DESIGNING FOR PHYSICAL ACCESSIBILITY IN MODEL VOCATIONAL TECHNICAL SCHOOL FOR THE VISUALLY IMPAIRED

by

Adu Ofori Eric (Bsc. Arch)

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DECLARATION

I hereby declare that this submission is my own work towards the M.Arch and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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Supervisors' name	Signature	Date

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Head of College's name	Signature	Date

DEDICATION

This thesis is dedicated to the sweet scents of my life;

My roses of Sharon,

Rose, Florence and Gifty.

God bless you all.

ACKNOWLEDGEMENT

The authors' utmost gratitude goes to all persons who have contributed to the successful completion of this thesis. This would not have been possible without their timely help. Primarily, my special gratitude goes to the almighty God for his gift of health and knowledge. The selfless help of Mr. Charles Essel (supervisor), Dr K.S. Kootin, a teaching staff of the Department of Architecture, Kumasi, is well noted. In addition, worthy of mention is the GRASSAG (Graduate Students Association of Ghana) for the internet services they offered me. Special thanks go to the staff at the KNUST main library as well as that of the College of Architecture and Planning. The contribution of the students and staff of the Akropong School for the blind, KNUST and other institutions for permission to use photographs of their respective institutions, is not forgotten. Lastly, my sincere appreciations go to my fellow course mates for their little but timely contributions here and there.

ABSTRACT

Discrimination against persons with physical disabilities dates back many centuries. The physically challenged includes the visually impaired, sensory impaired (visual/speech impaired), mentally impaired, emotionally/behaviorally impaired etc. The discrimination cuts across all areas of daily living including education, health, employment, recreation and others.

In modern times, there have been improvements in the human rights of disabled persons. Issues concerning the physical accessibility of visually impaired persons as well as those physically challenged (e.g. wheelchair users) have come to the fore. This has been the case in Ghana which culminated in the passing of the disability bill (2007) which is aimed at among others encouraging the provision of increased physical accessibility in the built environment to facilitate easy use by such persons.

This thesis sought to come up with a physically accessible model vocational school for the visually impaired student and to document architectural barriers to physical accessibility for visually impaired students in some selected schools in Ghana. These objectives would be arrived at through literature reviews, case studies, development of design concept and a presentation of the proposed school.

In the end, important recommendations and conclusions would be drawn which is hoped will serve as literature to enhance physical accessibility for such persons in existing and yet to be built schools in the country and elsewhere.

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CHAPTER ONE

1.0 INTRODUCTION

Architecture has so much unrealized potential; architects could solve substantial social needs worldwide, addressing issues that seem beyond the impact of design or buildings, such as education, health, self-employment etc (Bryan's foreword, Sergio and Christian, 2004). The World Health Organization (WHO) sees disability as any restriction, lack of ability, usually one that prevents a person from performing an activity within the range considered normal for a human being (answers.com). The body estimates there are about 650 million disabled persons in the world. It recognizes that the disability can be physical, sensory, cognitive and intellectual. The visually impaired (blind), speech impaired, physically challenged (wheelchair users, ambulant persons etc), and those with multiple disabilities are considered disabled. The disabilities affect persons in activities of daily living such as learning and applying knowledge, communicating, accessing buildings, domestic life etc. Across all cultures, persons with disabilities are discriminated against. Among the challenges, persons with visual impairments face include discrimination in the areas of building accessibility, education (high illiteracy levels), health services, lack of employment etc. The United Nations, in an effort to protect and enhance the rights and opportunities of such persons, agreed formally on the convention of the Rights of Persons with Disabilities in 2006, which Ghana is a signatory. Ghana in this direction enacted the disability bill to create equal access to education, health, buildings and others.

1.1 Who is a blind (visually impaired) person?

Primarily, a visually impaired person is someone with severe visual eye malfunctions that can cause partial or total sight loss. (Datasegment.com). For a person to be considered legally blind, the person must have a visual acuity of 20/200 or worse in the better eye with correction (glasses) or a visual field which subtends to an angle of not greater than 20%. (visualdisabilities.htm). The World Health Organization (WHO) estimates that in 2002, out of 672.2million people in Africa, 6.8million people were blind, 20million people were with low vision, and 26.8million were with other visual impairments. This represents about 17% of the world population of persons with visual impairments.

1.1.2 Who is a blind student?

Medically, a blind student refers to a an individual 'who has a verified visual impairment accompanied by limitations in sight that interfere with acquiring information or interaction with the environment to the extent that special education instruction and related services may be needed'. (www.asec.net). Visual loss of students could be total or partial. A University of Edinburgh Handout on Student Disability (2001) stated that students with a total loss of vision are unable to produce handwritten work, have pronounced mobility impairments, rely on listening rather than watching and use Braille rather than regular print. Such persons are educated in special schools. Special schools are institutions offering specialized education for students with peculiar needs such as those with physical disabilities of hearing, vision, etc. For those with partial sight impairments; they can see in certain conditions, may take longer time to read print, may be able to use low vision aids in the classroom, probably might not use Braille and can be educated in mainstream (regular) schools. (University of Edinburgh student handout on student disability)

Common causes of blindness or visual impairments in youth (student) and adult populations include cataracts, glaucoma, optic nerve atrophy (ONA), retinis pigmentosa (RP), macular degeneration (AMD), ocular albinism as well as domestic, industrial and road accidents. Ocular albinism creates difficulties for students in reading; optic atrophy can eventually lead to total vision loss; glaucoma impairs night vision whiles macular degeneration creates difficulties in reading and problems in color discrimination (http://www.asec.net). Some people are born with these impairments whiles others develop it later on in life. There are different aids and technologies that help blind students to get along with their daily activities. Such aids include special spectacles, Braille literature, Seeing Eye dogs, canes, and adaptive computer technology, audio books, large type books, audio-visual equipment and others.

1.2 Visual impairments and Architecture

Visual impairments to a larger degree affect mobility of persons in accessing and using the built and un-built environment. Architecture is the activity of designing, constructing buildings and other physical structures, primarily to provide socially purposeful shelter (answers.com). There is the need therefore for architecture to accommodate such persons. Concerns about difficulties disabled persons face in accessing the built (buildings) and un-built environment and has led to the evolution of architectural concepts and interventions such as universal design, inclusive design, barrier-free design, and physical accessibility among others. These are aimed at facilitating the easy movement of such persons in the built and un-built environment. These concepts are necessary as buildings and its surroundings are crucial in the provision of social services such as education (schools) and health (hospitals).

1.3 Education of visually impaired students in Ghana

The Ghana Society for the Blind; an organization seeking the advancement of blind (visually impaired) persons in all areas of national life; put the number of such persons (youth and adult) at 180,000 in 1999. Out of this number, a meager 0.1% can read Braille. The formal education of blind persons started in 1945 with the coming in of the Basel missionaries, who set up the first school to formally train such persons in 1945 at Akropong-Akuapem in the Eastern region of Ghana. Later on another school was set up to cater for the northern part of the country (Wa). Since then, many persons with visual impairments have trained as teachers, stenographers, handicraft instructors and a few have graduated from university. There is however a low number of blind persons at the tertiary level (Ghana Education Service). The

Special Education Unit of the Ghana Education Service (GES) supervises special education in Ghana, which is geared towards physically disabled persons, sensory impaired (visual, hearing and speech impairments), mentally handicapped persons, emotionally and behaviorally maladjusted persons. Some persons with visual impairments, school in mainstream schools (basic to tertiary education) where there is heavy discrimination. It is aware of the discrimination which comes in the form of poor or no physical accessibility and lack of special reading materials etc. The Ghana Education Services' (GES) policy on education for persons with disabilities is clear in the new educational reform of 2007. It calls for Community training rehabilitation centers for such persons, increased public awareness on the importance of educating such persons, more special schools, inclusive education for persons with mild forms of particular disabilities (Key Recommendations for Special Education, New Educational Reform, 2007).

1.4 Problem Statement

Increasingly issues concerning blind persons and other disabled persons are gaining recognition in Ghana. Physical accessibility problems affecting physically challenged persons in the built environment is recognized (Disability Bill, 2007), however physical accessibility problems facing especially visually impaired students in schools in Ghana were highlighted in detail.

1.5 Justification

The Disability Bill (2007) calls for all existing and yet to be built public and private buildings including schools, houses, etc to be made physically accessible for all persons notwithstanding their physical states. This thesis will go a long way to show how physical accessibility features can be integrated into the architectural design of a school for the visually impaired after highlighting some of the architectural barriers in selected schools.

1.6 Research Questions

1. Are there really architectural barriers to physical accessibility for visually impaired students in schools in Ghana? If yes, what are these architectural barriers?

2. If these architectural barriers exist, how are they affecting physical accessibility for the visually impaired student in the schools?

3. How best can physical accessibility be integrated into the architectural design of a school for the visually impaired?

1.7 Objectives

1. To design a model physically accessible school for the visually impaired student based on criteria gained from existing literature, successful case studies and other visitations.

2. To document architectural barriers to physical accessibility faced by visually impaired students in selected schools in Ghana.

1.8 Target Group

Post junior high school visually impaired students

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Purpose of literature review and implications on area of research

This chapter dealt mainly with the review of relevant literature. The purpose was mainly to gain a deeper understanding of certain existing concepts etc. and review this information which in the end the researcher will apply in chapter five of this material. The review of relevant literature will have implications on the design of physical accessibility in model vocational technical for visually impaired students. A good understanding of concepts such as good ramp design, physical accessibility, and special school among others will help the researcher to come up with a very functional school design at the end.

2.2 Functional limitations of visual impairments on mobility and access of buildings and its surroundings

Vision is involved in the total performance of the human body (Thejobofvision.htm). This assertion cannot be disputed in all fields of human endeavor. This assertion makes the eye one of the important organs of the body as it is used in sitting, walking, talking, eating, and drinking among other things.

