Requirements of visually impaired in Public Buildings
(Living is easy, with eyes closed...)

Dissertation submitted in Partial Fulfilment
For the Award of the
Degree of Interior Design

By
Shivani.R.Gandhi
B. ID. VIII– Semester (2016)

Department of Architecture & Interior Design
Shantaben Manubhai Patel School of Studies & Research in Architecture and Interior Design,
New Vallabh VidyaNagar, Gujarat, India
FEB 2016
Acknowledgement

First and foremost to God Shree Krishna, Sai baba, mummy-papa for their support and love which encourage me to pursue interior designer as my career. Thanks to my brother and sister-in-law for supporting me throughout thesis.

This thesis could not have been realized without a great deal of guidance and both mental – practical support. I would like to deeply thank those people who, during the several months in which this lasted, provided me everything I needed.

First of all I would like to thank Ar. Devyani shrivastava and Id. Namrata shah for their guidance during the entire project. Despite the length of this project you both never hesitated to answer my questions, to help me out with statistical analysis, and number of other things. I really appreciated your support. I would also like to thank the co-reader, Shilpi madam and Preety madam for her time and useful comments.

I would like to dedicate this project to my parents, brother and bhabhi and all of them who has supported me.
# TABLE OF FIGURES:

1.1 Plan of Preston bus terminal................................................................. 29

1.2 Passages with signage - weakness (as it should be there with braille so that they can easily read)................................................................. 30

1.3 Flooring provided with texture.........................................................

1.4 Passages and waiting area designed with the use of senses smell providing landscaping.................................................................

1.5 Ramp designed with handrail for easy access.................................................................

1.7 Connection between entrance and street.................................

1.8 Near every gate they have provided both the side handrails for easy walk................................................................. 31

1.9 The linear walk for station entrance with protection around for visually impaired.................................................................

1.10 Exterior of bus terminal.................................................................

1.11 Handrail but not safe for visually impaired.................................

1.12 Exterior view of the Preston bus terminal.................................

1.13 Section of Preston bus terminal building.................................

1.14 Bus stops near entrance of the building so they can easily walk with the support of handrails provided................................................................. 32

1.15 Materials used in Preston terminal................................................................. 33

1.16 View showing the arrangements for with easy circulation...... 34

1.17 Sitting provided for waiting with the different texture on floor for easy access.................................................................

1.18 Different texture for flooring in passages to walk easily......

1.19 Waiting sitting provided at different levels.................................

1.20 Plan of Amsterdam Airport – Schiphol................................................................. 35
1.21 Outdoor garden sitting so that it can be also used with senses of smell for visually impaired

1.22 Sitting with plants and texture and level difference so senses used smell and texture

1.23 Wooden log with the tree around created park café

1.24 Sitting with the linear arrangement and texture difference in flooring

1.25 Different types of plants used to create smell sense for café and waiting area in Amsterdam airport

1.26 Plan of Hazelwood school

1.27 Hazelwood school building

1.28 Royal academy school building plan

1.29 Concept of anchor centre school

1.30 Use of stained glass

1.31 entrance and passages

1.32 view from entrance

1.33 waiting area

1.34 Drop/pick up for bus

1.35 Delux waiting area

1.36 Entrance from terminals

1.37 Ticket window

1.38 Ladies waiting room

1.39 Main front view of ved transcube

1.40 Entry for buses

1.41 3D view of ved transcube plaza

1.42 Night view of building

1.43 Backside view of building

1.44 Plan of ved transcube plaza
1.45 creating the sound sense........................................ 17
1.46 linear pathways.................................................... 18
# TABLE OF CONTENTS:

## CHAPTER: 1 INTRODUCTION 09 - 11

1.1 Need for study

1.2 Aim of the project

1.3 Objective of the project

1.4 Scope of the project

1.5 Limitation of the project

1.6 Methodology

## CHAPTER: 2 APPROACHING BLINDNESS 12-13

2.1 What is blindness?

2.2 Symptoms and types of blindness

2.3 How to assist them?

2.4 Approaching them through their senses

## CHAPTER: 3 DESIGN GUIDELINES FOR VISUALLY IMPAIRED 14-30

3.1 Design Considerations

  3.1.1 Lighting

  3.1.2 Color

  3.1.3 Texture

  3.1.4 Acoustics

  3.1.5 Smell

  3.1.6 Legibility

3.2 Design Inferences by universal design

3.3 Design Inferences by World Blind Union

3.4 Environmental adaption that enhance functioning....

## CHAPTER: 4 CASE STUDIES 31-48

4.1 Preston bus terminal, London England

4.2 Amsterdam Airport

4.3 Hazelwood School – Glasgow, Scotland

4.4 Royal Academy for visually disabled people - Tabarbour, Amman....
CHAPTER: 5 CONCLUSION

5.1 Comparative analysis

5.2 Conclusion of research

CHAPTER: 6 DESIGN

6.1 Site introduction

6.2 Zoning of existing site

6.3 SWOT analysis

6.4 Design inferences

6.5 comparison between building with facilities for visually impaired and building without facilities for impaired

REFERENCES

4.5 Anchor Center for blind children – Denver, Colorado

49-50

45-50

51-57

58-70

71-72

73
1. INTRODUCTION

Importance of studying requirements of visually impaired in public building is now-a-days we don’t see any kind of special facilities provided for them in public buildings like shopping malls, theatres, government offices etc. it is provided for physically handicapped persons but not for visually impaired so want to just make it visually friendly for impaired.

CENSUS RECORD EVERY YEAR IN OUR COUNTRY:

India needs 2.5 lakh donated eyes every year, the country’s 109 eye banks manage to collect a maximum of just 25,000 eyes, 30% of which can't be used.

Shortage of donated eyes is becoming a huge problem. Of the 15 million blind people in India, three million, 26% of whom are children, suffer due to corneal disorders. The Union health ministry has already launched a national programme to control blindness and expects to reach its blindness elimination target of 0.3% by 2015, five years before the WHO deadline of 2020.

BCP – BLINDNESS CONTROL POLICY

The planning of blindness control in India should take into account recent population-based data for the entire age range, which suggest that the number of blind persons in India is currently over 18 million.

This estimate is 50% more than the figure of 12 million from a decade ago that is still quoted widely in the blindness control policy documents. If avoidable blindness is to be substantially reduced in India by 2020, effective strategies against blindness due to cataract and refractive error are needed urgently as both these conditions are relatively easy to treat.

Also, strategies against preventable corneal and glaucoma blindness need to be strengthened soon for them to show an impact over the next two decades because it is increasing day-by-day it need to be prevent.

