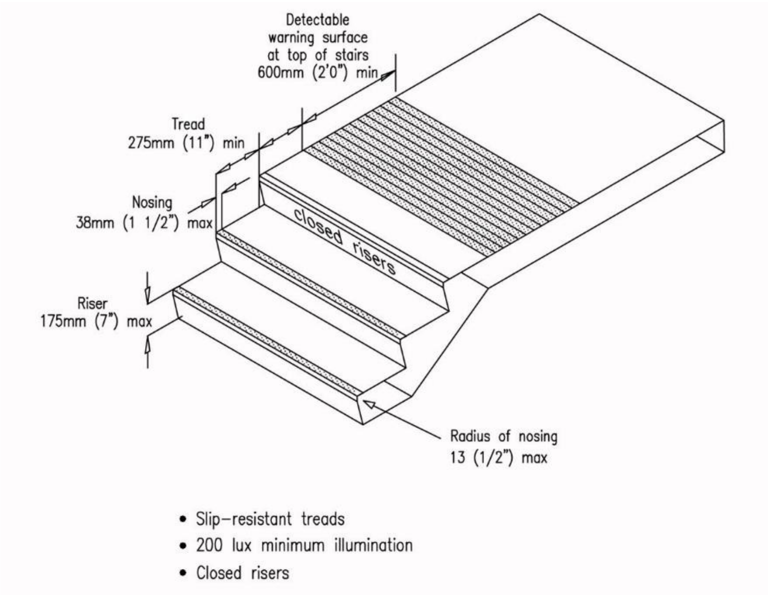


Figure 89: Requirement of Vertical Circulation (Office for Students with Disabilities University Planning Office, June, 2004)

8.1.4.4. SURFACE FINISHES

- Glare and reflections from highly polished floor surfaces might be challenging for those with low vision, especially in rooms with floor-to-ceiling windows. Instead of polished flooring, it is advised that they have a matte surface with a textured covering.
- Refrain flooring patterns like stripes or geometric patterns that could be misconstrued for stairs or changes in the floor's surface. In particular, when the design is perpendicular to the direction of movement, these may be very misleading. These can be particularly dangerous in such staircase leading to changes in floor level.
- Vertical reflecting surfaces can also be perplexing for those with low vision; therefore "full-height" mirrors shouldn't be installed in close proximity to the floor as the reflection can be misinterpreted for a doorway or an extension of the room. (National Institute of Building Sciences, May 2015)

8.1.4.5. LIGHTING

- Generally speaking, electric illumination should be consistent throughout the length of hallways. Pinpointing the room through the help of room number is made easier with the use of task lighting, such as that seen at room entrance doors. The pools of light should be avoided in otherwise dark area. (National Institute of Building Sciences, May 2015)

8.1.4.6. FENESTRATION

- Energy and security concerns should be weighed with the impact of glare when deciding whether to allow sunshine and external vistas in lobby spaces. Glare can be a nuisance, especially when entering a naturally lit lobby with more subdued electric illumination coming from an internal hallway or elevator lobby.

8.1.5. LOUNGES AND WAITING AREAS

The use of the lounge or waiting room, whether it be for brief retention or lengthy purposes, such as reading, breaks, and relaxation requirements, must be taken into consideration.

8.1.5.1. SURFACE FINISHES

- Flooring: If the lounge or waiting area is a part of a circulation area like a lobby or hallway, a different flooring option could be desirable for aesthetic, acoustic, or other reasons. Consider the risk around tripping hazards like matting and low tables.
- Wall finishes: Wall finishes: It's crucial to consider how to minimize the contrast between the colors and values of the wall finish and the surrounding windows. Increasing contrast can be beneficial to a person with low vision when it is necessary or crucial to differentiate one wall feature from another, such as door frames. (National Institute of Building Sciences, May 2015)

8.1.5.2. FURNITURE

- In order to avoid being collision risks, waiting and lounge furniture in the lobby should be chosen such that its form, color, and value are completely obvious against the flooring and other nearby surfaces. When "floated" in open lobby and other circulation spaces, low ottomans and coffee tables can be especially dangerous.
- Seating should be arranged so that people can select a spot that faces a vista or away from the sun.

- One might utilize daylight as task lighting when reading a book or the newspaper.
- Conversation seating should be adaptable and mobile. Avoid placing bulky furniture, such as couches and loveseats, near windows because it will generate contrast. (National Institute of Building Sciences, May 2015)

8.1.5.3. LIGHTING

- In general, high-intensity downlighting may not be appropriate in lounge seating areas where people could sit to read since the downlighting may cast unpleasant shadows on reading material. Table lamps or similar task lighting offer more control and may be more appropriate. (National Institute of Building Sciences, May 2015)

8.1.5.4. FENESTRATION

- A lounge or waiting area's fenestration location and design should take into account the influence of glare on persons using the space.
- Users should be able to choose a seat that faces a view or away from a glare source through the seating arrangement.

8.1.6. INTERIOR CIRCULATION SPACES

8.1.6.1. CORRIDORS

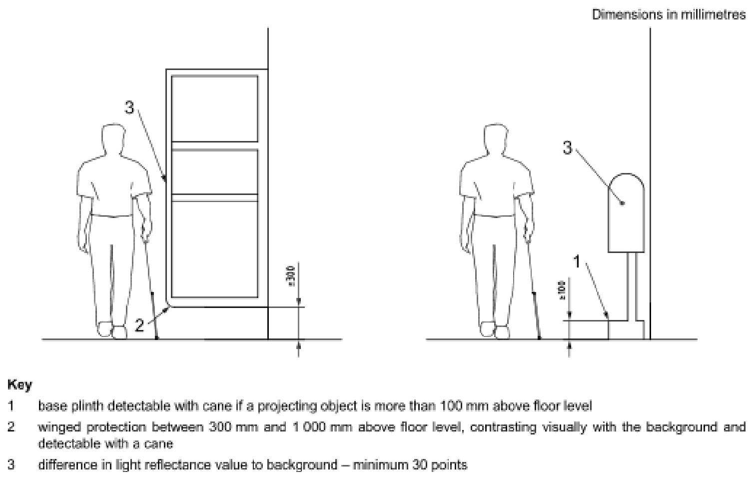


Figure 90: Clearance from obstacles in Circulation Space (ISO, 2011)

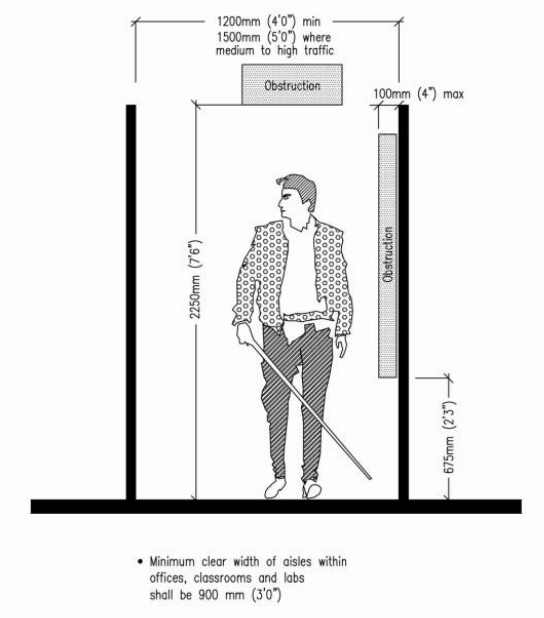


Figure 91: Clearance from obstacles in Circulation Space (Office for Students with Disabilities University Planning Office, June, 2004)