Further, the aforementioned website states that the eye is an identification and navigational system and that it is linked to the body's balancing. This assertion has implication for the design of the built environment for persons with visual impairments especially. Impairments to the eye therefore affect posturing, identification of things in the built environment, and assured mobility. This being true, it means that impairments to the eye affect a person's effective navigation in educational buildings (schools) and its environments. Due to the impairments of the eye, a person might bump into things and move about with less confidence. That is why persons with low vision and without any vision use assistive devices such as the cane, guide dogs etc. Mobility is the ability of visually impaired persons to move with ease, speed and safety through the built environment and its surroundings (teachingmobilityskills.htm). This stresses the problems faced by such persons as they go to schools, playgrounds, workplaces etc. Hence the built environment and its surroundings should promote effective mobility for such persons. Generally impairments that affect mobility include those that confine people to a wheelchair, and those with disabilities that affect vision among others (Crum and Foote, 1996). The designer should thus understand the role visual impairments play in the mobility of people in buildings so mobility can be enhanced through building design.

2.3 What are Architectural Barriers?

Alan Faber (1979) define architectural barriers as those physical attributes of buildings and facilities which by their presence, absence or design present unsafe conditions and or deter access and free mobility for the physically handicapped in and around buildings and facilities. Faber recognizes the fact that these architectural barriers put further strain on the physical state of such persons. The presence of a poorly designed stair can cause a visually impaired person to trip and fall down. He not only talks about barriers inside buildings but also around buildings. This is crucial as barriers around a building also affect such person's access into buildings. For example, the absence of a ramp into a building's entrance can negatively affect accessibility. Crum and Foote (1996) wrote that, "Architectural barriers are those aspects of the built environment which lessen a disabled persons' access". This definition encapsulates the effect of these barriers on the disabled person in terms of physical accessibility. It recognizes that disabled persons have no less a right to access all parts of the built environment. Crum and Foote (1996) go on to list examples of architectural barriers. These include parts of the building(s), landscaping, walkways, or parking areas, and include high curbs, lack of curb cuts or ramps, gravel walkways, narrow sidewalks, extreme variations in the grade of walkways, debris which interferes with passages, narrow doorways, and heavy doors requiring excessive force to open. The examples listed impede easy access of the built environment by disabled persons such as the visually impaired. The uneven surface of the gravel walkway for instance can impede free movement of such persons just like a narrow walkway. Also the lack of curb cuts on walkways and badly designed ramps impede the safe and easy access of the built environment and its surroundings.

2.4 What is School Architecture

Dober (1996) defines a school as an institution, which is intended to nurture, care for and educate children within the framework of a structured age related class. Dober recognizes the aims and aspirations of the school across all societies. The institution encompasses the administration, curricula and the physical environment. Dudek (2002) wrote that in a school there is a relationship between educational and architectural aspirations so that learning can take place without distractions. It is true that the built environment plays a big role in the effective running of any academic program. The influence of an environment that is not accessible can be very negative. In the end, the environment should respond effectively to unimpeded mobility.

2.4.1 Special School Architecture for the visually impaired

Wikipedia.com defines special school as an institution that is aimed at meeting the educational needs of students who have peculiar educational needs compared to 'regular' students (Google, wikipedia.com). It is an institution providing education for students who due to some disabilities cannot participate fully in the mainstream education (answers.com). Persons who usually are provided with special education include those with mental and intellectual disabilities, visually impaired among others. These definitions capture the basis for special schools or special education. Some have argued against special schools on the premise that they are discriminatory. However, mainstreaming in Ghana is someway far off.

"A person with sensory impairments may experience difficulty in approaching and using buildings unless buildings compensate for their specific impairments" (Quentin 2002). As stated earlier Dudek (2002) wrote that there is a relationship between educational and architectural aspirations so that learning and teaching can take place without distractions. Quentin's statement captures it well when it suggests buildings should compensate for the specific impairments of such disabled persons (e.g. visually impaired). In the case of special schools, the need for physically accessible buildings is more than necessary. Special school environments should make it easy for students to approach and use buildings. Dudeks' assertion means that designing special schools put additional demands on the architect is true. Quentin further mentions the need for additional spaces for teaching and learning.

2.5 What is physical accessibility?

Mary and Catherine (googlebooksearch.com) define physical accessibility as the ease with which the physical environment may be reached, entered and used by all individuals. Relating it to the school environment, it can be said to be the ease with which the physical environment of schools can be reached by all persons regardless of physical disabilities. It recognizes the need for all persons to have unrestricted access to the physical environment i.e. the built environment and its surroundings. The definition further underscores the need for all persons to have easy access in reaching, entering and using the physical environment. When this is ensured all persons can perform whatever they want to do with little or no extra effort. Mary and Catherine recognize that it is important that not only should physical environments be easy to reach but to be entered and used as well.

It is pleasant and easy to move around in an environment that is physically accessible even if you happen to use a wheelchair, white cane etc (Physicalaccessibility.htm). This is true because such persons will not feel inadequate when accessing physical environments since their concerns have been taken care of in the design. With minimum of no extra effort, they can have physical access. Physical access means accessible parking spots, level passageways, large enough elevators and toilets, auxiliary aids and comfortable rest places among others (Physicalaccessibility.htm).

The intervention of an access ramp to a classroom block entrance can make a lot of difference to physical accessibility for a sight-impaired person. This means more people including the physically challenged can use that particular building and its environment.

2.6 Designing physical accessibility for visually impaired persons

Mary and Catherine (googlebooksearch.com) define physical accessibility as the ease with which the physical environment may be reached, entered and used by all individuals. Deducing from that definition, physical accessibility for the visually impaired can be said to be the ease with which they can reach, enter and use the physical environment (built and un-built). Several ideas have been put forward concerning the making of the physical environment more accessible for a visually impaired person. Crum and Foote (1996) talked about architectural barriers as those parts of the built environment that lesson a blind person's access. The removal of these barriers such as narrow sidewalks, lack of ramps or poorly designed ones, gravel walkways will provide good mobility for the use of blind persons. Several literature have concentrated on the accessible design of parts of the built environment (in and around buildings) such as approach routes, parking spaces, entrances, ramps and railings, doors and doorways, corridors, floors and wall treatments, staircases etc.

2.6.1 Building layout design

'The design of the physical environment should be logical and simple for visually impaired persons' (Http://www.tilgaengelighed.emu.dk/tilgaengelighed/fy…). This websites' statement is one that must be adhered to since it goes a long way to help such persons move about independently from one facility to the other. A simple physical environment design will help such persons to navigate with ease and safety. For example, having toilets near an eating area or main reception area, or placing soap and hand drying facilities adjacent to the washbasin area would help. Http://www.australiavision corroborates this assertion by stating that physical design should be simple and logical. A simple layout will facilitate easy movement form one point to the other within a particular environment. The simple layout of the school physical environment will facilitate easy mobility from the classroom to the library etc.

2.6.2 Approach routes and entrances

Peloquin (1994) states that from the parking space or drop off points, the route to the entrance, should be as short as possible. This is true because walking too long from a drop off point for blind persons can be disorienting. The student or person can thus take few assured steps to the approach of a classroom, an administration block, a dormitory block, a library block etc. Thorpe (2002) writes that approach routes should be covered if possible and there should be the avoidance of changes in levels. Covering approach routes to a building can protect a visually impaired person from weather conditions such as rain.

Accessibility for the Disabled-A Design Manual for a Barrier Free Environment, (United Nations 2003-2004) states that building entrances should have accessible and easy to find building entrances. This recommendation is good as difficult to find building entrances makes accessibility difficult for visually persons. This manual further recommends that thresholds to doors of building entrances should be removed and that the color of the entrance door should contrast with the surrounding surface. These recommendations are good.

2.6.3 Parking spaces

Federal register (1991) recommends that parking spaces serving a particular building shall be located on the shortest accessible route of travel from adjacent parking to an accessible entrance. This recommendation is in the right direction since sight impaired persons will not have to walk a long way to a buildings' entrance. There is a greater chance of visually impaired persons losing their bearings if the parking space is too far away from a buildings' entrance.

2.6.4 Staircases and steps

Staircases and steps can be the biggest barrier to independent access for people with mobility impairments. As such safety and ease of usage should be considered when designing (http://www.tiresias.org). This assertion is true since staircases cannot be avoided in the access of buildings esp. storey ones. Accessibility for the Disabled-A Design Manual for a Barrier Free Environment (United Nations, 2003-2004) recommends that these things should be avoided; un-uniformed steps, circular staircases, steep staircases and staircases that are difficult to find. These recommendations when integrated into the design of the staircases would make their usage easy and safe for such persons. Steps that are not uniform and circular staircases will confuse users. Circular staircases and steep ones will put so much physical challenges on sight-impaired individuals due to their configurations. Http://www.tiresias.org writes that 'nosings should be highlighted to indicate the location of the nosing or leading edge of tread to provide safe usage up and down the stair and that open risers should be avoided'. The feet of such persons can enter openings in such risers and can cause them to fall down or trip. Accessibility for the Disabled –A Design Manual for a Barrier Free Environment (United Nations, 2003-2004) recommends that a 'textural marking strip (of different color from surrounding environment) should be placed at the top and bottom of the stairs and the intermediate landings to alert sightless persons as to the location of the stairs'. This strip when used will serve as a good guide for visually impaired students.