So government is providing plans for blindness control by helping the nation and the visually impaired want to design the public building by providing all facilities for them in it and design by keeping in mind their comfort for moving around.

REFERENCE: www.ncbi.nlm.nih.gov/pubmed/11804362
1.1 **NEED FOR STUDY:**

In India, visited most of blind organizations and even special schools for blinds and I have noticed that they don’t have any special facilities for them. Even in public buildings of India it don’t have special facilities provided for visually impaired, it is provided for physically handicapped but not for blind people. So I want to make by provide facilities and also to make them comfortable and move easily in public building.

1.2 **AIM OF THE PROJECT:**

Approaching requirement of visually impaired and applying it in interiors of public building with all required facilities provided for them and to approach it with all their senses in the form of designing to make their lives easy with eyes closed.

1.3 **OBJECTIVE OF THE PROJECT:**

To understand their senses and psychology with the medium of design and approach them with comfort level through language of assisting them.

1.4 **SCOPE OF THE PROJECT:**

To study special provisions designed for blinds and to know their senses and mapping their day-to-day activities and even by knowing their characteristics and implantation in the interiors of public building.

1.5 **LIMITATION OF THE PROJECT:**

Limitation of project will be within the public building and designing the interiors with the comfort level for visually impaired and also to make them comfortable in day-to-day life.
1.6 **CASE STUDY**

1.6.1 Preston bus terminal

1.6.2 Amsterdam airport

1.6.3 Hazelwood school

1.6.4 Royal academy school

1.6.5 Anchor centre school

**Preston bus terminal – London, England**

**BRIEF** – Bus terminal specially designed for visually impaired so want to study the design inferences provided by them

**Amsterdam airport – Amsterdam, Europe**

**BRIEF** – It is the most eco-friendly airport in the world as well they have designed especially for visually disabled people by taking care of their senses.

**Hazelwood School – Glasgow, Scotland.**

**BRIEF** – special facilities provided in the terms of all senses to approach them as well the whole building is designed by using their different senses as designing factor.

**Royal academy for the visually disabled people – tabarbour, Amman.**

**BRIEF** - Easy simple design of construction, especially; in making clear lines for main movements and functional separation in divisions/departments. The building takes the (L) shape so the circulation is linear and straight.

**Anchor Center for Blind Children - Denver, Colorado**

**BRIEF** – The concept of designing the school is colors they have created whole space by using their senses as theme so want to study the different aspects of design for various senses.
CHAPTER: 2 APPROACHING BLINDNESS

2.1 What is blindness?

**Blindness** is the inability to see anything, even light. If you are partially **blind**, you have limited vision. Complete **blindness** means that you cannot see at all and are in total darkness.

2.2 Symptoms of blindness:

- Inability of the person to see objects as clearly as a healthy person.
- Inability of the person to see as wide an area as the healthy person without moving the eyes or turning the head.
- Inability to look at light (Photophobia).
- Double vision (Diplopia).
- Visual distortion.
- Visual perceptual difficulties

2.2 Types of blindness:

**Colour blindness** - is the inability to perceive differences in various shades of colours, particularly green and red, that others can distinguish. It is most often inherited (genetic) and affects about 8% of males and under 1% of women. People who are colour blind usually have normal vision otherwise and can function well visually. This is actually not true blindness.

**Night blindness** - is a difficulty in seeing under situations of decreased illumination. The majority of people who have night vision difficulties function well under normal lighting conditions; this is not a state of sightlessness.

**Snow blindness** - is loss of vision after exposure of the eyes to large amounts of ultraviolet light. Snow blindness is usually temporary and is due to swelling of cells of the corneal surface. Even in the most severe of cases of snow blindness, the individual is still able to see shapes and movement.

**Total blindness** - loss of 100% vision.

REFERENCE: www.livestrong.com

2.4 How to assist them?

- **Approach**: if you suspect someone may need a hand, walk up, greet them and identify yourself.
- **Ask**: "Would you like some help?" The person will accept your offer or tell you if they don't require assistance.
• **Assist:** listen to the reply and assist as required. Not all people who are blind or vision impaired will want assistance - don't be offended if your assistance is not required.
• Address people who are blind or have low vision by their names so they know you are speaking with them.
• Let the person who is blind or have low vision know that you have entered the room.
• Do not walk away from a person who is blind or have low vision without indicating that you are doing so - it is embarrassing and frustrating.
• In dangerous situations say "**STOP**" rather than "**LOOK OUT**"
• Do not relocate objects or furniture without telling the person who is blind or has low vision.
• Use ordinary language when directing or describing and be specific. Do not point, or say "over there". Direct people who are blind or have low vision to their left and right, not yours.
• Use words like "look" and "see"; they are part of everyone's vocabulary. Otherwise both you and the person who is blind or have low vision will feel awkward.
• Describe the surroundings and obstacles in a person's pathway (remember to look up as well as down).
• Do not leave doors ajar. Close them or open them fully.
• Ask people who are blind or have low vision what they want or need. Do not direct questions through their companion.
• If people who are blind or have low vision extend their hands to shake, do so.

When seating people who are blind or have low vision, put their hands on the back of the chair and they will then be able to seat themselves.

It is necessary because they see there safer side before seating on chair so that they don’t fall and they all have their senses powerful so they work with their senses like sound, smell, touch (feel) and colour as well.

**REFERENCE:** [www.visionaustralia.org](http://www.visionaustralia.org)

2.5 **Approaching them through their senses:**
• **Sound** - Sounds can assist in providing orientation clues about a space. The key for the designer is to utilize the Acoustics.
• **Smell** - Smells can assist in defining a space for visually impaired. Smell may be natural or artificial.
• **Texture (Touch)** - Texture can assist in providing orientation clues about a space.
• **Lighting** - Adequate lighting is the single most important aid to vision.
The lighting needs of persons who are visually impaired vary according to the individual and their particular eye condition.

**Colours** - Limit use of colour and keep colour schemes simple and avoid large-scale patterns. Keeping in mind that too many Colours used in design can create confusion.

- Approaching them through their language **braille**.

CHAPTER: 3 DESIGN GUIDELINES FOR VISUALLY IMPAIRED

3.1 DESIGN CONSIDERATION

Design considerations for visually impaired people include the following elements of built environments:

3.1.1 LIGHTING

Adequate lighting is the single most important aid to vision.

The lighting needs of persons who are visually impaired vary according to the individual and their particular eye condition.

Each source has their own attributes and weakness when considering lighting situations for persons who are partially sighted.