- In general, circulation corridors would need to keep their same width. To prevent obstructing free and safe movement, columns, furniture, and other items should be located beyond the paths of circulation and made plainly evident by contrasts in color and value. (National Institute of Building Sciences, May 2015)

8.1.6.2. RAMPS

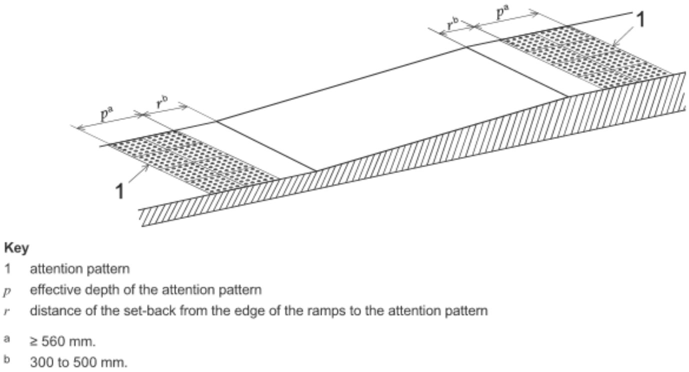


Figure 92: Dimensions and placement of attention patterns at ramps (ISO, 2011)

- Steps and ramps are potentially dangerous if they are not readily visible, such as at the beginning and end of the ramp or staircase, the treads and risers needs to be contrasting in terms of color, texture and value. It is not advisable to use patterns in flooring because they could make it difficult to see the edge of a step.

8.1.6.3. RAILINGS

- Railings are beneficial in a variety of circulation places, and when there are breaks, as at doorways, the use of contrasting color and value, ease in the detection of the railings.

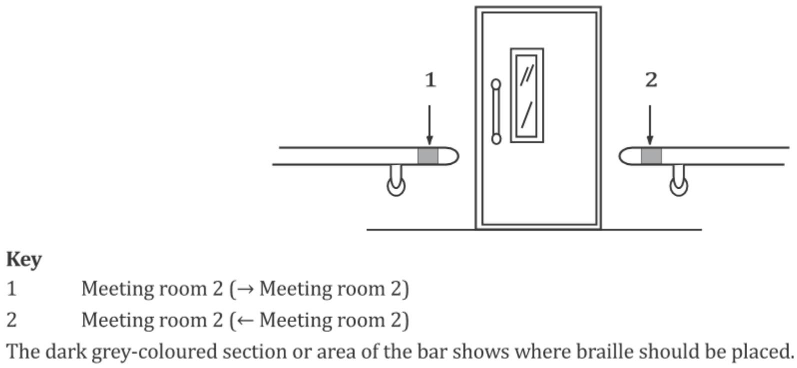


Figure 93: Signage with braille in the railings (ISO, 2011)

8.1.6.4. DOORWAYS

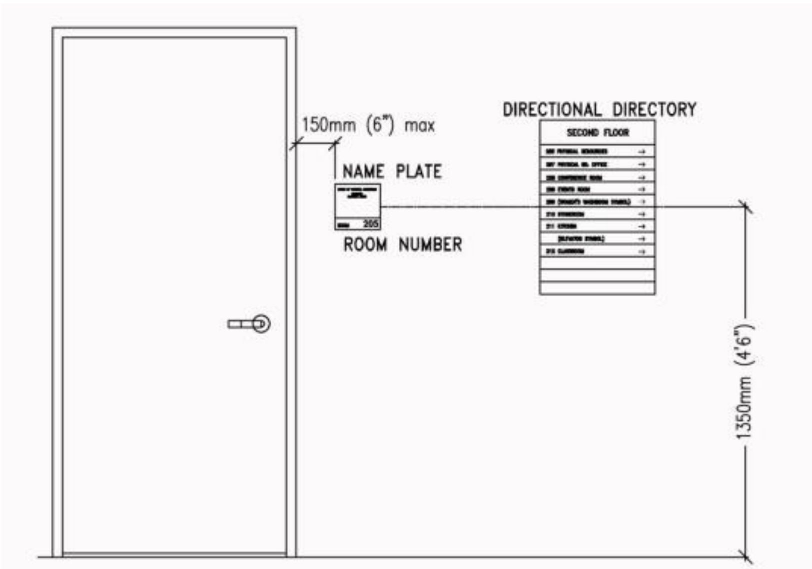


Figure 94: Doorways and Signage (Office for Students with Disabilities University Planning Office, June, 2004)

- For easier identification, doorways should be contrasted with the adjacent walls in terms of material, color, and value. Room numbers and other graphics should be positioned and lighted to make them easy to read, and hardware like locks, latches, and pulls should contrast in color and value with the door. If a door has the same finish on both sides, the leading edge of the door should have a contrasting color and value. This keeps someone with limited eyesight from running into the door's edge and enables them to recognize that the door is open.

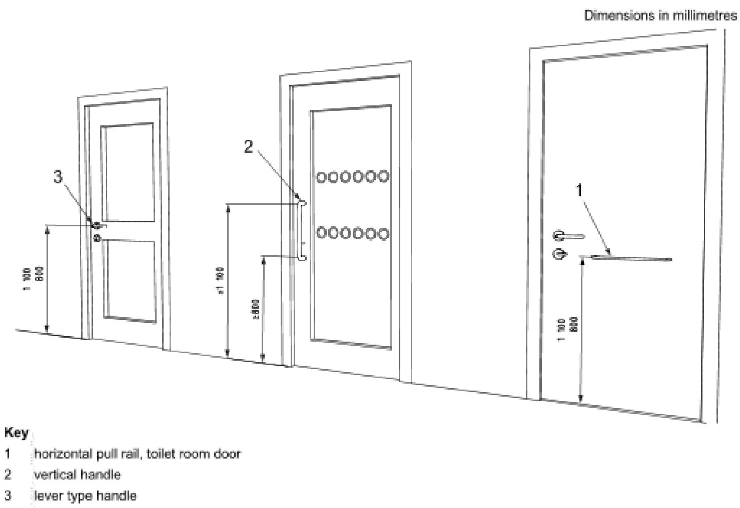


Figure 95: Door Handle Type and Heights (ISO, 2011)

8.1.6.5. ELEVATOR LOBBIES

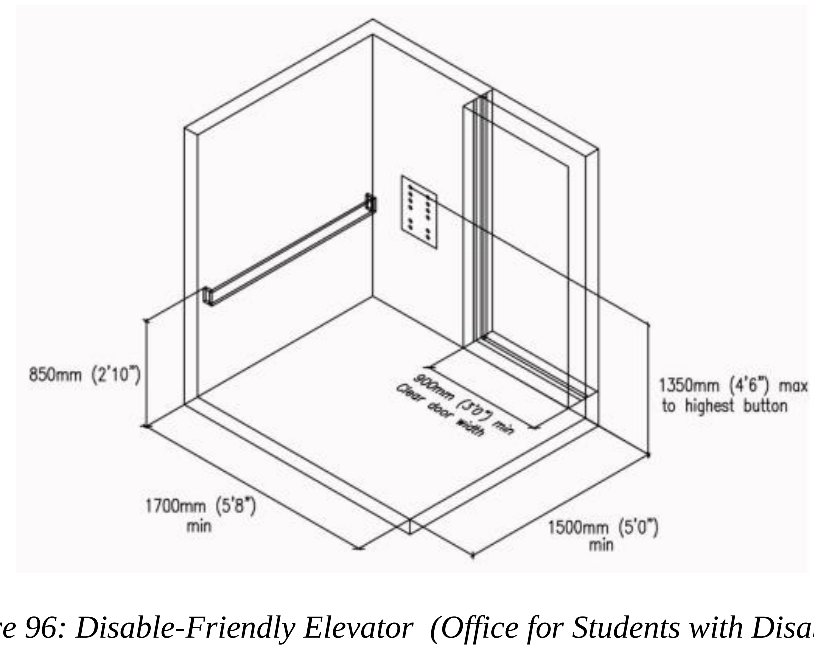


Figure 96: Disable-Friendly Elevator (Office for Students with Disabilities University Planning Office, June, 2004)

- Contrasting colors and textures are recommended between elevator doors, frames, and walls of the elevator alcove.
- Elevator lobbies or alcoves should be varied in design, finishes, and other features from floor to floor to help elevator users identify the specific floor, including large-type floor numbers or names.