Fig. 1-Highlighted stair nosings

Fig.2-Handrails on both sides for support

Fig.3-Tactile marking on a stair tread

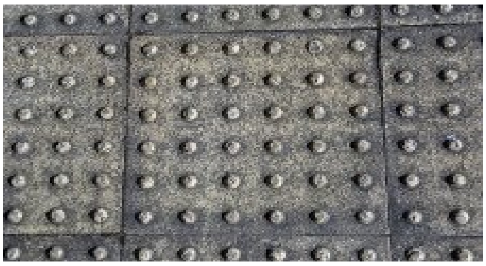
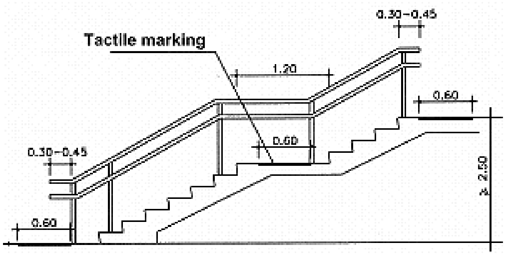


Fig.4 Embossed plate as tactile marking

Note: (Figures courtesy http: //www. irnb.org)

Http://www.tiresias.org further recommends that visually impaired persons should be provided with handrails for support. They are used to steady and provide guidance in ascent or descent of staircases. Accessibility for the Disabled-A Design Manual for a Barrier Free Environment (United Nations, 2003-2004) recommends that handrails should be installed on both sides of the stairs and around the landing for gripping and that handrails must extend a distance between 0.37m and 0.47m at the top and the bottom of the stairs. The handrails will provide safety and ease. Http://www.tiresias.org requests the ends of handrails to be designed to reduce incidence of injuries to users. A handrail not designed to prevent injuries at its end can be fatal.



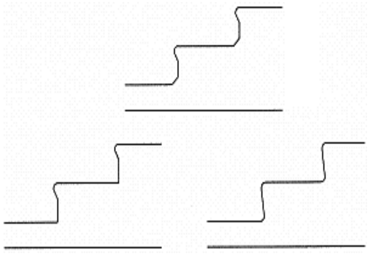


Fig.5-Accessible stair design Fig.6 Nosing design for treads

(Figures Courtesy, Accessibility for the Disabled-A Design Manual for a Barrier Free Environment, United Nations, 2003-2004)

2.6.5 Ramps

A ramp is a slope or inclined plane or way leading from one level to the other (Cassell Popular English Dictionary, 1995). Accessibility for the Disabled-A Design Manual for a Barrier Free Environment (United Nations, 2003-2004) recommends that ramps should be provided wherever stairs obstruct the free passage of visually impaired users. The assertion of the manual is good since a ramp well designed for accessibility, will pose less physical strain on such users and enhance access to classrooms, libraries, dining hall etc.

Fig.7-Handrails on the sides of an access ramp Fig.8-Entrance ramp at the Aarhus business school, Denmark

(Fig.7 courtesy http: //www.tiresias.org)

(Note: Fig.8 courtesy http://www.tilgaengelighed .emu.dk/tilgaengelighed/fy…)

Accessibility for the Disabled-A Design Manual for a Barrier Free Environment (United

Nations, 2003-2004) states that ramps can be configured in many different forms depending on the space available. It talks about the straight run, 90-degree turn ramp and the switch back or 180-degree turn types. As much as possible, any of the configurations can be chosen having in mind easy manipulation. The straight-run type can potentially be too long for users although it is less confusing in its usage. The 90-degree type can be confusing if there are more students using it. However, the use of tactile markings at vantage points could assist easy negotiating for persons.

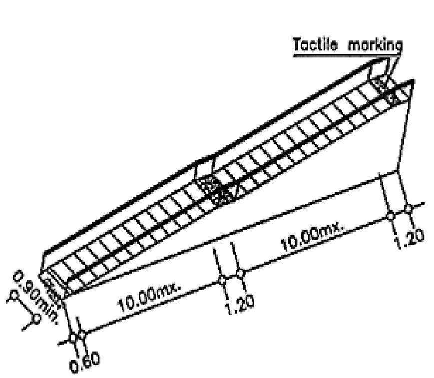


Fig.9-Straight-run ramp

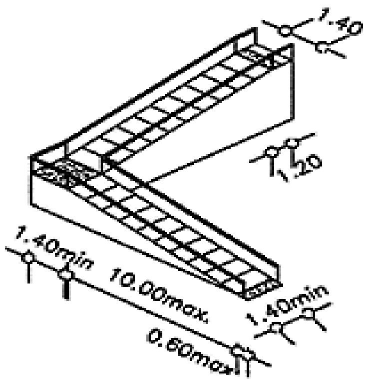


Fig.10-90 degree turn ramp

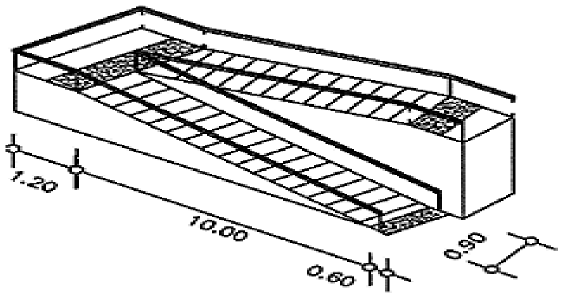


Fig.11-Switch back or 180 degree turn ramp

(Figures courtesy Accessibility for the Disabled- a Design Manual for a Barrier Free Environment, United Nations, 2003-2004)

Http://www.tiresias.org recommends that two handrails should be installed on both sides of a ramp at least 0.40m high and its design should be ergonomic (can be used by all). This is commendable since the handrails will provide protection for sight impaired persons. Holding on to two rails would be good for all users. Concerning the width of stairs, the Accessibility for the Disabled-A Design Manual for a Barrier Free Environment, (United Nations, 2003-2004) recommends that the width should vary according to the configuration of the ramp but broadly, it should be not less than 0.90m. However, the designer should have in mind the expected traffic and the place of installation. For a school block, the expected traffic will be higher than in a residential facility and as such larger.

Accessibility for the Disabled-A Design Manual for a Barrier Free Environment (United Nations 2003-2004) makes some recommendations on examples of slopes depending on the available space to be covered. They include 1:20 (9%), 1:16 (6%) for a length of 8m (0.50m) rise, 1:14 (7%) for a length of 5m (0.35m), 1:12 (8%) for a length of 2m (0.15m) rise, 1:10 (10%) for a length 1.25m (0.12m) rise, 1:08 (12%) for a length of 0.5m (0.06) rise.

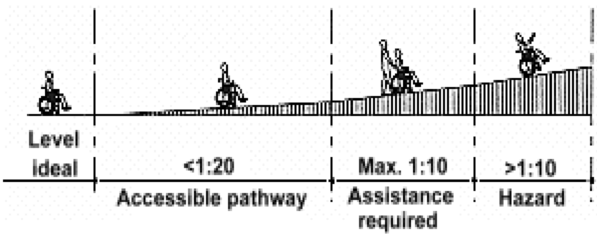


Fig.12-Picture showing ramp slopes and accessibility

(Picture courtesy Accessibility for the Disabled-A Design Manual for a Barrier Free Environment, United Nations, 2003-2004)

Ideally slopes with 1:20 gradient are good. A sight-impaired can independently use such slopes with a lot of ease and safety. In the end, slopes should ensure safe use. Http://www.tiresias.org recommends that the surface of a ramp should be hard and non-slippery and that circular ramps are not recommended. Hard surfaces will prevent accidents. Accessibility for the Disabled-A Design Manual for a Barrier Free Environment, (United

Nations 2003-2004) writes that adequate drainage should be provided to avoid accumulation of water. This is important to prevent accidents. Http://www.tiresias.org suggests that textural colored marking should indicate the top, bottom and landing of a ramp to alert persons with visual impairments. Landings are very crucial since persons with visual disabilities can rest as they use ramp.

2.6.6 Doors and doorways

Accessibility for the Disabled-A Design Manual for a Barrier Free Environment, (United Nations 2003-2004) identifies the need to provide accessible doorways and doors for the visually impaired. There is the need because doors and doorways are essential parts of the buildings. They are the main access into classrooms, offices, toilets, dining spaces, dormitories, libraries etc. Quentin (2002) recommends that revolving doors as much as possible should be avoided as they pose great difficulties. Simple operation doors can thus facilitate easy usage. Accessibility for the Disabled- A Design Manual for a Barrier Free Environment, (United Nations, 2003-2004) recommends that an accessible door should have the following features; a sign, a door handle (simple lever), an extra pull handle, kick plate and that door handles should be located at a comfortable height of 0.9m and 1.00m from the floor surface.

These features will go a long way to make use of doors and doorways very easy. Also the placing of door numbers on the doorframes or doors can facilitate the independent use of such persons. In addition, the door or the doorframe can be painted in a color that contrasts with the adjoining wall to facilitate its identification (http://www.tiresias.org). This will allow students with low vision to make out doors.

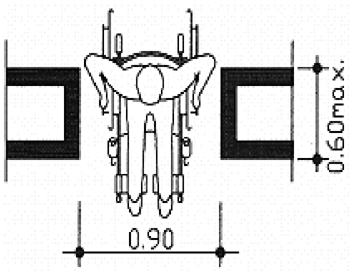


Fig.13-Minimum dimensions for a door

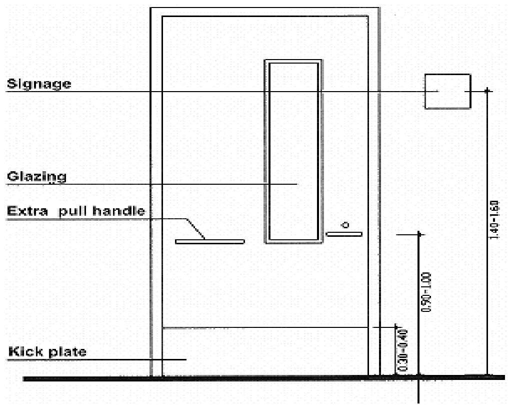


Fig.14-Accessories of an accessible door

(Figures Courtesy of Accessibility for the Disabled-A Design Manual for a Barrier Free Environment, United Nations, 2003-2004)

2.6.7 Corridors and circulation areas

Barrier Free Environments Inc. (1991) recommends that all appliances and fittings should be recessed where possible on corridors and other areas of a building to improve accessibility for all persons. This recommendation is particular good, in the sense that fittings such as electrical plugs, chairs and tables etc. in the line of movement can cause sight impaired persons to fall or trip. It is hence crucial that such persons have a free path for movement. Circulation areas should thus be free of obstructions.