The 3 principle light sources are:
The key for the designer is to utilize these light sources optimally and considering the following:

- Avoid glare and reflection, which are often caused by shiny or glossy surfaces.
- Place light sources in locations to avoid creating shadows. Shadows can create optical illusions.
- Distribute light levels throughout different spaces as many people have difficulty adjusting to fluctuations in light levels.
- Include task and spot lighting to augment the overall lighting system.
- Use of dimmer switches allows light levels to be adjusted to suit the unique needs of users...

### 3.1.2 COLOUR

**Colour:** The key for the designer is to utilize the contrast colours optimally and considering the following

Colours to avoid using together include:
Red/black, yellow/grey, yellow/white, red/green, black/violet and blue/green.

Be consistent in use of colour to convey messages. Limit use of colour and keep colour schemes simple and avoid large-scale patterns. Keeping in mind that too many Colours used in design can create confusion.
3.1.3 TEXTURE

Texture can assist in providing orientation clues about a space. The key for the designer is to utilize the Texture optimally and considering the following:

Using materials easily identified in terms of texture.

Using detectable warning surfaces which have a texture that can be felt under foot or detected by a person using a long cane to alerts a person who is visually impaired to a hazard.

Using tactile signs.
**3.1.4 ACOUSTICS:**

Acoustics: Sounds can assist in providing orientation clues about a space. The key for the designer is to utilize the Acoustics optimally and considering the following:

Providing different reverberation especially for floors so visually impaired can obtain a feel of the space.

Provide acoustically well-defined position items such as escalators, fountains, and elevators to create useful sounds.

Avoid noise sources from mask sounds intended to provide directional cues.

When someone walk it directly gives noise and feel that somebody is walking so that can disturb and confuse visually impaired so this should kept in mind while designing for visually impaired.

This figure is example of reverberation.

Adding this kind of water body with fountain it helps as design element for sense call sound.
Smells can assist in defining a space for visually impaired. Smell may be natural or artificial.

By adding flowers and blossoms to the space for adding sense of smell to the space for visually impaired in building to guide them various spaces or surroundings they are entering.

Or by creating artificial atmosphere and also sense of smell can be created with artificial aroma or fragrance by providing electrical room fragrance to the space.

3.1.6 LEGIBILITY:

It refers to the degree to which building is understandable or recognizable.

The key for the designer is to making the building easy to understand and considering the following:

Clear and easily understandable floor plan.

Continuity in the path and completely free of Any obstacles.

Using readily comprehensible graphic symbols.
3.2 DESIGN INFERENCES BY UNIVERSAL DESIGN:

DESIGN RECOGNIZED BY FEET:

Linear units to determine the route.

The round units to give warning at the end of the pavement so as not to overcome.

Also to alert people with visual impairments of their approach to streets and hazardous drop-offs.

Different texture floors at the crossing to give the necessary guidance and known to the right way.

- Providing two kind of linear pathway for easy access.
- Tactile indicator pathways to guide visually impaired.
- Tactile indicator before staircase.

- Legibility to various highlighted spaces.
- Outer area tactile indicator.
DESIGN RECOGNIZED BY TOUCH, SOUND AND SMELL:
The wall is laid with different textures and in different configurations. Fragrant, richly textured plants also invite touching and smelling.
The label gives the visually impaired an access to the information of the space.

DESIGN RECOGNIZED BY CONTRAST COLOUR:
Linear units with contrast colours to determine the route for visual impaired.
Contrast colours at the pavement for visual impaired. Handrails at the both sides for blind people.
Borders with a low kerbs.
TO FEEL THE OBSTACLE.
LOW KERB IS USED FOR
VISUAL IMPAIRED.

Adding low kerbs

Visual Impaired Aids & Facilities

Watches and braille language phone is specially designed for visually impaired by using that they can easily read the matters and even feel it and watch by specially designed for them have the senses inbuilt in it.

Small camera linked to powerful wearable computer. It sees what you see and through your finger-pointing understands what information you seek
DESIGN INFERENCE BY UNIVERSAL DESIGN:

- Equitable use – the design is useful and marketable to people with diverse abilities
- Flexibility in use – the design accommodates a wide range of individual preferences and abilities
- Simple and intuitive – use of the design is easy to understand, regardless of the user’s experience, knowledge, language skills or current concentration level
- Perceptible information – the design communicates necessary information effectively to the users, regardless of ambient conditions or the user’s sensory abilities
- Tolerance for error – the design minimized hazards and the advance consequences of accidental or unintended actions
- Low physical effort – the design can be used efficiently and comfortably and with a minimum of fatigue.
- Size and space for approach and use – appropriate size and space is provided for approach, reach, manipulation, and use regardless of user’s body size, posture, or mobility
- Simple, logical and consistent layouts enable people to memorise environments that they use regularly and predict and interpret environments that they are encountering for the first time.
- Non-visual features (e.g. audible and tactile devices) convey important information about the environment to users who are blind or have low vision.
- Visual contrast is important to accentuate the presence of certain key features. This will enable many people to use their residual vision to obtain information.
- A warning indicator is a textured surface feature consisting of truncated domes built into or applied to walking surfaces to warn people who are blind or have low vision of a nearby hazard.
- They alert pedestrians who are blind or have low vision to hazards in their line of travel, indicating that they should stop to determine the nature of the hazard before proceeding further. They do not indicate what the hazard
- A directional indicator is a textured surface feature consisting of directional grooves built into or bars applied to walking surfaces to give directional orientation to people who are blind or have low vision. As with any facility, directional indicators should be used appropriately and not overused.
- If overused, it can lead to pedestrians who are blind or have low vision being unable to tell the difference between indicators intended for different purposes.
- Also, directional indicators can sometimes be uncomfortable when being negotiated by wheelchair users, people using other ambulatory devices, prams etc. so other environmental solutions/indicators should be sought e.g. landscaping and visual contrast. Directional indicators should only be used where other tactile and environmental cues, such as the property line or kerb edge, are either absent or give insufficient guidance.
- They give are as follows:
  - Give directional orientation in open spaces;
  - Designate the continuous accessible route to be taken to avoid hazards; or
  - Give directional orientation to a person who must deviate from the continuous accessible path to gain access to a crossing point, public transport access point, or point of entry to a significant public facility e.g. public toilet, information centre. Provide yellow colour were safety is needed for visual impaired.
- Providing different shapes and texture on the pathways they are walking and also it can be made different by giving brass strips in the way so that they can feel as texture while walking and that can be done same by giving different shapes too.
- Provide low kerbs railing at different heights for children’s and even for adults and aged group of visual impaired so that they can be safe by obstacles.
- Staggering of kerbs can be also done for directional indicator but in parallel manner by not confusing them.
- Have a depth of 600mm and extend across the full width of the footpath.
- Be setback at least 300mm from the expected travel path of a large vehicle turning to enter or leave the vehicle crossing point.
- Stairs can be particularly hazardous people who are blind or have low vision, given the serious fall or trip that could occur
- If a pedestrian were inadvertently to step off, or onto, a flight of stairs. At the top of the stairs a fall could be particularly serious, while the bottom stair presents a trip hazard, and indicates the commencement of the landing.
- At stairs, warning indicators shall be installed.
- The full width of the path of travel 300mm back from the top and bottom steps.
- At least 600mm deep at the top and bottom of a flight of stairs.
- Similarly, moving escalators are also hazardous for pedestrians who are blind or have low vision.
- At escalators, warning indicators shall be installed.
- The full width of the passages to walk 300mm back from the moving handrail.
- At least 600mm deep at both ends of the escalator.
- Total blindness or impairments affecting sight to the extent that the individual functioning in public areas is insecure or exposed to danger.
- Persons in this category are totally blind or with impaired vision. Visually impaired.
- Persons make use of other senses such as hearing or touch to compensate for the lack of vision. It is necessary to give instructions accessible through the sense of touch (hands, fingers or legs).
- While walking with a white cane to spot their feet near the tip of the cane the persons may bump his or her head or shoulder against protruding objects.
- Persons with limited vision may be able to discriminate between dark and bright shades and differences in primary colours.
- Use of guiding blocks for persons with impaired vision to guide them within the buildings and facilities and outside the building. (Refer details of guiding/warning blocks).
- Installation of information board in braille.
- Installation of audible signage (announcements).
- Removal of any protruding objects and sufficient walking space for safe walking.
- For persons with limited vision use of contrasting colour arrangements.
- Walks should be smooth, hard level surface suitable for walking and wheeling. Irregular surfaces as cobble stones, coarsely exposed aggregate concrete, bricks etc. often cause bumpy rides.
- The minimum walkway width would be 1200 mm and for moderate two way traffic it should be 1650 mm - 1800 mm. * Longitudinal walk gradient should be 3 to 5% (30 mm - 50 mm in 1 meter)
- When walks exceed 60 Meter in length it is desirable to provide rest area adjacent to the walk at convenient intervals with space for bench seats. For comfort the seat should be between 350 mm - 425 mm high but not over 450 mm.
- Texture change in walkways adjacent to seating will be desirable for blind persons. * Avoid grates and manholes in walks. If grates cannot be avoided then bearing bar should be perpendicular to the travel path and no opening between bearing bars greater than 12 mm in width.
• Guiding floor materials shall be provided or a device which guides visually impaired persons with audible signals or other devices which serve the same purpose shall be provided.

• Stepped Approach: - For stepped approach size of tread shall not be less than 300 mm. and maximum riser shall be 150 mm. Provision of 900 mm high hand rail on both sides of the stepped approach similar to the ramped approach.

• visually impaired persons either by a person or by signs, shall be provided as follows:

• ‘Guiding floor materials’ shall be provided or devices that emit sound to guide visually impaired persons.

• The minimum width shall be 1500 mm.

• In case there is a difference of level slope ways shall be provided with a slope of 1:12. Hand rails shall be provided for ramps/slope ways.

• Protruding objects, such as directional signs, tree branches, wires, guy ropes, public telephone booths, benches and ornamental fixtures should be installed with consideration of the range of a visually impaired person’s cane.

• Places to install guiding blocks for the person with impaired vision.

• Immediately in front of a location where there is a vehicular traffic. Immediately in front of an entrance/exit to and from a staircase or multilevel crossing facility.

• Entrance/exit to and from public transportation terminals, or at boarding areas.

• Sidewalk section of a guiding or approaching road to the building. Path from a public facility which is frequently visited by persons with impaired vision (e.g. a city hall or library) to the nearest railroad station (to be installed at intervals)

• Other places where installation of a guiding block for persons with impaired vision is considered effective (e.g. locations abruptly changing me n level or ramp).

• An information board with information about the facility should be provided for persons with impaired hearing. The board should be designed to be easily legible by using sufficiently large text size, distinct contrast and illumination. The information should also be in Braille.

• Guiding blocks should be provided for persons with a visual impairment.

• It should have one row of dotted guiding blocks for persons with impaired vision, 800 mm. or more from the edge.

• Stairs, kiosks and dustbins on the platform must not hinder the clear passage of persons with impaired vision.
- Bench should be installed on the platform, having guiding block around it.
- The signage board should be made easily readable by using sufficiently large text size, distinct contrast and illumination.

**REFERENCE:** www.ids.org
- www.worldblindunion.org

### 3.3 DESIGN INFERENCEs BY WORLD BLIND UNION:

#### Lighting

Adequate lighting is the single most important aid to vision. The lighting needs of persons who are blind or visually impaired vary according to the individual and their particular eye condition. One level of light might work well for a person with glaucoma and be too low for someone with macular degeneration.

The three principle light sources are natural light; incandescent and florescent each has their own attributes and weakness when considering lighting situations for persons who are blind or partially sighted. The key is to utilize these light sources optimally and considering the following:

- Avoid glare and reflection, which are often caused by shinny or glossy surfaces.
- Place light sources in locations to avoid creating shadows. Shadows created by natural or artificial light can create optical illusions.
- Distribute light levels evenly throughout working and walking areas as many people have difficulty adjusting to fluctuations in light levels.
- Include task and spot lighting to augment the overall lighting system.
- Use of dimmer switches allows light levels to be adjusted to suit the unique needs of users.

#### Colour Contrast

Colour contrast is another key component in designing spaces for persons who are partially sighted; its importance cannot be overemphasized enough. A building can be logically laid out, include proper use of signage, provide good lighting but the building can cause disorientation if there is very little use of colour contrast within the building. Colour can be used effectively for many purposes such as:

- To draw attention to signage.
- To define a route of travel.
- To define areas.
Colour contrasting items, is also a very effective means in defining spaces. A colour contrast of 70% is generally accepted in many countries as the preferred amount to define items such as:

- A dark door frames, against a light door and a light wall.
- A light floor colour with a dark perimeter against a light coloured wall.
- Hand rails that colour contrast with the surrounding wall colour.
- Stair nosing is best seen when a colour-contrasted edge is provided.

Furniture that is colour contrasted with the floor and walls assists in locating furniture.

Considerations when using colour:

Colors to avoid using together include red/ black, yellow/ grey, yellow/ white, red/green, black/ violet and blue/ green.