8.1.6.6. Surface Finishes

- In some buildings where corridor systems may be complex or potentially confusing to the user, it may be helpful to vary the wall treatments, colors, patterns, artwork or materials to help orient the user.

8.1.6.7. Lighting

- Electric lighting should generally be uniform along the length of corridors. The use of task lighting, such as at hotel room entrance doors, facilitates visibility of the room number and use of an entrance device such as a key or card key. Higher lighting levels at elevators provide a wayfinding device to help locate the elevator. Lighting levels should be even; avoiding pools of light on the floor or scalloped patterns on the walls in an overall dim environment.

8.1.6.8. Fenestration

- Fenestration may be introduced to circulation areas such as side walls of the corridors for aesthetic purposes,, to improve security and to help in orientation by maintaining views of the outdoors. Light levels must be even, avoid high luminance contrast created from windows, especially at the end of corridors.

8.1.6.9. Wayfinding Aids

- Wherever possible, wayfinding aids should be placed facing the direction of travel rather than on walls and doors along the corridor sides. Signage placed across corridors at the ceilings may be difficult to see for some people with low vision to see and may be difficult to illuminate properly.
- All wayfinding aids must be in high contrast with the surrounding fields in color and value.
- All wayfinding aids require electric lighting illumination that does not result in glare from reflections off the signage or adjacent surfaces.

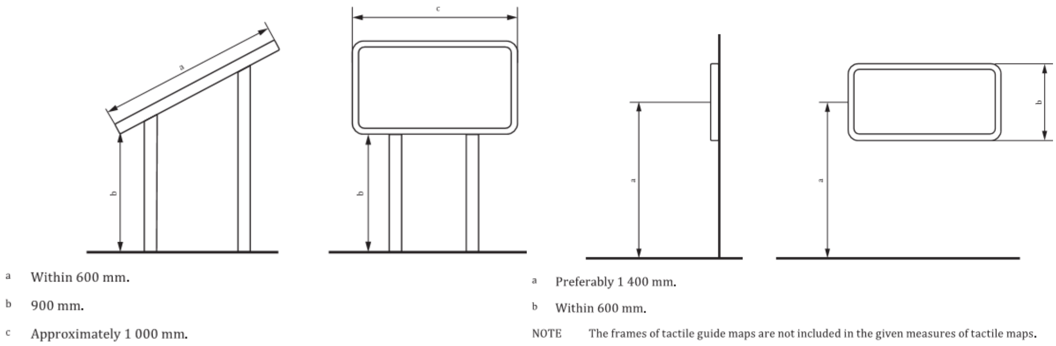


Figure 97: Installed tactile guide maps (Desk: Left and Wall: Right) (ISO, 2011)

8.1.7. STAIRWAYS

8.1.7.1. SURFACE FINISHES

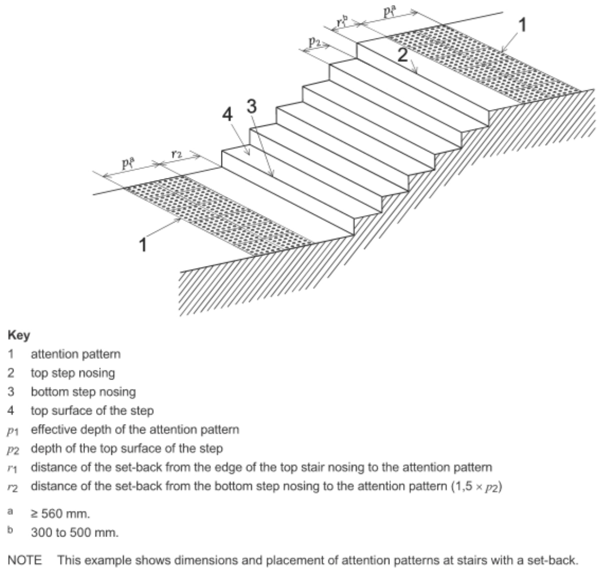


Figure 98: Attention patterns at stairs with a set-back (ISO, 2011)

- Stair risers should contrast with treads to aid in visibility to persons ascending the stairs.
- Stair tread nosings should be in high contrast colors and values from stair treads and should be 50 mm (2 in.) wide so that the edge of each tread is highly visible to the user descending.

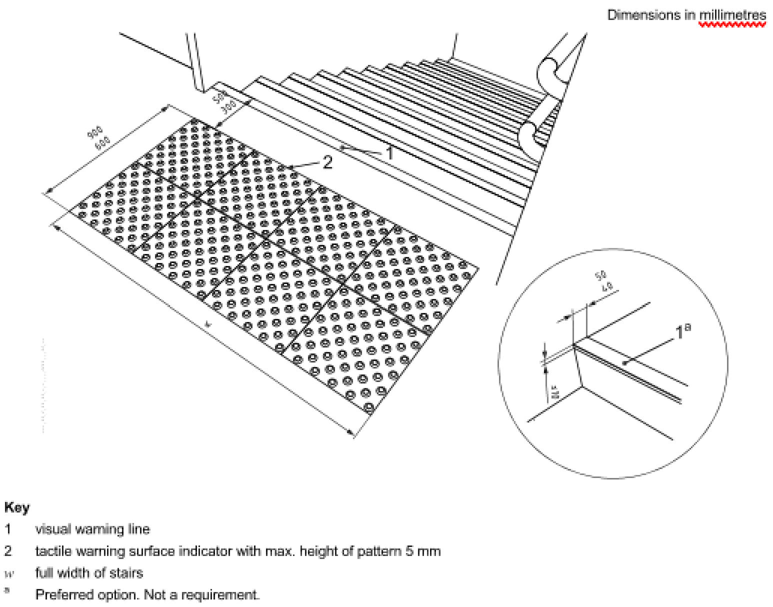


Figure 99: Tactile walking surface indicator (TWSI) and visual indicator (ISO, 2011)

- Stringers or skirting should have a strong value contrast with treads and risers to enhance their visibility.
- Highly figured or patterned materials should be avoided, as they may be confusing to those with low vision. Continuous carpeted stair runners with such designs may camouflage the edge of the tread and create a fall hazard.
- The sloping undersides of stairs and escalators could become a head-bumping hazard, so spaces under the stairs or escalators must be enclosed or otherwise protected to prevent access below a height of 2030 mm (80 in).