2.6.8 Windows

Mace (1991) writes that “to make a window accessible to all persons there should be a clear floor space, a minimum of about 2’- 6’’ x 4’- 0’’ available at each window so that a person can maneuver and get close enough to operate the window’’. Thus desks and chairs in a classroom should not be placed too close to a wall area containing any window. With such a design, such students can easily and safely control. Quentin (2002) writes that accessibility principles should be applied to all the functions of windows, including views out, ventilation, screening and security. Quentin (2002) touches on all the salient issues on the matter of making it usable for all. To ensure easy access to windows the height of window from the ground should be noted. Window types e.g. louvre should be made easy to use.

2.6.9 Controls, facilities and furnishings

Quentin (2002) states that ‘accessible controls should be easily reached, easy to manipulate and should give legible information’. Therefore, these controls should be easily reached by the visually impaired. These controls in the built environment include levers, switches, knobs, taps, and stopcocks among others. Window controls should be independently usable by such students. It is crucial that controls have legible information (i.e. Braille) for independent use. The embossed lettering can be at a location that can be easily accessed.

Quentin (2000) recommends that for controls to be easily reached, controls need to be within a height range generally between 600mm and 1200mm. This height range is good as the sight impaired can use the window.

Http: //www.australiavision.com recommends a logical design and layout within a room based on the activities performed in that space. This is crucial so that visually impaired persons can use such spaces independently. Spaces such as classrooms, offices, sleeping areas and dining areas among others need logical design. As stated earlier, such persons rely so much on their visual memory. As such, they can use such spaces independently with ease and safety after some time. Chairs, tables, cabinets, beds among others can be placed such that movement is unimpeded. Furthermore, the website recommends that luminance contrast can be used to highlight furnishings, facilities and controls. This can help those who have some residual vision to differentiate between things. For example, different colors for curtains, walls, chairs, floor, will help blind persons move with ease.

2.6.10 Walkways and Pathways

Http://www.australiavision.com recognizes the crucial role well designed walkways play in mobility for the visually impaired in the use of the physical environment. It recommends walkways should be fitted with visual signs and tactile clues (e.g. Braille blocks); different colors and textures used to clearly define edges of paths and routes and well considered placement of plants for emphasizing pavement edges. This should be well considered by designers of the built environment. The visual signs and tactile clues (e.g. Braille blocks) can play an important role in the mobility of sight impaired persons in the built environment. The users can use their sense of feel (feet) to move safely and easily along the walkway(s). Patterns in the paving should be carefully thought out to guide people through routed areas or to entrances. Http://www.australiavision.com recommends that pathways should have a minimum vertical clearance of 2000mm (2m) and should be obstacles free.

The obstacles may include potted plant, rubbish bins, fire hydrants, etc. These obstacles pose lots of danger to visually impaired persons. There should be clues to warn against potential harm such as the use of textural markings. Poles and freestanding columns can also be designed such that they are not in the direct line of pathways or walkways. It is essential that architects and other designers consider this so persons can move about without injuring themselves.

Fig.15-Planting obstacle in a walkway

(Picture courtesy Accessibility for the Disabled-A Design Manual for a Barrier Free Environment, United Nations, 2003-2004)

Http://www.tiresias.org states that tactile surfaces when used in various forms and applications can be used to convey important information about the external and internal environment along their paths of movement. Http://www.australiavision.com talks about tactile ground surfaces to direct and war users of dangers ahead. Tactile surfaces can help sight impaired persons to use their sense of feel and memory effectively. They give a safe path of travel.

2.6.11 Floor surfaces

Http://www.australiavision.com recommends the use of a 'matt (non gloss/glare) finish that is slip-resistant for all floor surfaces of the built environment'. It goes on to talk about highly reflective surfaces such as highly polished, metal or marble floors sometimes disorienting people with low vision. As such the matt surface will prevent incidents of tripping and falls. Worthy of mention is the question of where to place specific floor textures to direct persons with sight impairments. Http://www.australiavision recommends that changing floor textures at strategic points such as intersections and at entrances of toilets, canteens facilitate independence in mobility for sight impaired persons. These textures will help such persons know when to go straight ahead and where to turn left or right to get to specific places like classrooms, library, sleeping rooms etc.

2.6.12 Lighting design

Lighting is very essential in the physical environment. Http://www.australiavision.com and Accessibility for the Disabled-A Design Manual for a Barrier free Environment (United Nations, 2003-2004) corroborates that persons with visual impairments have some residual vision and can perceive some lighting. As such, interior and exterior environments should be well lighted for visually impaired persons. Http://www.australiavision.com recommends that for most people with sight problems, more light is better and that glare conditions should be avoided. Http://www.tilgaengelighed.emu.dk/tilgaengelighed/fy... also recommends anti glare lighting and lighting levels for general rooms (4-800lux), pedestrian areas (200lux), classrooms (600lux) and at workstations (200Lux). The two schools of thought recognize the fact that glare conditions are not good for such students. This is true as glare lighting would be overpowering, too intense and can be potentially confusing. 600lux for classroom lighting is not likely to lead to glare conditions since students can use their residual vision to read and perform other tasks in such settings. In summary, classrooms and general rooms such as bedrooms, libraries require high lighting levels since important tasks have to be performed. Http://www.tilgaengelighed.emu.dk/tilgaengelighed/fy... recommends that care should be taken in the choice of colors for ceilings, walls and floors since they play a role in light characteristics of indoor spaces such as classrooms, libraries, etc. This is true as a dark ceiling would reflect light differently from the way a white ceiling would. With this in mind the designer would chose good colors that augment or mellow the intensity of the lighting for the intended purposes of the space.

2.6.13 Walls and Ceiling design

Walls and ceilings form part of almost every classroom, dining hall, office, bathroom, and dormitory space which will be used by a visually impaired person.

Http://www.australiavision.com recommends that to maximize brightness and facilitate an even distribution of light in a room, all ceilings and walls should be light in color.

Http://www.australiavision.com further states that ceilings should have a matt finish to reduce glare. These assertions are all true and can go a long way to make classrooms, libraries, etc. accessible.

With regard to the design of walls, http://www.rnib.org.uk recommends that textural clues can be incorporated into the design of it so that they can assist visually impaired persons. This recommendation is in the right direction, as persons can comfortably trail their fingers on the walls to know where they are or going. However, the finishes of the walls should not be injurious to them. For example, a rough terrazzo finish can be potentially dangerous. For example, the inner wall of a classroom can be finished with wood paneling whiles that of the library can be finished with fabric.

Fig.16-Textural clues on walls

Fig.17-Tactile fabric for trailing

(Pictures courtesy http://www.rnib.org.uk)

2.6.14 Washroom design

Accessibility for the Disabled-A Design Manual for a Barrier Free Environment (2003-2004) recognizes the need to provide accessible washrooms. It identifies the problem of insufficient spaces within washrooms, poor design and position of fittings and fixtures such as taps, grab bars, etc. for use by the physically challenged. Insufficient spaces within washrooms will present mobility problems for such persons e.g. the visually impaired, wheelchair users etc. Also the correct positioning of lavatory sinks, water-closets, would also ensure that students are able to use it safely and easily. However, in other to design well for them the designer has to understand how such persons move. A room that allows enough maneuvering would thus provide some degree of ease. Quentin (2002) writes that the layout of the room, i.e. bathroom(s), toilet(s), lavatory sinks among others, should be simple so that easy access is guaranteed. This is essential for the visually impaired. Careful design of the wall and floor of a washroom can give directional clues such users.

Typically, a washroom would consist of a lavatory sink(s), toilets (WC's), bathrooms (showers) among others. Barrier Free Environments Inc. (1991) recommends that to make

bathrooms usable for persons such as visually impaired students, a roll in shower stall with no curb that is large enough for comfortable showering is good. This is good compared to a typical bathtub where sightless persons can be exposed to dangers such as tripping and falling. Also this can be used by everyone. With the shower stall, such persons can stand and use taps and grab bars. Http://www.tiresias.org suggests non-slip floors for shower stall to prevent accidents. In that case for example, polished tiles should not be used for the floors of such a space. Instead a screed or rough terrazzo is preferable since it is not slippery.
Barrier Free Environments Inc. (1991) recommends that there should be a clear floor space in front of lavatory sinks, easily operable faucets (lever type) and the use of the right type of lavatory sinks (both wall mounted and counter-top types). It is essential that there is a good floor space in front of lavatory sinks so that there is unimpeded mobility. The presence of objects in the path of movement can cause tripping. Also the simple lever faucets are easy to operate compared to the types which require twisting and turning (Barrier free environments 1991).

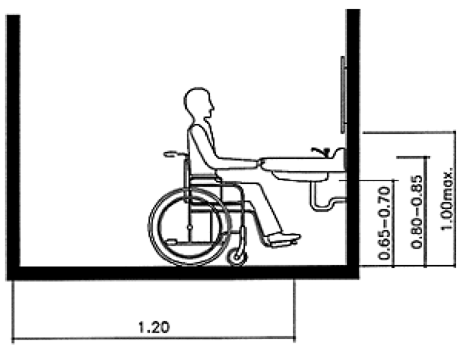


Fig.18-Positioning of lavatory sinks for accessible use

(Figure courtesy Accessibility for the Disabled-A Design Manual for a Barrier Free Environment, United Nations 2003-2004)
Accessibility for the Disabled-A Design for a Barrier Free Environment (United Nations, 2003-2004) recommends that toilet seats should be installed at the height of between 0.45m

and 0.50m and that flushing should be made easy. At that height such students can safely use it without falling, though in addition grab bars must be installed to serve as support. Complicated flushing systems would pose difficulties for sight impaired persons. Finally concerning the accessible design of urinals for the use of sightless persons, the design manual suggests that; the full length urinal is the most accessible and urinals with protruding lips should be mounted at a height of 0.45m from the ground. At this height, visually impaired persons should be able to use safely.