- Be consistent in use of colour to convey messages.
- Limit use of colour and keep colour schemes simple and avoid large-scale patterns. Keeping in mind that too many Colours used in design can create confusion.

**Acoustics**

Sounds can assist in providing orientation clues about a space. A person can use reflected sound to determine a room size, the presence of corridors and proximity of walls or other structural barriers.

Inappropriate use of sound can create problems such as high levels of ambient sound or high levels of reflective sound. Some things to consider when planning space are:

- Well-defined, acoustically alive spaces are easier for people who are visually impaired to negotiate safely. Position items such as escalators, fountains, and elevators to create useful sounds.
- Carpets, acoustic tiles and furniture reduce sound reflectance. Consideration should be given to providing some reverberation so that people can obtain a feel of the space.
- Noise sources may mask sounds intended to provide directional cues, such as ventilation ducts or air-conditioning units. These sounds may be useful, however they should not obscure the sound of an elevator. Sound reflections are frequently a good source of auditory cues.
- Consideration should be given to the structure and texture of planned circulation routes and how they would interact with the sound created by the tapping of a cane.
• Signage
• Tactile signs
• Information on signs should be available for persons who are blind and visually impaired. It is commonly considered adequate for tactile signs to consist of raised characters only. However, Braille can be read so much faster and easier than raised print for those who read it. A best practice in some countries is to include raised print and Braille in signage that identifies rooms or spaces such as auditoriums, cafeterias, washrooms and elevator floor numbers.
• Signage should be consistently located at a height and distance from the door to which it defines. The raised tactile lettering should be colour contrasted with the background. The sign should be colour contrasted with the surrounding wall surface.

**Protruding Objects:**
Objects that protrude into paths of travel can be hazardous to persons who are visually impaired. In many cases protruding objects consist of:
• Signs
• Canopies
• Underside of stairs
• Drinking fountains
• Items protruding from walls
• Over hanging branches
• Telephone booths

Consideration should be given to eliminating these hazards such as:
• Placing a railing or planters below the underside of stairs.
• Ensuring all overhangs are removed within a certain height range.
• Telephone booths and drinking fountains are cane detectable. This can be achieved by placing an object at floor level.

**Detectable Warning Surfaces**
Detectable warning surfaces have a texture that can be felt under foot or detected by a person using a long cane. The texture is usually built in or applied. The texture alerts a person who is visually impaired to a hazard.

Detectable warning surfaces should be used on unprotected platforms, around reflecting pools, top of stairs, and curb ramps.

Detectable warnings should be consistently used to identify features in the built environment.
3.4 ENVIRONMENTAL ADAPTATIONS OR MODIFICATIONS THAT ENHANCE FUNCTIONING

**LIGHTING**
- In recreation and reading areas, provide plenty of floor lamps and table lamps.
- Advise people who are visually impaired that light should always be aimed at the work they are doing, not at the eyes.
- Replace burned out light bulbs regularly.
- Place mirrors so that lighting doesn't reflect off them and create glare.
- For window coverings, use adjustable blinds, sheer curtains, or draperies, because they allow for the adjustment of natural light.
- Keep a few chairs near windows for reading or doing hand crafts in natural light.

**FURNITURE**
- Arrange furniture in small groupings so that people can converse easily.
- Make sure there is adequate lighting near furniture.
- When purchasing new furniture, select upholstery with texture when possible. Texture provides tactile clues for identification.
- Use brightly colored accessories, such as vases and lamps, to make furniture easier to locate.
- Avoid upholstery and floor covering with patterns. Stripes and checks can create confusion for people who are visually impaired.

**ELIMINATION OF HAZARDS**
- Replace worn carpeting and floor covering.
- Tape down or remove area rug.
- Remove electrical cords from pathways, or tape down for safety.
- Do not wax floors; use nonskid, non-glare products to clean and polish floors.
- Keep desk chairs and table chairs pushed in.
- Move large pieces of furniture out of the main traffic areas.
- If telephone booths protrude into main traffic areas, have them moved.

**USE OF COLOR CONTRAST**
- Place light objects against a dark background, a dark table near a white wall, for example, or a black switchplate on a white wall.
- Install doorknobs that contrast in color with doors for easy location.
- Paint the woodwork of the door frame a contrasting color to make it easier to locate.
- Mark the edges of all steps and ramps with paint or tape of a highly contrasting color.

**HALLWAYS AND STAIRWAYS**

- In hallways, make sure that lighting is uniform throughout.
- Place drinking fountains and fire extinguishers along one wall only throughout hallways to allow individuals who are visually impaired to trail the other wall without encountering obstacles.
- Install grab bars where they may be needed.
- Light stairwells clearly.
- Make certain that stairway railings extend beyond the top and bottom steps.
- Mark landings in a highly contrasting color.

**SIGNS**

- Place all signs at eye level, with large lettering according to specifications outlined in the Americans with Disabilities Act.
- Provide braille signage according to ADA specifications.
- Mark emergency exits clearly.
- When making signs by hand, use a heavy black felt-tip pen on a white, off-white, or light yellow, non-glossy background.

**REFERENCE:** [www.americanblindasso.org](http://www.americanblindasso.org)
CHAPTER: 4 CASE STUDIES

4.1 PRESTON BUS TERMINAL – LONDON, ENGLAND

4.1.1 INTRODUCTION:

**History:** Built in the Brutalism architectural style between 1968 and 1969, designed by Keith Ingham and Charles Wilson of Building Design Partnership with E. H. Stazicker, it has a capacity of 80 double-decker buses, 40 along each side of the building. Pedestrian access to the Bus Station is through any of three subways, one of which links directly to the adjacent Guild Hall, while the design also incorporates a multi-storey car park of five floors with space for 1,100 cars.

**REFERENCE:**

www.dezeen.com  
www.prestonbus.co.uk

4.1.2 CONCEPT OF DESIGNING:

**Design:** The building's engineers, Ove Arup and Partners, designed the distinctive curve of the car park balconies "after acceptable finishes to a vertical wall proved too expensive, contributing to the organic, sculptural nature of the building. The edges are functional, too, in that they protect car bumpers from crashing against a vertical wall. The cover balustrade protects passengers from the weather by allowing buses to penetrate beneath the lower parking floor."

4.1.3 DESIGN INFERENCES:

1.1 plan of Preston bus terminal

- Landscaping
- Entrance
- Sitting for passengers travelling
- Passages
1.2 Passages with signage - weakness (as it should be there with braille so that they can easily

1.3 Flooring provided with texture.

1.4 Passages and waiting area designed with the use of senses smell providing landscaping.

1.5 Ramp designed with handrail for easy access.

1.7 Connection between streets and station entrances.

Street and station connection walk by visitors.