8.1.7.2. HAND RAILS

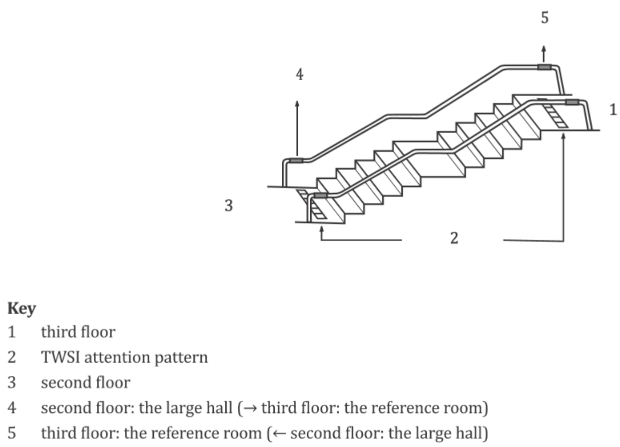


Figure 100: Example of Tactile cues in handrails for stairs (ISO, 2011)

- Hand rails should contrast with wall surfaces in color and value.
- Where handrails turn corners, it is preferable that they be continuous rather than interrupted.

8.1.7.3. UNDERSIDES

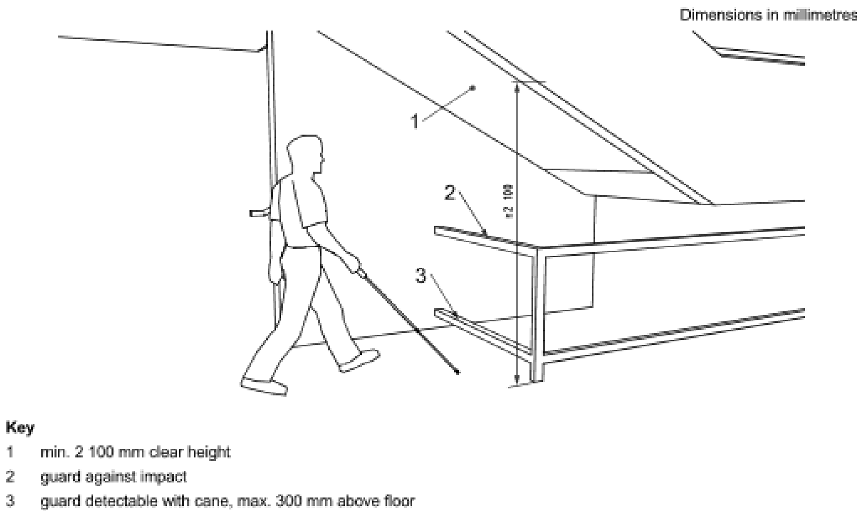


Figure 101: Clear height under stairs

- The sloping undersides of stairs could become a head-bumping hazard, so spaces under the stairs should be enclosed or otherwise protected to prevent access below a height of 2030 mm (80 in.).

8.1.7.4. LIGHTING

- In addition to requirements of life safety codes, electric lighting of stairways must be designed to make the step edges clearly visible, especially in the direction of egress- usually in the downward direction. Uniform, diffused lighting which does not produce soft shadows on the treads is desirable.

8.1.7.5. FENESTRATION

- Fenestration with glare control may be introduced to stairways to improve aesthetics, to improve security, increase light levels, and to help in orientation by maintaining views of the outdoors.

8.1.8. TOILET AND BATH ROOMS

- Public toilets and baths are problematic for persons with low vision because often the spaces are small relative to the number and size of objects typically in them- fixtures, compartments, accessories, etc. Monochromatic color schemes may have the effect of confusing the viewer with low vision. Entrance doorways and screening entrance vestibules are often difficult for a person with an escort to use. Therefore, wherever space permits, entries without doors and with extra width is desirable (such as is common for high volume use in airports). The following recommendations are offered to improve the definitions of these objects in order to make them easier to see and use.

8.1.8.1. SURFACE FINISHES

- Matte finishes on architectural surfaces are preferable to highly polished ones.
- Colors and values of wall and floor surfaces should contrast with those of the plumbing fixtures.
- Partitions arranged to baffle views into the toilet room from the public areas outside can be confusing to the person with low vision. It may help to vary the colors and values of the baffle wall to make it stand out by providing contrast with other walls.
- Lavatory bowls should contrast in color and value from the countertop in which the bowl is set.
- Toilet partitions should differ in color and value from the walls of the toilet room.

8.1.8.2. PLUMBING FIXTURES

- In many public buildings, white plumbing fixtures are the most practical to maintain, clean, and replace, so these may be the brightest objects in the room. This is appropriate since they will be most discernible when set against darker finishes surrounding them.

8.1.8.3. PLUMBING TRIM AND ACCESSORIES

- Plumbing trim (such as faucets and flush valves) may be seen more easily if specified finishes are darker and less mirror-like such as brushed or satin chrome or nickel, pewter, or oil-rubbed bronze rather than polished chrome.
- Everyone easily uses electronically activated faucets and flush valves, and they are especially convenient for people with low vision.

- Accessories such as paper towel and other dispensers may be used more easily when their finishes contrast with the walls and countertops on which they are mounted. The operating devices for paper towel dispensers should be of high contrast.
- Liquid and foam soap dispensers should be placed so that spillage falls into lavatory basins or on a countertop rather than on the wall or floor. Designs that have larger spaces under the dispensing nozzle are easier for everyone to use.
- Full-length mirrors may be mistaken for doorways by persons with low vision, if the mirrors are located where a door might be expected such as at the entrance to a public toilet room. Many building owners prefer not to place mirrors over the lavatories to reduce hair grooming over the lavatories. However, these can be placed on other walls at an appropriate height for grooming without being full height. They should be placed to allow lighting from the sides rather than from directly above.
- A shallow counter or shelf below the mirror provides a place for cosmetics and other grooming aids and helps to define the mirror as a grooming area.

8.1.8.4. LIGHTING

- To avoid shadows and dark areas, ambient lighting for restrooms should cover all areas evenly, including toilet stalls and entrance vestibules. Shadows and dark areas often occur in the entrance areas, and create discomfort and confusion because of the decrease in visual functioning.
- Vanity lighting at mirrors should be selected to avoid glare while illuminating the vanity surface and the face of the user. Lighting should be placed on each side of the mirror in addition to ambient lighting from above.

8.1.8.5. FENESTRATION

- Most public restroom do not have windows with a view, others may have clerestory windows to provide daylight. Where windows do occur, glare from daylight may be exacerbated by the light colors and polished surfaces often used in these spaces. Window position and treatment to control the amount of daylight entering should be considered.

- Windows facing the user upon entering a toilet room are especially challenging to persons with low vision. It is recommended that the room entrance be placed, if possible, to avoid opening directly opposite a window.

8.1.9. OFFICES AND OTHER WORKSPACES

8.1.9.1. LAYOUT

- Daylighting conditions and the associated view connections are key factors influencing an occupant's choice of workspace layout. Shared workspace will result in different layouts than individual spaces due to privacy needs, individual work preferences, and co-worker relationships that likely will result in very different luminance distributions:
- Circulation patterns should be clearly recognizable, and wayfinding must be user friendly. Proceeding through the office should be simple and intuitive for the users.
- Glazed partitions with glare control fronting the open area add to a feeling of spaciousness and should be used extensively where appropriate, but must not present a hazard by being dangerously less visible in circulation pathways.
- In laying out workstations, avoid long rows of cubicles, but do not create mazes or confusing paths of travel among workstations.