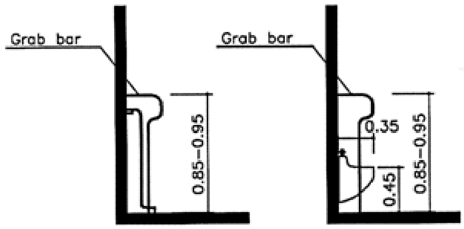


Fig.19-Recommended location of urinals for accessible use

(Figure courtesy of Accessibility for Disabled-Design Manual for Barrier Free Environment, United Nations, 2003-2004)

2.6.15 Acoustic design

Pocket Oxford dictionary defines acoustics as the properties or qualities of a room etc. in transmitting sound. Http://www.worldblindunion.org writes that sounds can assist persons with visual impairments by providing orientation clues about a space. Http://www.tilgaengelighed.emu.dk/tilgaengelighed/fy… writes that good acoustics is essential in physical design for blind persons since they offer good orientation clues. The sense of hearing of such persons can be enhanced with the design of good acoustics in the built environment. Http://www. worldblindunion.org writes that 'sound reflections are a good source of auditory clues for sight impaired persons and that a person can use reflected sound to determine a room size, the presence of corridors and proximity of walls and other structural members'. The design of rooms i.e. classrooms, offices, sleeping rooms, laboratories etc should reflect good sounds so that they can hear effectively. Http://www.tilgaengelighed.emu.dk/tilgaengelighed/fy... makes further recommendations for the use of materials such as brick, fabrics, and acoustic tiles among others to encourage good acoustics.

Fig.20-Brick facing at back wall for good acoustics in a classroom

Fig.21-Ceiling design for acoustics in a classroom

(Photographs courtesy http://www.tilgaengelighed.emu.dk/tilgaengelighed/fy...)

It is good that finishes to walls and ceilings among others reflect sound well without echoes. For example, specific sound of a wooden paneled wall in a classroom.

2.6.16 Recreational facilities (Playgrounds)

Recreation plays an important role in the lives of all persons. Playground%20accessiblity.pdf and Kern (2002) confirm the assertion above. Kern (2002) writes that a playground or place of recreation should be a good learning environment and that such spaces in the built environment are not usually designed with the needs of persons such as those with impaired vision, developmental disabilities and other physical or mental challenges'. Kern (2002) defines an accessible playground as one that offers a range of play experiences to children (persons) of varying abilities. With kerns' definition, it means that architectural or physical barriers must be removed so that persons with disabilities can use recreational spaces such as football pitches, tennis courts, playgrounds, with ease and safety. Kern (2002) goes on to list some barriers. These include inappropriate materials, inaccessible routes, and lack of ramps or poorly designed ones, poorly designed steps etc. Deducing from his writing, it means that for persons with visual impairments, some of the barriers would include inaccessible routes, poorly designed play equipment including swings, climbers etc. Kern (2002) recommends that such persons should be able to move about and exercise to promote the enhancement of developmental skills such as social and, motor skills and self-expression.

2.6.17 Furniture design and layout

"The most universal physical occupation of civilized human beings is sitting" (Bennett, 1928), Sitting is carried out in schools (libraries, classrooms, libraries, dining areas, etc), banks, churches, etc. and it plays important role in learning. Hence, the need for effective accessible furniture design to accommodate uninterrupted movement and sitting by students of all abilities by its design, materials and its arrangement. Http://www.librisdesign.org lists some furniture types such as chairs, tables, carrels, desks, special chairs and tables, book cases, beds etc. Clayton and Forton (classroomsthatwork.htm) recognize the problem of poor furniture design in schools. It mentions problems of overcrowding, unsafe aisles or pathways, poor seat design and layout among others (in classrooms, libraries, dining halls, etc). Http://www.librisdesign.org sees accessible furniture as chairs, tables, desks, etc that is available for the use of all persons (including the disabled). The website recommends tables and other work surfaces should provide 30''wide x19''deep x 27"high knee space and the tabletop must be from 28''-34''max above the floor. Such a furniture design would allow usage by teenage and adult students however the needs of sight impaired children should be taken care of. Furniture in a classroom should be arranged to prevent students from bumping into furniture. Since sitting in school chairs has been related to a high incidence of discomfort among school students (Evans, Collins and Stewart 1992; Goodman and McGrath, 1991) and it's believed to affect students' performance (Akerstedt, 1994; Vercrussen and Simonton, 1994). In a school environment such as classroom and library, students should be able to sit and perform tasks such as reading, writing comfortably. www.librisdesign.org mentions that in general, furniture in a room should be safe to use, of a good material, stable, and durable. Beds in a dormitory should have all those qualities in addition to being well arranged to facilitate easy movement with minimum or no distractions. Visually impaired students should be able to approach a bed and use it easily.

2.7 Conclusions

To conclude, this chapter has demonstrated that architecture plays an important role in making life comfortable in school for the visually impaired student. The educational environments (schools) for the sight impaired should thus be designed with the peculiar needs brought on by such impairments. This is to ensure that such persons are able to participate fully in the educational environment which requires one to move from the library to the classroom, the dormitory to the recreational grounds, the dining area to the dormitory etc. this calls for an educational environment that is accessible for such students. Whether it is a special school or mainstream school, students should be able to use its buildings and surroundings independently and safely. Existing schools would thus need to bring accessible features into design of entrances and approaches, ramps, bathrooms, toilets, floor surfaces, classrooms etc. This would require the removal of physical and architectural barriers such as steep ramps, dangerous staircases, and slippery floors, weedy walkways, badly arranged beds, chairs etc. to make schools physically accessible for visually impaired students.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

In this chapter, the author presents the various research methods employed to collect useful data for analysis and interpretation so as to realize the aims started in chapter one. The author has detailed the various steps that were taken in other to arrive at the results in chapter four.

3.1 Qualitative data collection

The first step was the undertaken of a qualitative data collection. Under the broad topic of qualitative data collection, several steps were taken. This included 1. Literature review, 2. Case studies (physical observations, taking of photographs etc, population sampling, drawing up of standardized questionnaires and in-depth interviewing). The author further went on to analyze the data collected. This resulted in the development of a physical accessibility criterion which the author integrated into the final model school for the visually impaired.

3.1.2 Literature review

The first step the author took in the qualitative data collection process was the literature review of certain books, journals, websites which had information relevant to the subject matter. This review was very essential in gaining understanding of certain key concepts relating to the subject matter. The World Wide Web (internet) was extensively consulted in this regard.

3.1.3 Case studies (Physical observations (photographs), preparation of questionnaires, population sampling and in-depth interviewing)

The author in other to document architectural barriers to physical accessibility in some selected schools in Ghana, then undertook case studies. Two cases were looked at. These included the Akropong School for the Blind, Akropong and the Kwame Nkrumah University

Science and Technology, Kumasi. The Akropong School was chosen because it is a leading special school for the visually impaired in Ghana. Kwame Nkrumah University for Science and Technology, Kumasi was chosen it is a leading university in the Ghana. The Disability Bill, 2007 calls for all institutions in the country to be made physically accessible to all.

3.1.3.1 Physical observations (Photographs)

The author undertook various visits to the KNUST and the Akropong School for the Blind and noted down architectural barriers present. This was extensively the method used at the KNUST were seriously visually impaired students were not visible.

3.1.3.2 Preparation of questionnaires, population sampling and in-depth interviewing

At the Akropong School for the Blind, this step was taken to deeply understand at first hand the experiences of the target population (i.e. the visually impaired students). The author visited the school and prepared standard questionnaires with the background of the literature review and physical observations. Random sampling of junior secondary students **(150)** out of the total school population **(400)** was done and **50 (fifty)** students were chosen at random by teachers and the author later on interviewed them. The students chosen were to be articulate. Out of the fifty, **20** (twenty) were males and **30** (thirty) were females. The respondents' ages range between 15 and 17. All the 20 (twenty) male students were in the third year whiles 20(twenty) of the females were in the second year whilst 10(ten) were in the final year.

The questionnaire addressed issues concerning furniture layout, style of furniture, street and walkway safety among others. The researcher tried to make a link between issues that came up from the questionnaires and compared it with those discussed in the literature review. A sample of the questionnaire used can be found in appendix VIII. A presentation of the responses can be found in Appendix H.

3.2 Qualitative Data analysis

The researcher undertook a qualitative data analysis to interpret observations from the case studies and data gained from the literature review undertaken and from sample unit responses to the questionnaires. Data from observations from case studies, reviewed literature and sample units responses were examined so as to come up with a physical accessibility design criteria. Some issues run through all the various data collection methods. Some were conflicting and needed harmonizing. Finally, the researcher drew up a list of physical accessibility criteria to facilitate physical accessibility for visually impaired students in such schools. A sample of this list can be seen in Appendix IX-X.

3.3 Application of physical accessibility criteria to architectural design of model school

The researcher then integrated the developed (evolved) list of design criteria into the design of the physically accessible model vocational technical school for the visually impaired. In this vain, the model school was to have well designed ramps and staircases, big corridors and walkways, tactile paving clues on the floor finishes, good layout of furniture among others. The author then presents the physically accessible model school for the visually impaired (developed out of the case studies, literature reviews and sample unit responses) in part two of chapter four in the form of relevant floor plans, elevations and some perspectives (see Appendix A-F)

3.4 Research limitations

The author encountered a lot of research limitations mainly in the area of locating relevant books in the library and reviewing them to gain vital data. The few of the books that were located also didn’t have recent information. The World Wide Web was however useful in the area of literature review. The author also encountered certain problems in the undertaken of the various case studies. These problems have equipped the author with some experiences that will be useful in the future.

CHAPTER FOUR

4.0 FINDINGS AND RESULTS

In this chapter, the researcher presents data collected from the two case studies undertaken (architectural problems present) and finally present the model design of the proposed school.