Street and station connection by bus.
1.8 Near every gate they have provided both the side handrails for easy walk.

1.9 The linear walk for station entrance with protection around for visually impaired.

1.10 Exterior of bus terminal

1.11 Handrail but not safe for visually impaired.

1.12 Exterior view of the Preston bus
1.13 Section of Preston bus terminal

1.14 Bus stops near entrance of the building so they can easily walk with the support of handrails provided.
1.15 materials used in Preston bus terminal

Material used:

1. The original seating and barriers are retained in appropriate location.
2. The iroko bus bay doors are replaced with stained black metal ones, keeping the proportion and layout.
3. The external curtain walling is preserved. The glazing replaced with more energy efficient glass.
4. Commercial facilities boxes made out of iroko and glass.
5. The mezzanine curtain wall system is stained black as in the original.
6. The external lighting numbers are replaced in the original location.
7. The original ribbed pireli rubber floor is retained all around the bus station.
8. The original lighting concept is reinstated and improving some areas by pendant fittings. The uplighters on top of the continuous Perspex sign and lighting inside it are preserved and improved the high bay down lights are removed.
9. The original white tiles are retained all around the building and replaced if necessary.

10. Glazed waiting areas for buses heated and provided with changing and digital facilities.

4.2 AMSTERDAM AIRPORT - SCHIPHOL

4.2.1 INTRODUCTION:

Schiphol Airport is an important European airport, ranking as Europe's fifth busiest and the world's twenty second busiest by total passenger traffic in 2015 (14th in 2014 and 2013 and 16th in 2012). It also ranks as the world's fifth busiest by international passenger traffic and the world's sixteenth busiest for cargo tonnage. 52.569 million Passengers passed through the airport in 2013, a 3% increase compared with 2012. Passenger traffic and cargo throughput are London Heathrow Airport, Frankfurt Airport, Paris–Charles de Gaulle Airport and Madrid–Barajas Airport.

4.2.2 CONCEPT OF DESIGNING:

It is the most eco-friendly airport in the world with the feature specially designed for visually impaired and it has been mainly designed with the concept of senses like smell and texture.

4.2.3 DESIGN INFERENCES:

1.16 View showing the arrangements for with easy circulation

1.17 Sitting provided for waiting with the different texture on floor for easy access

1.18 Different texture for flooring in passages to walk easily.

1.19 Waiting sitting provided at different levels
1.20 PLAN OF AMSTERDAM AIRPORT - SCHIPHOL

1.21 Outdoor garden sitting so that it can be also used with senses of smell for visually impaired.

1.22 Sitting with plants and texture and level difference so senses used smell and texture.

1.23 Wooden log with the tree around created park café.

1.24 Sitting with the linear arrangement and texture difference in flooring.
1.25 Different types of plants used to create smell sense for café and waiting area in Amsterdam airport.

4.3 Hazelwood school – Glasgow, Scotland

4.3.1 INTRODUCTION

LOCATION: Glasgow, Scotland

DESIGN TEAM: Gordon Murray and Alan Dunlop

Age (student): (3 -18) years
4.3.2 CONCEPT OF DESIGNING

It is specially designed for visually impaired students to live their life easily and to stand equally with the society and to win and not to lose and be the shining star of the world.

4.3.3 DESIGN INFERENCES

The distinctive curving interior spine meets the complex demands for an intuitive way finding system.

The curved form of the building reduces the visual scale of the main circulation spaces and helps remove the institutional feel that a single long corridor might create.

1.26 plan of Hazelwood School

1.27 Hazelwood building
The focus-learning rooms offer viewing for staff and visitors without disturbing the children. These areas also offer quiet time as needed.

A separate residential unit, is used to teach the children basic life skills but also provides respite accommodation.

- High level windows are used as some of the students with visual impairments can be easily distracted by (movements/activities occurring outside).

4.3.4 MATERIAL USED:

- 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.
MATERIALS:
- zinc on the roof
- timber
- brick
- glass
- 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 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.

CONCLUSION:
The defining component of the interior design is the cork-clad ‘trail wall’ that meets navigation needs on one side and the extensive needs for storage on the opposite side. It runs the length of the building and enables children to navigate independently.

Corridors are designed as streets, which also assist with orientation and mobility.

To grow and develop their special skills and explore education and to lead in society.

4.4 Royal Academy for visually disabled people – Tabarbour, Amman.

4.4.1 INTRODUCTION

Location: Tabarbour- Amman

Age – 3 -20 years
4.4.2 CONCEPT OF DESIGNING

Engineering design philosophy of the Royal Academy for the visually disabled people

Visually impaired people, in their movements, depend on what is called Spatial Mental Map Design. Easy simple design of construction, especially; in making clear lines for main movements and functional separation in divisions/departments. This is to draw a spatial map for such building in their minds; thus, it will be easy for them to move easily, safely and independently.

4.4.3 DESIGN INFERENCES:

The building takes the (L) shape so the circulation is linear and straight.

1.28 royal academy school building plan

1.28 royal academy school building plan
• The school has a skylight which gives a blue light (strong blue light and from my readings this light bothers blind people and is not comforting them so it’s one of the disadvantages of this school

The handrail along the corridors and the stairs

On the handrail of the stairs there is a circle to tell them which the floor they are.
Also there is a circle on the wall in different shape, to tell them (the number of the floor)

The titles of every space or room very legible for the visually impairment or for the blind, because it’s wrote by Braille and there is a simple drawing logo for each title expresses the function of the room and they can recognize it by touching that logo.

CONCLUSION:

- To approach requirement of blindness.
4.5 ANCHOR CENTER FOR BLIND CHILDREN – DENVER, COLORADO

4.5.1 INTRODUCTION

LOCATION – Denver, Colorado

Age – 3 -20 years

In plan, the building is a succession of three "pods" connected by a linear hallway.

The pods "Blue," "Yellow" and "Red" play off the themes of mind, body and spirit and house the various classrooms and activity spaces, as well as spaces for staff, teachers and parents.
The poetry of this building comes from designing an environment where you enrich the experience by embracing as many senses as possible.

The 15,600-square-foot building (named for a longtime supporter) and surrounding two-acre campus incorporate learning experiences at every turn, through light, sound, touch, smell — and even taste.

**4.5.3 DESIGN INFERENCEs:**

Three classroom pods connected by a central circulation spine are flooded in diffused light through a series of filtered clerestory windows just below the angled roofline.