8.1.9.2. FURNITURE AND WORKSTATIONS

- Furniture for private offices may be selected to suit the tastes of the occupant, but in open offices with modular workstations, the following are recommended:
- Vertical surfaces of cubicle panels and upholstery for seating should contrast with flooring and main walls in hue and value or be trimmed with contrasting material to make these forms visible for individuals with low vision.
- Persons with low vision can find their way more easily through modular workstations when they are arranged with clearly visible aisles of generally constant clear widths. Flooring texture and color may be used to define the aisles more clearly.
- Modular office cubicle panels may provide screening from glare from windows, but controls should be used to avoid glare when cubicle panels are omitted or are transparent on sides facing windows

8.1.9.3. SURFACE FINISHES

- High gloss finishes should be avoided on horizontal and vertical surfaces to avoid reflected glare.
- Highly figured or patterned floor and wall surfaces in a space with many workstations and other furniture can be visually disorienting and should be avoided.

8.1.9.4. LIGHTING

- Electric lighting of office and other work areas must be designed to coordinate with the fenestration and natural daylighting:
- Lighting controls that react to fluctuations in daylight levels can assist in maintaining comfortable lighting levels for general illumination while maximizing energy savings, but always of high enough illumination intensity to allow persons with low vision to clearly see their surroundings.
- Individual task illumination levels may need to be higher for particular tasks than is justified for circulation and other areas to suit individual preferences. For optimal positioning and flexibility, task lighting that is movable and adjustable in brightness is usually desirable. Luminaires should be selected with non-glare producing, direct/indirect ambient illumination, or with cutoff angles for lenses and baffles that reduce visibility of lamps to the occupants at their tasks.

8.1.9.5. FENESTRATION

- For daylighting design, the most critical luminance relationships are those between the daylight opening, its immediately adjacent surfaces and the surfaces surrounding the work tasks. Electric lighting on surfaces adjacent to fenestration may reduce high luminance contrast and the glare effect from daylight.

8.1.10. DINING AREAS

8.1.10.1. LAYOUT

- In situations where the dining facility is specifically for populations in which low vision is common, self-service cafeterias may need to be staffed to provide assistance in guiding patrons to food, condiment, and beverage stations and to carry trays and locate seating.

- Scatter-type cafeteria serveries can be confusing for persons with low vision, and lighting levels should be maintained throughout the space rather than concentrated at each service island.
- In general, a dining space has relatively simple circulation needs that may confuse the person with low vision if the circulation routes are not intuitively designed, clearly visible and with easily read and lighted wayfinding. The circulation routes also need to be augmented with color and texture changes in flooring as wayfinding guidance. Some of the destinations needing clear guidance and definition include:
    - Entrances to destinations such as cafeteria line or captain (for seating assistance), menu and notice boards, and empty tables and Layouts
    - Scatter-type cafeteria food and beverage stations
    - Cafeteria line to condiment and tableware stations and to cashier
    - Dining tables to self-help tables, such as salad and dessert bars
    - Dining table area to restrooms
    - Dining table area to exits

8.1.10.2. FURNITURE

- To avoid a sterile, institutional appearance, dining tables are typically grouped non-orthogonally where possible. This, however, makes wayfinding more difficult where patrons self-seat, such as in cafeterias. Use of distinctive visual landmarks such as columns, sculpture, and planters can assist in visually locating a table in a large dining space. Variation in furniture upholstery colors and value contrasts may also help, although some types of low vision involve difficulty in color perception.

8.1.10.3. SURFACE FINISHES

- Reflective or highly polished floors and walls can be visually challenging, so these types of surface finishes should be avoided.

- Table and chair colors and patterns that contrast in color, value and texture with wall and floors are easier to see and less likely to cause collisions.

8.1.10.4. LIGHTING

- Generally, the following provisions are recommended: • Lighting at cafeteria lines and steam tables should be placed so as to avoid glare on such surfaces as glass separators, as well as stainless steel and other polished surfaces.
- Menu boards and other information must be easily visible and illuminated without glare.

8.1.10.5. FENESTRATION

- Skylights or top lighting fenestration should be diffused or designed to prevent direct sunlight penetration, glare, and shadows on floors and table surfaces.
- Window areas facing direction of travel from the entrance and cafeteria serving area may present glare and interfere with the diner's ability to navigate the space. Outdoor landscaping and/or window shading can mitigate this problem.

8.1.10.6. OTHER DESIGN CONSIDERATIONS

- Menus may be a reading challenge for many people with low vision due to small font size. Menu boards mounted on the wall behind preparation areas of cafeteria stations and short order counters may be difficult for many people to read, especially when the menu selection is large and restrictive space dictates using small font size. At tables in dining areas with wait staff, printed menus may be hard to read due to low lighting. Some options to be considered to address this issue follow:
- If space is available at the beginning of the cafeteria line or short order counters, task-lit menu boards and other information may be located there. Labels of food and beverage selections located at the place of display or point of sale such as at the steam table or dessert case may also be helpful.
- Hand-out paper menus in large font size, with contrasting print on a matte finish, at the beginning of the cafeteria line or short-order counter may be a simple way to accommodate low-vision customers.

- Task lighting luminaires at tables can help diners read traditional menus, review the bill and see their food and dishes in otherwise low ambient light.
- Video and touchscreens may also be useful tools for presenting menus and other information.

8.1.11. ASSEMBLY AND CONFERENCE AREAS

8.1.11.1. LAYOUT

- In general, an assembly space has relatively simple circulation needs, which may confuse the person with low vision if the main paths for travel are not clearly visible and provided with easily read and lighted wayfinding as guidance in varying ambient lighting conditions:
- In fixed seating auditoriums, aisles leading to seats should have lighting from row ends and on any steps.
- In flexible-seating spaces, the way to seats, tables, etc. will be facilitated when the arrangements are in simple geometries with clear pathways to and from entrances, restrooms, refreshment tables and exhibits.
- In conference rooms, seating that faces directly into windows is problematic due to glare. Window shading may help mitigate this glare.
- Speakers' rostrum, screens, etc. must be placed to avoid receiving direct sunlight or being backlit by sunlight or daylight from windows or skylights. Provide contrast to define the edge of the stage and steps leading to the stage. A handrail at the steps will not only call attention to the location of the steps, but will also provide stability to all users.

8.1.11.2. FURNITURE

- Rectangular conference tables should be arranged perpendicular to windows so that neither long side faces the glare of the windows, which may also obscure the view of a person silhouetted by the window. Window shade material which is dark will control the brightness from the window, but may also retain some of the view, depending upon the opacity of the material.
- Round conference tables allow a variety of choices of seating with respect to windows and glare.

- Glass-topped or other reflective table surfaces may reflect glare into the eyes of those seated at the table. Clear glass table tops are not recommended, due to the loss of depth perception.
- In conference rooms with fixed seats in auditorium-style arrangements, light-colored seating fabrics can make finding seats easier in the dark.

8.1.11.3. Surface Finishes

- Polished floors and walls may confuse the person with low vision for whom flat or low-luster finishes are more comfortable. Polished floors may create glare and potentially be a safety issue.
- Seating upholstery colors and textures that contrast with surrounding walls and floors make it easier to negotiate the space and to locate and identify seats.

8.1.11.4. Lighting

- Electric lighting requirements for assembly spaces are complex and vary widely with the type of assembly function. In spaces where darkened audience seating areas may be needed, the following special recommendations should be considered:
- Aisles must always be visible even when seating is not fixed.
    - Transition lighting levels at entrances can lessen the impact of entering and leaving the assembly space when the space is darkened.
    - Provide a strong value contrast between the floor, walls and seating. In addition to ambient lighting, provide supplemental light at the floor level.