4.1 Case studies

Two (2) case studies were undertaken to collect useful data on the architectural barriers present. The institutions are the School for the Blind, located at Akropong-Akuapem in the Akuapem-North District of the Eastern region of Ghana and Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

4.1.1 Case 1: Akropong School for the Blind

Briefly the school was established in the 1945. It was the first school (special school) to be set up in the country for the special education of visually impaired persons. It currently houses over 400 (four hundred) visually impaired students (primary to secondary).

4.1.2 Physical layout of school

The physical structures in the school include a main access road, administration block, main classroom block, girls' and boys' dormitory blocks, KVIP, playground, vocational training and rehabilitation block, staff residences, playground and a football pitch. The layout of the

Fig.22-Administration block

Fig. 23-Classroom block

buildings in the school pose some challenges to students. The location of the dining hall across the street is a challenge as well the location of the girls' dormitory. All the 50 (fifty) students interviewed complained about this barrier. In the model school, facilities hence have to closer to each other and street design placed to avoid conflicts.

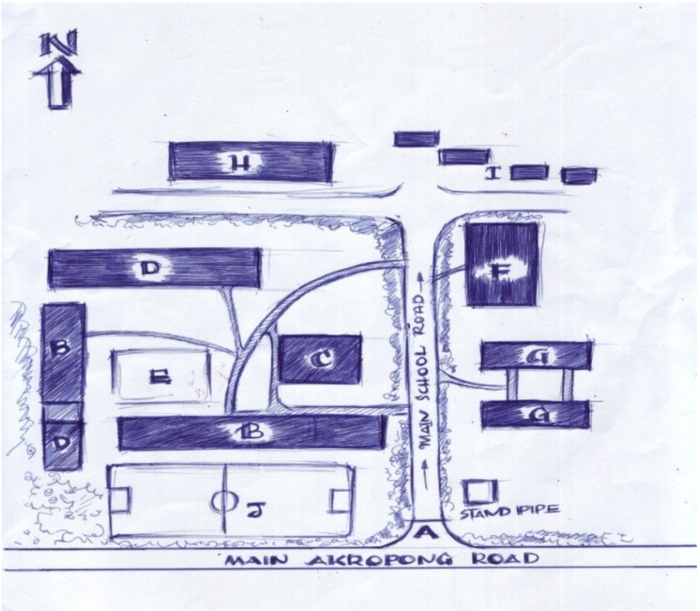


Fig.24-Layout of Akropong School for the Blind

Legend

A-Main entrance
B-Main classroom block
C-Administration block
D-Boys dormitory block
E-Playground
F-Dining hall
G-Vocational/rehabilitation block
H-Girls dormitory block
I-Staff residence
J-Football pitch

4.1.3 Street

One of the first architectural barriers that one would notice on entering the school is the unsafe design of the main street. Some of the architectural barriers present on the street have been listed below.

First, there are no defined pedestrian walks on the shoulders of the street hence students are forced to walk on the street. There is a high probability that cars can hit students, some of whom are very young. Secondly there are metal railings on only one side of the street. The railings provide some assurance for the students in the use of the street. Another barrier is the uncovered drains (gutters) on the sides of the main street. Students walking on the shoulders of the street sometimes fall and injure themselves.

Fig.25-Students walking on street

Fig.26-Railings on only one side of street

4.1.4 Walkways and Footpaths

Walkways play an important role in moving students move from one block to the other safely. There are walkways connecting the boys' dormitory block to the main classroom block, from the administration to the dormitories and from the administration to the dining hall. The students had to be very cautious when using the paved concrete walkways. However there are no tactile blocks on the concrete paved walkways from the classroom block to the boys' dormitory block to serve as guides. This is also present on the walkway from the administration to the dining hall. Students have to walk very slowly in a bid not to lose way. There are no changes in floor materials to warn students of junctions and the road. Hence in the model school, hard landscaping will be used to give tactile clues to students.

Fig.27-Walkway between classroom and administrative blocks

Fig.28-Walkway from administration to the dining hall

4.1.5 Steps and Staircases

Steps and staircases are present in almost every building in the school i.e. classroom block, administration, dining hall and the dormitory blocks. Architectural barriers run through the design of all steps and staircases. This came about as a result of student respondents and the physical observations.

First, there is the lack of tactile clues on the ground to warn of an approaching step or stair. This was evident at the administration block, dining hall, dormitory blocks, main classroom block among others. Nosings of all stairs and steps are not highlighted. Treads and risers of the stairs at the administration and the dormitory block had the same color. The staircase at the dormitory block was not well day lighted though there were slots in the walls to bring in light.

Fig29-Steps at entrance to dining hall

Fig.30-Steps at ground floor of dormitory block

Fig.31-Un-highlighted nosings at the administration block

Fig.32-Un-highlighted nosings at stair of boys dormitory block

4.1.6 Windows

Generally, the louvered windows on the north and south elevations of the dining hall, classroom block, administration bring in good natural light. Students are also able to open and close windows; however there were some barriers that the students talked about. In the classrooms and dormitories, however, furniture is too close to the windows and they impede mobility.

Fig.33- Furniture layout in a classroom

4.1.7 Floor and wall finishes

First, there is the lack of tactile clues on walls and floors to guide the students. For instance, the floor and wall treatments of the corridors and the classrooms are the same (cement screed). The situation is no different in the dormitories and dining hall.

4.1.8 Doors

The doors of the classrooms, dormitories, offices are single leafed (1000mm). One architectural barrier the students mentioned is doors of the classrooms having the same color as the surrounding wall. The doors of the classroom also don't have room number embossments to assist students. The doors of the classrooms have padlocks instead of simple lever handles which aid easy manipulation. Students find it difficult to locate doors and use padlocks. Another barrier is that the doors to the dining hall have the same color as the surrounding wall. However, the door to the dining hall is double leafed and aids easy mobility of students.

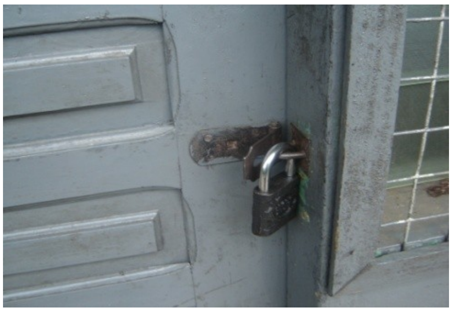


Fig.34-Padlocks on classroom doors

Fig.35-Doors are of same color as the surrounding wall

Fig.36-Simple lever handle on door

4.1.9 Furniture layout

Furniture layout in the classroom is generally organized. Chairs and desks for 25 students or less within a space of 8000mm x 4000mm. The students are able to move comfortably within the aisles (1500mm). Furniture layout in the dormitory is a bit crowded. There are 8 beds within a dormitory of size 6000mm x 4000mm.

Fig.37-Furniture layout in classroom

Fig.38-Furniture layout in dining hall

Furniture layout in the dining room is good. There are big aisles within seating. The aisles measure about 2000mm wide.

Fig.39- Aisles between tables

4.1.10 Corridors

Corridors of the dormitory blocks are free of rubbish bins and other obstacles and are protected with guard rails to prevent students falling from higher floor levels. This is the case at the dormitory blocks and the main classroom block as well as the upper terrace of the administration. Also, corridors are big (2000mm) for increased number of students to move easily. Notwithstanding these positives, certain architectural barriers are present.

First, a wooden post box hanging from the corridor wall of the main classroom block sometimes impede student mobility. A piano placed against a wall in a circulation area in the dining hall also impede mobility. There are no textural clues on the corridors to guide students as to the location of doors and staircases. Students have a hard time moving about quickly. Another barrier on the corridor is the exposed end of the metal tube of the railing. Students sometimes hit against them as they move about.

Fig.40-Wooden post box on the corridor of classroom block

Fig.41-Piano on the wall of dining wall of hall

Fig.42-Metal railings on corridors of classroom block

Fig.43-Metal railings on the corridor of dormitory block

In the proposed school, corridors will be large (1500mm) to facilitate easy use. Floor finishes of corridors will be designed to give assistance in their usage. Corridors will be free of obstacles.

Fig.44-End of railing can be hazardous

4.1.11 Dining hall

The dining hall is able to seat close to 300 (three) hundred students. There are aisles for good movement however the first barrier mentioned and observed is the lack of tactile clues on the ground to warn students of the many exposed structural columns in the dining hall space. Students could miss their way and hit their heads against these. Also there are no textural clues on the walls of the dining hall for enhanced movement of students.

Fig.45- Structural columns in dining hall

4.1.12 Playground

Visually impaired students enjoy playing and having fun outside the classrooms. The school has a football pitch and a playground with metallic play equipment for students. However these places must be safe for use. All the students mentioned some barriers they encounter in using the playground. One notable barrier is the lack of clues on the ground to warn students of the location of these metallic equipments (i.e. swings, goal posts etc.). The lack of this, result in students running and hitting their heads and other parts of their bodies against equipments. The football pitch also had debris (stone).

Fig.46-Playground close to footpath

Fig.47-Dry patchy football pitch

4.2 Case study 2 :Kwame Nkrumah University of Science and Technology, Kumasi

This institution was looked at because it is one of the prestigious educational institutions in the country and. It has been an institution mostly attended by sighted students. However the Ghana Education Services' (G.E.S) new educational policy of ensuring mainstream as well as special education means that existing educational institutions have to be accessible to all. The author used deep insights gained from literature review and observations made at the Akropong school for the blind to document the architectural barriers present.

4.2.1 Physical layout

The university is zoned into teaching area (colleges, faculties and departments), central functions area (main administration, great hall, library) staff housing, amenities for housing areas (shops, schools, banks etc), students' accommodation areas, landscaped areas, recreational areas (Paa Joe park, tennis court etc.) and others. Generally the teaching area contains classrooms, lecture theatres, staff offices, parking areas among others areas) college and faculty buildings (classroom blocks, lecture theatres, offices), roads, staff residential areas, recreational areas (Paa Joe Park, senior staff club, tennis courts).