Entrance, pavement scoring draws wheelchair users toward the front door, and a subtle Braille-like motif enlivens the exterior brickwork. The gate at right opens into the Sensory Garden.

- High ceilings and skylights bring in light, and clerestory lights in the hallway's pod entry ones are correspondingly tinted blue, yellow and red. Along the side wall, a Trail Rail and Light Walk provide additional way finding.

- Through specific wall placements and flooring selections, carpet, rubber and hard-surface material all the classrooms are acoustically engineered to minimize noise and give directional sound cues. Benjamin's Niche, a classroom for children with both vision and hearing loss, is the only one with a wood floor it resonates, allowing the children to "feel" the sound.

1.30 use of stained glass
Color and contrast are integral to the design. In the Motor Room, vertical punctures of tinted glass and sunlight invite children to play within child-sized cubbies. Photograph by Ron Pollard.

Their realization that the project was all about light, not darkness, "Because the children have varying degrees of vision impairment, some can distinguish light and dark, as well as colors. So contrast and color play an important role in the design.

Sound, touch and light cues help children navigate the Grand Hallway. At the entrance to each pod, hardwood flooring gives way to tile, so children not only feel the texture change, but hear the sound change as their canes and footsteps resonate on the different surfaces. Acoustic baffles are also strategically suspended from the ceiling.

Anchor Center for Blind Children incorporates sensory cues inside and out to help visually impaired children engage with and learn about the world around them.
• Sculpture for the garden. Created three interactive, kid-size bronze sculptures modeled. All elements on the sculptures, from a book with a readable **Braille surface** to the differently shaped buttons on a girl's blouse, are meant to **encourage exploration through touch**.

• The Sensory Garden, located to the right of the entrance, is a feast for the senses. It features meandering pathways, a dry streambed with a small bridge, **varying surface textures**, **bench seating**, and **native plantings selected for their texture, scent and color**. "It's fairly sturdy stuff, so the kids can touch it and pull on it," An interactive **fountain** feature allows children to rearrange its stones, feeling their smoothness and changing the sound of the **falling water**. A slatted cedar fence surrounding the garden offers another tactile experience, with different-size pickets that **play with light and shadow** and change pitch when canes are run across them.

**CONCLUSION:**

To develop their skill and confidence as well to complete all requirements of visually impaired children’s.
### 5.1 COMPARATIVE ANALYSIS:

<table>
<thead>
<tr>
<th>Case study: 1 Preston bus terminal</th>
<th>Case study: 2 Amsterdam airport</th>
<th>Case study: 3 Hazelwood school</th>
<th>Case study: 4 Royal academy school</th>
<th>Case study: 5 Anchor center for blind</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is designed with legibility and linear passages with the sense of texture (feel) as main designing concept.</td>
<td>It is eco-friendly airport designed with the use of sense feel and smell as main concept of designing.</td>
<td>Hazelwood school has been designed with legibility taking care of not giving institutional feel as well for easy access.</td>
<td>Royal academy is designed with the legibility but the drawback is there in the context of lighting and safety for visually impaired.</td>
<td>Anchor center has been totally designed by taking care of visually impaired main concept – senses.</td>
</tr>
<tr>
<td>No colour and contrast is used</td>
<td>Colour and contrast used.</td>
<td>Colour and contrast used with different texture finish.</td>
<td>No colour and contrast used- it is just used for staircase.</td>
<td>Colour and contrast is done according not distracting them.</td>
</tr>
<tr>
<td>No braille language used for signage board.</td>
<td>Braille language used for signage board.</td>
<td>Braille language is used everywhere it is required.</td>
<td>Braille language is used everywhere.</td>
<td>Braille is used and even it is used for walls subtle braille wall.</td>
</tr>
<tr>
<td>Texture flooring is used to guide them.</td>
<td>Texture flooring is used.</td>
<td>Texture flooring is used and even for walls.</td>
<td>No texture flooring.</td>
<td>Texture flooring is done for easy access.</td>
</tr>
<tr>
<td>Use of handrails in possible areas like ramps, entrance and staircase on both the sides.</td>
<td>Handrails for guiding them.</td>
<td>No handrails provided as they have used different texture for walls.</td>
<td>Handrails is used everywhere even in passages.</td>
<td>Handrails is used.</td>
</tr>
<tr>
<td>Sense of feel.</td>
<td>Different plants used by using the sense of smell.</td>
<td>Sense of feel is used.</td>
<td>No such sense is used.</td>
<td>Sense of smell and feel is used in sensory garden.</td>
</tr>
</tbody>
</table>
5.2 CONCLUSION OF RESEARCH:

Concluded from the research that most the buildings which is designed for visually impaired are mostly designed with the concept of legibility for linear pathways so that they don’t get confuse for access and they easy straight and accessible pathways. And even the provisions for visually impaired is designed with the concept of senses like feel which includes texture and braille language they can touch feel the space, sense of sound where they have used water bodies, fountains, audio sensors to guide them and sense of smell in which they have aromatic plants, artificial electric fragrance for the specific space. All are designed by taking care of visually impaired requirements according to the space they are entering. Also playing with colour ad contrast most of places are designed like by painting or by using stained glasses and colour reflection of it and even by using sunlight they made walk through in passages. So by adding required facilities for visually impaired we can create friendly and easy living atmosphere for them.

CHAPTER: 6 DESIGN

6.1 Site introduction:

**Vadodara bus terminal – ved transcube plaza**
• It is in the heart of Vadodara and near railway station.
• Created with the concept of “VAD” derived from Vadodara meaning banyan tree.
• It has all kind of facilities for commercial space and even for bus terminal. For commercial space they have shops & showrooms, Indian heritage market, crazy lane market, food court, multiplex, banquet, studio and hotel (coming soon). For bus terminal they have waiting lodge, deluxe waiting lodge, ticketing window, tourist information centre etc.

□ It was built under a public-private partnership between the Gujarat State Road Transport Corporation (GSRTC) and realty firm Cube Construction. Built at a cost of ₹114 crore, the five-storey terminus is spread over 2.4 lakh square feet.
• The terminus handles over 800 buses and as many as 28,000 to 35,000 passengers daily.