8.1.11.5. Fenestration

- All fenestration can produce glare, and may need shading of some type.
- Most assembly functions will need to have lower lighting levels during some presentations, so wayfinding must be visible under all daylight or darkened conditions.
- Where tables are set aside for refreshments, information materials, etc. during conferences, dedicated lighting of these areas is recommended when the main space has a lower ambient lighting level.

8.1.12. DWELLINGS, RESIDENT AND PATIENT ROOMS

- The most intimate spaces for human occupancy are also the most Important for day-to-day living and are therefore most subject to differences in occupant preference. Because the spaces become so familiar to the occupant, many features that could be hazardous or problematic for the occasional user (as in a public facility) will be more easily remedied . Following are recommendations that can be helpful to persons with low vision.

8.1.12.1. LAYOUT

- Since residents will become very familiar with their dwelling or room layout, the need for signage or other aids may be minimal, but the placement of doors and passages connecting rooms should be coordinated with potential furniture arrangements to keep paths of travel simple, direct and unencumbered.
- Recommended design minimum dimensions for persons with low vision are as follows except as provided in applicable codes and regulations:
- Widths of Pathway

Person with cane or walker	750 mm (30 in.)
Person with guide dog	1100 mm (44 in.)
Person with escort	1200 mm (48 in)
Doorways (clear opening)	900 mm (36 in.)
Corridors	1200 mm (48 in.)

- Light switches and power outlets should contrast in color and value with wall surfaces and have an indicator light when turned off. Light switches should be mounted at 1300 mm (52 in.) and power outlets located at 500 mm (20 in.) above the finish floor.
- All doors should be able to be held mechanically completely closed or completely open with predictability.
- Double-acting doors can be hazardous unless they are recessed or otherwise protected from opening into a path of travel.
- Raised thresholds may present a tripping hazard, so should be avoided.

- Corridors, passageways, and other spaces used for circulation may be made safer by providing handrails along the path of travel in a contrasting color and value to the walls.
- Wiring for power, data, phone, and cable TV can be tripping hazards if room arrangements and furniture require long wires to reach outlets. Placement of convenience outlets should be such that no wire from an appliance crosses any path of travel.

8.1.12.2. FURNITURE

- Wherever possible, familiar furniture owned or selected by the occupant is important to retain. Coffee tables and other furniture with transparent glass tops and without opaque edges can be hazardous even to the occupant with normal vision, and should be avoided.

8.1.12.3. SURFACE FINISHES

- Rugs and carpets may present tripping hazards unless well secured to the floor and with edges firmly attached to avoid entangling feet, cane or crutches.
- Doors and frames may be easier to identify when they contrast with the surrounding walls in color and value. If a door has the same finish on both sides, a contrasting color and value should be provided on the leading edge of the door. This allows a person with low vision to identify that the door is open and limits them from running into the edge of the door.
- Full-length mirrors may be mistaken for openings if the mirror extends to the floor, so the bottom of the mirror should be kept above the baseboard.
- Floors and walls should be of contrasting colors or values so the person with low vision can know where the floor and wall meet. This may also be enhanced with a baseboard or border that contrasts with both surfaces.
- Ramps and steps are hazardous if they cannot be easily seen such as by change in color, value or texture, at the beginning and end of the ramp and by contrasting color and value between treads and risers. Patterns in the flooring material may obscure the edge of a step and are not recommended.

- Floor patterns in carpeting, tile, and other materials may be visually confusing to the person with low vision, and it may become especially difficult to retrieve dropped items. Solid colors may make this less of a challenge.
- Highly polished flooring may be a visual and slipping hazard; matte finishes may be more appropriate.

8.1.12.4. TOILET AND BATH FIXTURES

- Wall and floor colors and finishes that too closely match the plumbing fixtures and fittings such as light switches, power outlets, robe hooks, towel bars, toilet paper holders, and soap dishes can make those items harder for the person with low vision to locate and use properly, so contrasting colors and values are recommended.
- Towel bars may be used accidentally as grab bars by their placement in or near tubs and showers and adjacent water closets, so they should be designed to support the same loads as grab bars as required by code. Grab bars should be mounted horizontally or vertically and not on a diagonal.
- Shelving for bathroom items such as lotions, gels, etc. may be accidentally used for support when in or adjacent tub/ shower and lavatory areas, so shelving should be designed to support the same loads as grab bars, or they should be constructed as ledges or in wall recesses.
- The wall to be seen reflected in a mirror should be painted in a medium value to provide the most contrast for the user's head and hair that is either light or dark.
- Vanity tops for lavatories that are highly polished may reflect glare from lighting if the angles of reflection are not carefully calculated to avoid direct reflections. It is recommended that matte finishes be used when possible.
- Highly patterned or textured finishes on floor and countertop surfaces (including granular materials) may make retrieval of small dropped items very difficult for persons with low vision, Untextured and unpatterned surfaces with a matte finish are recommended.

8.1.12.5. KITCHENS AND KITCHENETTES

- Floor and wall colors that contrast with base and wall cabinets and with countertops are recommended to assist in visual orientation. The edge of the countertop should contrast in value to the counter surface to clearly define the horizontal from vertical.
- Highly patterned or textured finishes on floor and countertop surfaces (including granular materials) may make retrieval of small dropped items very difficult for persons with low vision, so untextured and unpatterned surfaces with a matte finish are recommended.
- Countertops for kitchens that are highly polished may reflect glare from overhead or under-cabinet lighting if the angles of reflection are not carefully calculated to avoid direct reflections. It is recommended that matte finishes, for example, honed granite or marble and synthetic solid materials, be used when possible. Some countertop surface areas might be provided that are dark while others are light to facilitate working with objects such as foods that are of the opposite values. Two cutting boards, one white and one dark, will also provide the desired contrast. The countertop horizontal surface should be clearly defined.
- Cabinet drawer and door pulls are more easily seen and used when they contrast with the cabinets in texture, hue, and value When cooking appliances such stoves and cook-tops are provided, controls must be easy to read and located so that the user does not need to reach across hot burners or pans.
- Select appliances that clearly identify the burners and distinguish whether the burners

8.1.12.6. LIGHTING

- Placement of overhead or under-cabinet lighting should avoid reflections and glare at the work surfaces.
- In any case, diffuse lighting is preferable to “spotlighting” from visible point sources or downlights, which can leave stark contrasts and annoying reflections.

8.1.12.7. FENESTRATION

- Sliding glass doors and fixed adjacent sections may be hazardous when mistaken for an opening. This can be mitigated by horizontal rails, mullions, or decals on the glass.
- Glass doors in a window wall may require solid surfaces, visible characters/marking, or other architectural features to distinguish the door from the window wall, even for the fully sighted user.

8.2. LIGHTING

Lighting design is an essential aspect of creating safe and accessible environments for visually impaired individuals. Good lighting design should aim to create a well-lit environment that minimizes glare and shadows while maximizing brightness and contrast. For visually impaired individuals, lighting can be used to aid in orientation and mobility, enhance communication, and facilitate independence.

One important lighting design principle to consider is the use of natural light. Natural light can help to create a more comfortable and visually stimulating environment, which is particularly important for individuals who spend a lot of time indoors. However, it is important to control natural light to prevent glare and ensure that the lighting levels are appropriate for the task at hand.

Another key principle of lighting design for visually impaired individuals is the use of task lighting. Task lighting is lighting that is specifically designed to support the completion of a particular task. This can include lighting for reading, writing, or other visually demanding tasks. Task lighting should be bright and even, with a high color rendering index (CRI) to help maximize color accuracy.