Fig.48-Physical layout of Kwame Nkrumah University of Science and Technology, Kumasi

Legend

A-Queens hall

B-Republic hall

C-Independence hall

D-Library

E-Great hall

F-University Hall

G-Administration

H-Faculty of Science

I-Faculty of Pharmacy

J-Faculty of Agriculture

K-CCB

L- Faculty of Architecture

M- New lecture theatre

N-Unity Hall

O- Paa Joe Park

P-Basketball Pitch

Q-Africa Hall

R-Commercial Area

S-Old Administration

For the proposed school, facilities will designed more compactly to reduce walking distances.

Fig.49-The Great Hall

Fig.50-College of Agriculture

Fig.51-Main library block

The researcher at a close look of the physical layout of the school recommends that streets should be made safe for visually impaired students so they can move from one building to the other. The author noted that the various facilities are too spaced out. This will put a lot of physical strain on any visually impaired student.

4.2.2 Walkways and Footpaths

Some walkways have broken concrete pavers e.g. walkways along the road leading from the main administration to the teaching area. These broken pavers can trip and injure such persons. Some footpaths are overgrown with shrubs and grasses and not well defined.

Some footpaths have stones and other debris which can injure such students. An example is the walkway from the library to the Independence hall. The transition between well defined walkways and non defined ones can be confusing to sightless student usage. This was so in cases where there was a change in level from one defined walkway to another or an undefined one. An example was the case at the College of Architecture and Planning car park which also is a circulation space.

Also there are no tactile blocks on the ground warning of the transition from a walkway into a street. This was the case at the College of Pharmacy and the College of Architecture. Some unpaved footpaths are transverse by uncovered gutters or drains. One big barrier is the poor location of signage on walkways.

Fig. 52-Structural columns at circulation area (Great hall)

Fig.53-Poorly defined walkway (Unity Hall to Paa Joe Park)

Fig.54-Signage on side of street

4.2.3 Street design

All the streets in the staff residential area would not be safe for the use of visually impaired students. There are no railings and no defined pedestrian walks by it. Students would have to walk on the roads or in overgrown areas along the shoulders of the roads just after the uncovered gutters. There are no defined walkways on the library road and some portions of the Queens road and the Ayeduase road.

Fig.55-Lack of pedestrian walk on the Duncanson road

Fig.56-Parking on Duncanson road reduce space for pedestrians

4.2.4 Drains

One big architectural barrier that would inhibit the easy physical accessibility of visually impaired students on campus is the issue of uncovered drains (gutters). The drains on the shoulders of almost all roads in the staff residential area of the university are not covered. Visually impaired students can fall into such openings. The drains on the shoulders of the road leading from the College of Agriculture Junction to the Central Classroom Block (C.C.B) are not covered. It is the same, along the road from Queens Hall to Independence Hall. Some drains are covered fully whiles others are broken. The drains along the road from the main administration block to the teaching area also present the same problem. For the proposed school all drains will be covered.

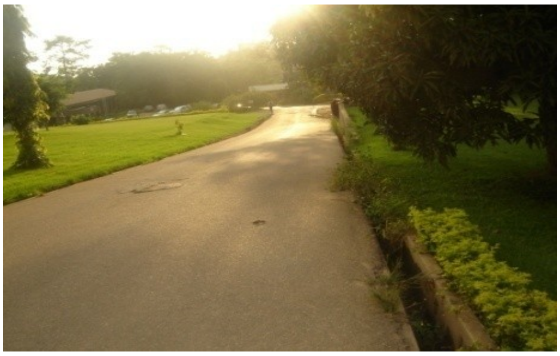


Fig.57-Gutter cutting through walkway to College of Pharmacy

Fig.58-Uncovered drain by road to Medical School

4.2.5 Staircases and steps

The spiral staircase in the exhibition hall of the College of Architecture main studio block and the Great hall would pose difficulties in safe accessibility for sight impaired students.

Fig.59-Spiral stair at Studio block (College of Architecture)

Fig.60-Spiral stair (Great Hall)

The reinforced concrete staircases at the Central Classroom Block (C.C.B) has balustrade on all sides of it including the landings but there are no tactile guides to enhance physical accessibility for sight impaired students. The staircases at the new lecture theatre block next to the old Central Classroom Block (CCB) don't have balustrades at the landings for extra support for mobility impaired persons. There are no highlighted nosings on all the staircases in all the buildings in the school. For the proposed school, stairs will be designed to effectively promote physical accessibility.

4.2.6 Lecture theatre design

lectures theatres are able to accommodate more students at a time. Some of the architectural barriers in the lecture theatres that were identified included the lack of tactile clues on the terracing of the seating areas so that visually impaired students would use it safely and independently. The barrier was noted in lecture theatres at the College of Agriculture, College of Architecture and the College of Science.

Also the flight of terracing from the lowest level to the highest level is too long and without landings for rest. In the event where a visually impaired student is moving down the terracing to find a seat he can potentially fall down and hurt him or herself. The flight down and up is quite steep. There are no supports on the side of the aisles in the seating area for persons with visual impairments to use safely and independently.

Fig.61-Aisle of lecture theatre (Faculty of Agriculture)

Fig.62-Wood paneling on wall to enhance acoustics

4.2.7 Classrooms

Furniture layout of some classrooms would present barriers for the visually impaired. Some classrooms were cramped with furniture thus movement would be difficult. Almost all the doors have no room embossments of room numbers and the door colors are similar to surrounding wall. Some classrooms had the blackboard area on a raised floor. Visually impaired students could hit their feet against this as they move in front of the classroom to find a seat.

Fig.63-Crammed furniture in a classroom (College of Science)

Fig.64-Raised floor at front of classroom (College of Science)

4.2.8 Corridors

Corridors without obstructions will enhance use by visually impaired students.

In some instances, dustbins have been placed along corridors in the line of movement. This was the case at the College of Science block. Also in some cases, free standing structural columns were in the line of movement of circulation areas. There were no tactile warning clues either on the wall or elsewhere. In other instances, potted plants were also not placed well in circulation areas. This barrier was present at the main Library foyer, Great hall and the College of Architecture.

Fig.65-Potted plant in circulation area

(Faculty of Architecture)

Fig.66-Furniture on corridors

(Central Classroom Block, C.C.B)

4.2.9 Ramps

There is a major ramp that leads to the main entrance of the old Central Classroom Block (CCB) which is very gentle. However a deliberate attempt has not been made to give clues on the ground so that visually impaired students can move from the street to the walkway.

Ramps are generally absent.

4.2.10 Halls of Residences

One architectural barrier associated with the halls of residences is the lack of tactile clues on staircases. The halls include the Independence, Africa, Republic, Unity and Queens. Also connecting walkways are generally without guard rails. This was the case at Queens hall, Africa hall, Republic hall, Unity hall among others.

Fig.67-Entrance steps without tactile warnings (Republic Hall)

Fig.68-Stair without highlighted nosings

4.2.11 Library

The library foyer with its free standing structural columns in the line of movement of persons presents the first obstacle. There are no tactile warnings to prompt a visually impaired person. The mushroom columns at the old library block. The main entrance door into the library is not on the same level with the foyer. There is no entrance ramp either. Students with visual impairments would find the 200mm door threshold a barrier.

Fig.69-Raised floor level of main entrance

The main reinforced staircase has no tactile warnings for safe and independent usage by such students. There are no tactile clues on the nosings, landings or on the walls although there are balustrades for extra support. The nosings of the stair treads are not highlighted either. It had the same rough terrazzo finish as the landings and the risers. In the washrooms of the library, the placement of wash basins in the line of direct movement from the doors is a barrier. Another obstacle is the raised standing concrete platform (200mm) for the urinal.

Fig.70-Raised floor level of urinal

Fig.71-Washbasins in line of movement

The layout of the book shelves and the small aisles between them and the external wall will present obstacles. Sight impaired students would find it difficult to orient themselves between the shelves and the narrow aisles (less than 500mm). Aisles between bookshelves are not big enough (less than 1500mm). There are also no tactile clues on the ground to know the location of the shelves from the reading areas.

Fig.72-Aisles between wall and bookshelves

Fig.73-Aisles between bookshelves

4.3 Aspects of case studies which impacted proposed design outcome

Some of the aspects of the considered case studies which finally impacted the proposed school design included;

- Poor street designs were noted at both cases and this posed challenges to students. For the proposed school, streets are to be placed outside academic and residential areas. Streets are to have well defined pedestrian walkways fitted with tactile clues.
- In the cases of Akropong School for the blind and KNUST, corridors were wide enough (1500mm-2000mm) to facilitate easy movement of students. In the proposed school, corridors of halls of residence, classrooms, dining halls etc were to have such dimensions to promote easy movement.
- In the case of the Akropong School for the blind, toilets facilities in some buildings were absent. This was an inconvenience. This was however not the case at KNUST, where toilets facilities were present in all buildings (i.e. classroom blocks, libraries, halls of residence etc). The situation at KNUST was preferably, so the new school was to have toilet facilities at different buildings such as library, halls of residence, classrooms etc.
- The compact physical planning of the Akropong School for the blind was adopted for the physical planning of the proposed school since it reduces walking distances. Facilities at the KNUST were too far away from each other.
- There was a general lack of tactile clues both on the ground (i.e. staircases etc) and walls (i.e. classrooms, corridors etc) at the Akropong School for the blind and KNUST. For the proposed design, walls and ground surfaces are to have tactile clues at staircases, corridors among others to aid orientation.

4.4 Model Design

The second part of chapter presents the model school for the visually impaired developed based on criteria developed after the literature review and the case studies undertaken.

4.4.1 Site and Site Location

The researcher proposes that the model school be located at Brofuyedu, a rapidly developing town in the Atwima-kwahoma District Assembly of Ghana. The researcher proposed this location because there is no special school serving the middle part of the country (Ashanti, Brong-Ahafo and Volta regions). It is located on the highway from Kumasi to Bekwai.