REFERENCE: www.indiatoday.com

• It has majorly 3 entries one from main entry near courtyard which gives connectivity to atrium another from two wheeler parking and third entry from bus drop off area.
• It has major shopping area on ground floor and first floor and third floor has theatre and food court.
• On ground floor it has hypermarket and mostly shops of clothing and snacks shops like jagdish and ATM and also ticket counter for the bus and waiting area for bus.
• Service areas like staircase to first floor and basement and escalator and lift area and toilets.
• On ground floor near waiting area there are water body and dry landscape which is existing and well maintained.
• Concourse area near waiting area.
• Tourism information centre near ticket counter for required information for passenger.
• Parcel room is there on ground floor.
• Canteen is there for passenger who are travelling want food near waiting area.
• Exhibition stalls on ground floor itself.
• Courtyard has sitting for events and food stalls.
• Rickshaw stand near courtyard and near entry connected to atrium.
INTERIOR PHOTOS OF VADODARA TRANSCUBE PLAZA.

1.31 Entrance and passage
1.32 View from atrium
1.33 Waiting area
1.34 Drop/pick up for bus
INTERIOR PHOTOS OF VADODARA TRANSCUBE PLAZA.

1.35 Delux waiting area

1.36 Entrance for terminals

1.37 Ticket window

1.38 Ladies waiting room
EXTERIOR PHOTOS OF VADODARA TRANSCUBE PLAZA.

1.39 Main front view

1.40 Entry for buses.

1.41 3D view

1.42 Night view

1.43 Backside view
BUILDING PLAN OF VED TRANSCUBE PLAZA.

In Vadodara transcube plaza there so many different areas for bus terminal facilities drop and pick up as well the waiting room for ladies and deluxe waiting room with the area provided of ticket window with tourist centre nearer. It also have entertaining area likes playing area for kids, food court and theatre with shopping area around.

1.44 Existing plan of ved transcube plaza
## ANALYSIS – PROBLEM AND SOLUTIONS FOR MAKING VISUALLY FRIENDLY FOR IMPAIRED

<table>
<thead>
<tr>
<th>PROBLEMS</th>
<th>SOLUTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>In main entry (to atrium) problem to climb staircase and courtyard area to recognize the new space they are entering.</td>
<td>Can be resolved by providing handrails and texture difference between any new space they are entering.</td>
</tr>
<tr>
<td>Facing problem to recognize entry/exit</td>
<td>Texture difference in entry and exit and audio sensor.</td>
</tr>
<tr>
<td>Facing problem to recognize the shops and to know where the shops are as well shops signage.</td>
<td>Signage with braille language and Audio sensor and different texture can be kept for shop passages.</td>
</tr>
<tr>
<td>Staircase and lift</td>
<td>Texture difference to know about staircase or lift and even for passages and ticket counter texture difference or any kind of sense can be kept like smell and audio sensor.</td>
</tr>
<tr>
<td>Passage circulation without any safety and guidance.</td>
<td>Can be solved as per above solution</td>
</tr>
<tr>
<td>Ticket counter (if anyone wants to buy ticket for bus)</td>
<td>Texture difference or audio sensor</td>
</tr>
<tr>
<td>Toilet (recognize) problem</td>
<td>Can be solved as per above solution</td>
</tr>
<tr>
<td>Waiting room</td>
<td>Can be solved as per above solution</td>
</tr>
<tr>
<td>Bus (to reach till bus)</td>
<td>Can be solved as per above solution</td>
</tr>
</tbody>
</table>
# 6.5 Comparison Between Building Without Facilities for Visually Impaired and Building With Facilities for Impaired

<table>
<thead>
<tr>
<th>Building without facilities for visually impaired</th>
<th>Building with facilities for visually impaired</th>
</tr>
</thead>
<tbody>
<tr>
<td>• In India, most of buildings like malls, theatres as well government offices are without any facilities specially provided for visually impaired. If someone add the features required in building to make it visually friendly for impaired.</td>
<td>• Building with facilities for visually impaired make their life easier if they visit any of public building.</td>
</tr>
<tr>
<td>• Taking an example of public building which the site I have chosen for making visually friendly for impaired – Ved Transcube Plaza</td>
<td>• So for that providing comfortable flooring for visually impaired and for proper and easy access I have provided tactile tiles indicator of three types one for passages other for shop passages and for important junctions with the combination of vitrified tiles – matte finish</td>
</tr>
<tr>
<td>• It recently don’t have any facilities for visually impaired it’s there for physically handicapped.</td>
<td></td>
</tr>
<tr>
<td>• Then there is no indication/signage for directions and shops</td>
<td></td>
</tr>
<tr>
<td>• No guidance for shops and surrounding areas.</td>
<td></td>
</tr>
<tr>
<td>• No guidance for staircase, escalator and lift.</td>
<td></td>
</tr>
<tr>
<td>• No guidance for directional signage board for entire mall.</td>
<td></td>
</tr>
<tr>
<td>• No guidance for any danger kerbs or end of anything like shop passage or any end of the space.</td>
<td>• So applied sense of sound by giving water bodies with fountains to guide them the end of shop passages or any space.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>• No safety while walking in atrium or any other space for visually impaired.</td>
<td>• So provided floor handrails and wall handrails for safety.</td>
</tr>
<tr>
<td>• Columns</td>
<td>• Columns are treated/clad with porcelain tiles and putting grass ball in it and used sense of touch in it.</td>
</tr>
<tr>
<td>• No guidance of which floor they are climbing or entering.</td>
<td>• So I have provided different shape and braille language on handrails of staircase to guide them floor.</td>
</tr>
<tr>
<td>• So by adding requirements of visually impaired we can easily make comfortable environment for them and easy access in public building.</td>
<td></td>
</tr>
</tbody>
</table>
REFERENCE:

- www.ncbi.nlm.nih.gov/pubmed/11804362
- www.livestrong.com
- www.visionaustralia.org
- www.ids.org
- www.worldblindunion.org
  - www.americanblindasso.org – creating comfortable atmosphere for low vision or total blind
- www.dezeen.com
- www.prestonbus.co.uk
- www.amsterdamairport.info
- www.indiatoday.com
- www.scribd.com
- www.geluidinzicht.nl/wp-content/
  - drum.lib.umd.edu/bitstream/handle/1903/.../Tsymbal_umd_0117N_11885.pdf
- www.afb.org/forum/careerconnect-forum-for...blind...visually-impaired/...design/
- www.slideshare.net/hum89/visually-impaired-as-a-design-challenge
- www.archnet.com
  - researchspace.ukzn.ac.za/handle/10413/5126
- https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEwi-3c6itoXLAhVRHY4KHUb5Dr4QFggpMAE&url=https%3A%2F%2Fen.wikipedia.org%2Fwiki%2FAmsterdam_Airport_Schiphol&usg=AFQjCNF0oHFl1JbRWYbVYyPDNEnM1q5NUw
It’s all about sense.