In addition to task lighting, it is important to consider the overall lighting levels in a space. Lighting levels should be bright enough to support visual function while minimizing glare and shadows. This can be achieved through a combination of direct and indirect lighting, such as using recessed lighting or wall washers to create an even, diffuse light.

The use of contrast is another important lighting design principle for visually impaired individuals. Contrast can help to enhance the visibility of objects and surfaces, making it easier to navigate and identify important features. This can be achieved through the use of high-contrast colors, such as black and white or yellow and black, or through the use of different levels of brightness.

8.2.1.1. Illuminance requirements for people with low vision

According to CIE 123 (CIE, 1997), due to significant individual variances both within and between samples, it is challenging to describe the visual performance of poor vision individuals as a group. This holds true even for those who have ARMD; it is challenging to generalize due to individual variances. The study of low vision must, to a considerable part, be an individual research. As a result, based on the findings of CIE 123, the suggested illuminance for individuals with limited vision is not given. However, since an increased task illuminance improves visual capability of people with certain causes of low vision, the provided lighting should be provided with luminaires with dimmers to tune task illuminance to the level that each individual needs. Similarly, the lighting should be provided in uniform. In the case of the provision of natural lighting, the artificial lighting should also be provided as an alternative to maintain the required illuminance level. The required illuminance level should be calculated based on the average comfort level of attending the school. (CIE, 2017)

8.2.1.2. Effect of correlated colour temperature of a lamp on visual performance of people with low vision

In a study, the effects of lamps with various spectral power distributions on low-vision subjects' visual performance were compared. Nonetheless, there haven't been any appreciable variations in the level of efficacy. Another study looked at how 13 people with ARMD performed visually under four different lighting scenarios: conventional (clear envelope) incandescent, daylight simulation (blue tint envelope), compact cool white fluorescent, and halogen incandescent. This study reaffirmed that it is unlikely that spectral radiance will have a clinically meaningful impact on reading for patients with ARMD. This suggests that lighting professionals may not need to choose lights for people with low vision more carefully than for people who are totally sighted when considering spectral power distributions of lamps. The preference for correlated colour temperature (CCT) depends on lighting levels, appearance, and culture. (CIE, 2017)

8.2.1.3. VALUE CONTRAST

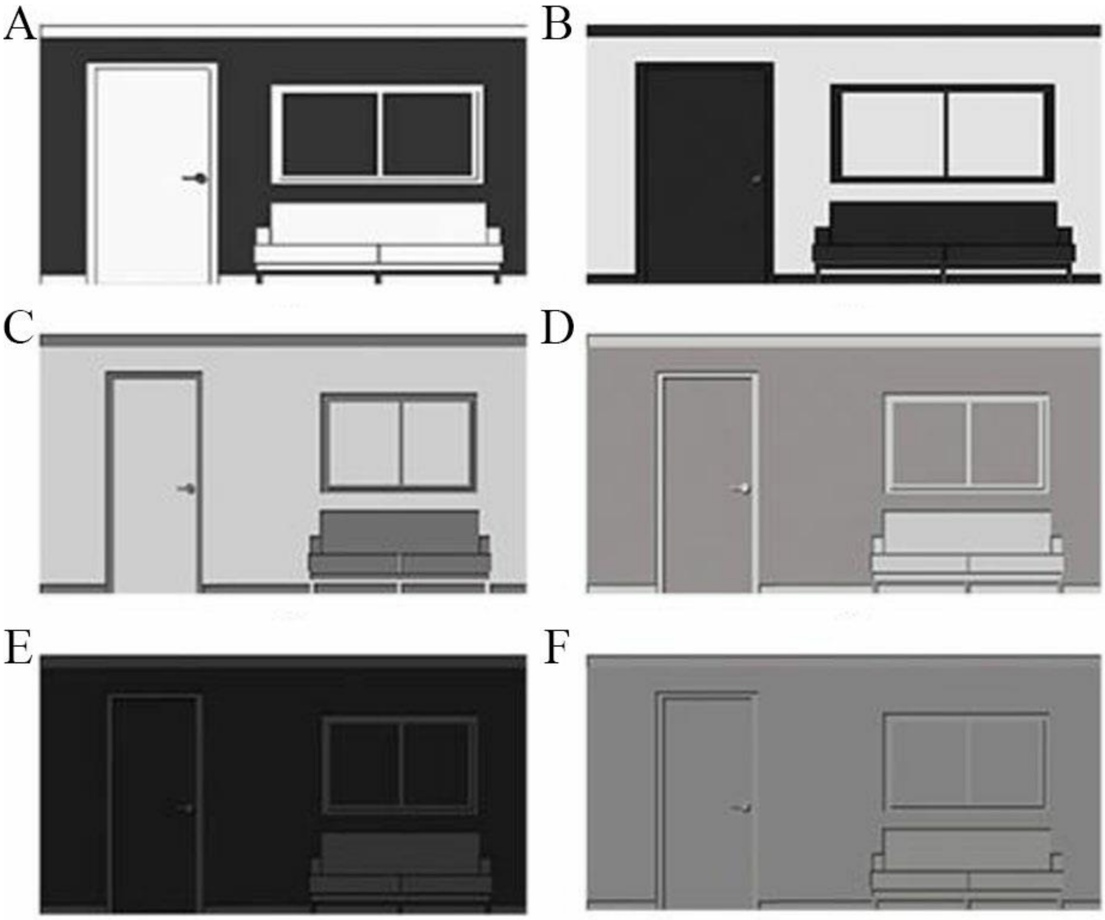


Figure 102: Living room images with different value contrast

Figure 102 shows the Living room images with different value contrast: (a) living room: High Value Contrast Image 1, (b) living room: High Value Contrast Image 2, (c) living room: Moderate Value Contrast Image 1, (d) living room: Moderate Value Contrast Image 2, (e) living room: Low Value Contrast Image 1, and (f) living room: Low Value Contrast Image 2. (Fallatah, Gaines, Adams, & Schambureck, 2020)

It's crucial to take low vision users' perception of color into account when designing visual settings for them. According to Sagawa and Takahashi's 2003 study, colors that were near to the fundamental color shared a lot of similarities. Researchers and experts highlight the advantages that people with visual impairments may have from their remaining vision. One of these strategies is the utilization of colors with various values to enhance item recognition and daily performance. Generally speaking, this can be accomplished by offering an appropriate contrast, which is often attained when the brightness differential is 70% or above. However, if the brightness differential is less than 70%, then the two colors are not recommended for this purpose (Fallatah, Gaines, Adams, & Schambureck, 2020). This can be calculated by:

There is a reliable formula based on the light reflectancy reading in percentages for each of the two colors involved. . . . By subtracting the darker reading from the lighter, dividing the difference by the lighter, and multiplying by 100, we get the "brightness differential" between the colors.

(Arthur & Passini, 1992)

Based on the research conducted by Fallatah, Gaines, Adams, & Schambureck, all of the participants concurred that images with high contrast and at least a 60% difference between the bright and dark values were simple to perceive. Participants also said that images with a 30% difference in medium value contrast were recognized. For appropriate visual contrast one of the two surfaces should have a light reflectance value of minimum 40 points for large area surfaces or (ISO, 2011)

8.3. SOUND

Sound is considered omnidirectional. It can travel in all directions, unlike light which travels in straight lines. When sound is produced, it spreads out in all directions from the source and can bounce off surfaces to create reflections and echoes. This characteristic of sound is particularly important in architecture and design for visually impaired individuals, as it allows them to perceive their surroundings through sound.

In architectural design, the use of materials and shapes can affect the way sound travels and is perceived in a space. For example, a space with hard, reflective surfaces such as concrete or glass may result in excessive reverberation, which can make it difficult for visually impaired individuals to distinguish individual sounds. On the other hand, soft surfaces such as carpet or acoustic panels can help to absorb sound and reduce echo. Using these characteristics of sound, the to help in way finding. One approach is to ensure that the acoustics of the space are well balanced and that there is minimal background noise. This can be achieved using sound-absorbing materials, such as carpets, curtains, and acoustic panels, to reduce sound reflections and echoes.

Another approach is to incorporate sound as a design element in the space. For example, adding a water feature or a wind chime can create a soothing and calming environment that enhances the acoustic experience. The use of soundscapes can also be employed to create an atmosphere that reflects the purpose of the space, such as using bird songs and natural sounds in a park.

Furthermore, the use of tactile surfaces can enhance the acoustic experience for visually impaired people. Textured surfaces, such as rough walls, can help to diffuse sound waves and create a more pleasant acoustic environment.

Additionally, the use of soundscapes and directional sound can be used to enhance the experience of visually impaired individuals in a space. This can involve using sound to convey information about the layout of a space or to guide individuals through a building. For example, sound can be used to indicate the location of stairs or doorways, or to provide information about the function of different areas within a building. Overall, the omnidirectional nature of sound can be leveraged in architecture and design to create more accessible and inclusive environments for visually impaired individuals.

Sound source can be identified through binaural and monaural cues. Binaural cues are the differences in the sound that each ear receives, which helps us to localize the sound source. Monaural cues are the aspects of the sound that are heard by one ear, which includes loudness, pitch, and timbre. Both binaural and monaural cues work together to help us locate sound sources in our environment. Thus, acoustics sense is an important aspect of architecture that can greatly enhance the experience of visually impaired individuals. Design strategies that stimulate the acoustic sense can help to create a more inclusive and accessible environment for all.

CHAPTER 9: CONCLUSIONS

The ultimate solutions should be reflected in the design process for the building built for people with different physical abilities. As the architects are responsible for developing solutions and recommending materials in which users must live, knowledge about functional impairments is particularly important. The rushed and flawed decisions give birth to poor solutions which are often the result of time and money. The primary responsibilities of Architects are to visualize the consequences of the choices they make, regardless of developers' requirements and reluctance to concentrate on availability and universal design. The innovative thinking, imagination, and visual expressiveness in design, color, and use of the material are crucial in achieving Universal design. Universal design should thus be an integral part of architectural education rather than a separate subject (Ahmer, 2014).

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ANNEX 1: QUESTIONNAIRE

Questionnaire of Visually Impaired

1. Personal Information

Name: ____________________

Age: ____________________

Gender: ☐ Male ☐ Female ☐ Others

Permanent Address: ____________________

Temporary Address: ____________________

Causes of Impairment: ____________________

Types of Impairment: ☐ Blind ☐ SVI ☐ ModVI ☐MildVI

Grade: ____________________

Family Size: ____________________

2. In Urban Context

a) What is your preferred mode of transportation?

☐ Public Vehicles   Comments:

☐ Online Services   ____________________

☐ Private Vehicles   ____________________

☐ Others   ____________________

b) What are the difficulties felt during the travels?

____

____

____

c) Are there any difficulties felt when using public transport?

☐ Daily   Comments:

☐ Often   ____________________

☐ Sometimes   ____________________

☐ Rarely   ____________________

d) What are the difficulties felt when using public spaces?

____

____

____

e) How do you navigate in the public spaces?

____

____

____

f) How often do you shop and what are the difficulties felt during shopping alone?

☐ Daily	Comments:
☐ Often	____________________
☐ Sometimes	____________________
☐ Rarely	____________________

g) Do you prefer traveling alone?

	Comments:
☐ Often	____________________
☐ Sometimes	____________________
☐ Rarely	____________________

h) List out the senses based on their dominance during navigating?

☐ Auditory Senses	Comments:
☐ Olfactory Senses	____________________
☐ Gustatory Senses	____________________
☐ Tactile Senses	____________________

i) How often do you use technologies to navigate?

☐ Daily Comments:

☐ Often ____________________

☐ Sometimes ____________________

☐ Rarely ____________________

j) Is the inclusive design provided to trigger the tactile senses satisfactory?

Comments:

☐ Often ____________________

☐ Sometimes ____________________

☐ Rarely ____________________

k) Does the fragrance of flowers have any positive impact?

Comments:

☐ Often ____________________

☐ Sometimes ____________________

☐ Rarely ____________________

l) How often do you encounter obstacles such as trees, vehicles, poles, etc. while traveling?

Comments:

☐ Often ____________________

☐ Sometimes ____________________

☐ Rarely ____________________

m) How hard is it to navigate on uneven surfaces?

Comments:

☐ Easy ______________________________

☐ Coarseness Based ______________________________

☐ Difficult ______________________________

n) How hard is it to walk on steep slopes in streets to make it an inclusive design?

Comments:

☐ Easy ______________________________

☐ Coarseness Based ______________________________

☐ Difficult ______________________________

o) Do you prefer the bustling streets or silent streets?

Comments:

☐ Bustling Streets ______________________________

☐ Silent Streets ______________________________

____

p) Is it easy to climb stairs or move through ramps?

Comments:

☐ Stairs ______________________________

☐ Ramps ______________________________

____

3. In Private Residence

a) Are your home interior spaces and elements satisfying in terms of use?

Comments:

☐ Satisfactory ______________________________

☐ Reasonable ______________________________

☐ Unsatisfactory ______________________________

b) Is it easy to accommodate yourself into your home space?

Comments:

☐ Easy ______________________________

☐ Space Based ______________________________

☐ Difficult ______________________________

c) Is it easy to follow the routine and complete the task in your home independently?

Comments:

☐ Easy ______________________________

☐ Task Based ______________________________

☐ Difficult ______________________________

d) Would you like to live alone in your home? Why?

☐ Often Comments:

☐ Sometimes ______________________________

☐ Rarely ______________________________

e) What are the hard and the easy spaces to use in your home interior?

____

f) Which part of interior spaces would you call a comfort zone to relax in?

g) What could be done to facilitate your use of your independent interior spaces?

h) How long have you been living in your current location?

i) Are there any family memories or feelings in your current home where you are dwelling?

Comments:

☐ Yes ______________________________

☐ No ______________________________

____

j) Is your family income enough to satisfy your needs?

Comments:

☐ Yes ______________________________

☐ No ______________________________

____

k) Do you have any suggestions to help you to live in your current home independently?

____

____

____

l) Any more suggestions to make your home a better place to live?

____

____

____

4. In Public Spaces

a) Are there any public spaces that trigger the multiple senses?

Comments:

☐ Satisfactory ____________________

☐ Reasonable ____________________

☐ Unsatisfactory ____________________

b) How hard is it to climb a staircase in newly visited public buildings?

Comments:

☐ Easy ____________________

☐ Space Based ____________________

☐ Difficult ____________________

c) How hard is it to navigate in the buildings without any tactile cues?

Comments:

☐ Easy ____________________

☐ Space Based ____________________

☐ Difficult ____________________

d) How often do you use the sound cues to navigate within the building?

☐ Often Comments:

☐ Sometimes ____________________

☐ Rarely ____________________

e) Are the spaces provided in the public building enough to navigate around?

Comments:

☐ Satisfactory ______________________________

☐ Reasonable ______________________________

☐ Unsatisfactory ______________________________

ANNEX 2: DRAWING DETAILS