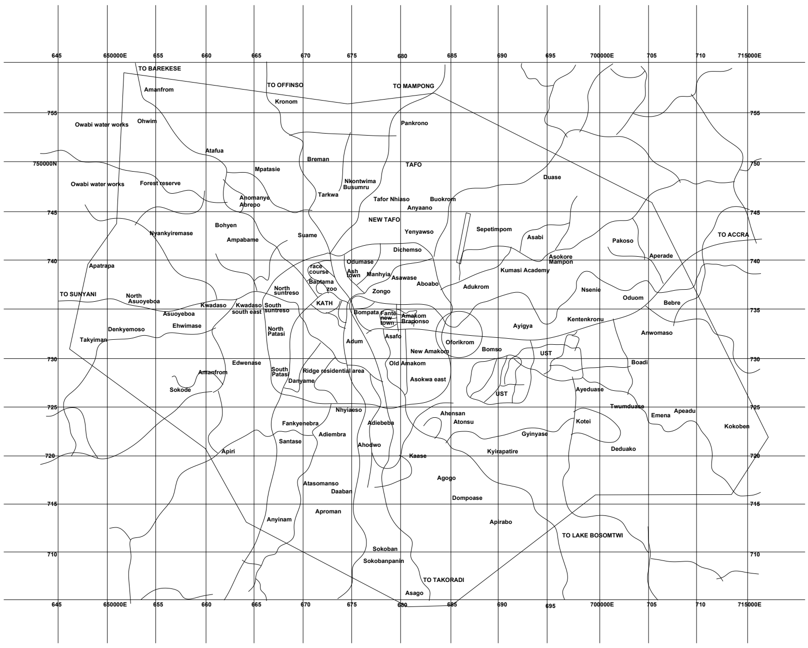


Fig.74-Ashanti regional map

Fig.75-Map of site showing site boundaries

Fig.76-Growing residential area around proposed site

Fig.77-Greenery on the proposed site

4.4.2 Site Inventory

A site inventory was done to familiarise with existing site conditions and respond accordingly.

4.4.3 Site Size

The proposed site measures approximately 300m x 200sqm = 60000sqm.

4.4.4 Climate, Vegetation, Geology and Topography

The macro climate of the proposed site is tropical in nature (hot and humid). The green nature of vegetation (shrubs, grasses, trees) suggests a rainy terrain. The site slopes generally from the north to the south. However, from east to west, the land is slightly undulating.

Fig.78-Site is gently undulating

4.4.5 Infrastructural services

The proposed site will have easy access to services including water, electricity and telecommunications. These services are available in the surrounding residences.

4.4.6 Traffic and noise

The roads bordering the site have a low level of traffic. This situation means that there will not be any immediate disturbance to learning.

4.4.7 Site analysis (Swot)

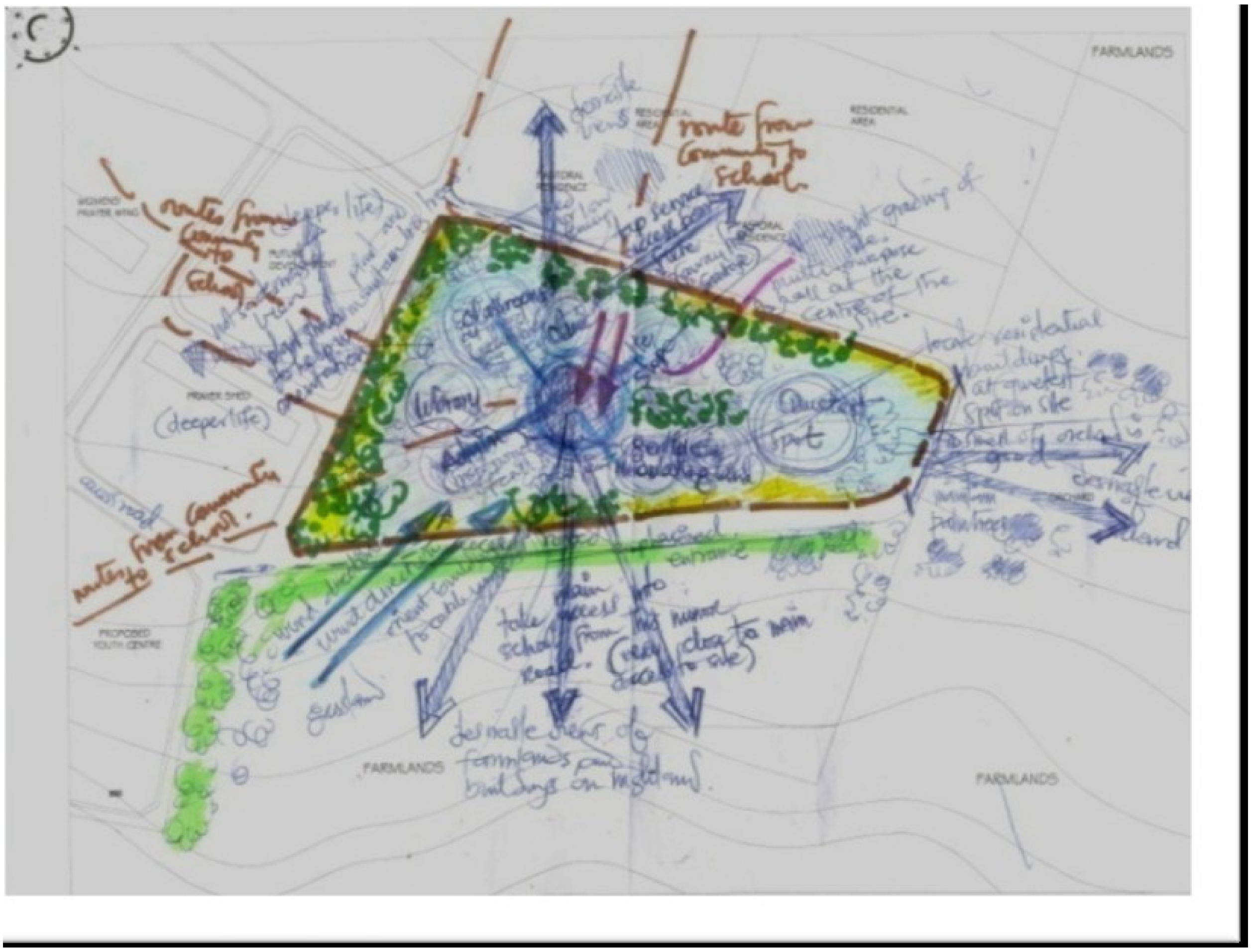


Fig.79-Graphical representation of site analysis (swot)

Fig.80-A rough sketch of site section showing topography of land (south to north)

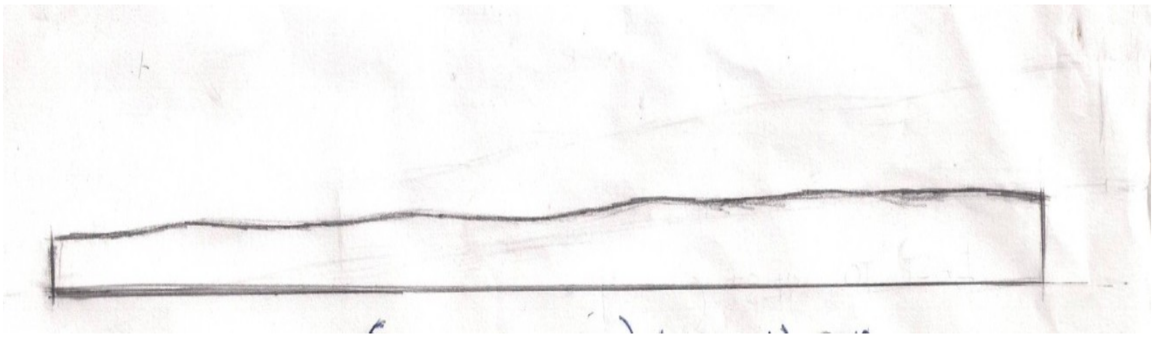


Fig.81-A rough sketch of site section through site showing topography (east to west)

4.4.7.1 Site strengths

- The site is easily accessible by the main Kumasi- Bekwai highway, which is in quite a good condition.
- The proposed land is undeveloped.
- Presence of electricity supply.

4.4.7.2 Site weakness

- The access roads to proposed site are all not tarred.

4.4.7.3 Site opportunities

- The size of the site allows for spaces such as administration, library, workshops, classrooms, boarding facilities.
- Opportunity exists for the proposed school to become a centre of community use.

4.4.7.4 Site threats

- Increased residential development can cause encroachments.

4.5 Brief development

The researcher came up with the various facilities (spaces) needed for a vocational technical school for the visually impaired after the literature review and the case studies that were undertaken. The developed design brief (spaces/facilities) are tabulated below;

4.5.1 Administration

- Entrance hall
- Reception
- Career counselling office
- General office
- Sanitary (visitors/staff)
- Access ramp
- Conference room
- Principals' office
- Assistants' office

4.5.2 Library

- Entrance hall/ control desk
- Photocopy room
- Access ramp
- Librarians' office
- Sanitary (visitors)
- Staffs work area
- Braille library
- Computer technology room

4.5.3 Teaching area

- Science laboratories
- Bookshop
- Sanitary
- First aid room
- Access ramp
- Raw material storage areas

4.5.4 Dining hall

- Main kitchen
- Dry goods store
- Pantry
- Dishwashing area
- Outdoor cooking area
- Sleeping room
- Sanitary
- Matrons' office
- Main dining hall

4.5.5 School and Community hall

- Main community hall
- Gallery
- Sound lobby
- Offices
- Changing areas
- Instruments store
- Sanitary

4.5.6 Students' residence

- Sleeping rooms
- Study rooms
- Access ramps
- Bath houses
- Storerooms
- Ancillary spaces

4.5.7 Clinic

- Physiotherapists' office
- Pharmacy
- Nurses station
- Waiting rooms
- Consulting rooms
- Wards
- Storerooms and changing rooms

4.6 Model Architectural design

At this stage, the researcher present the model architectural design for the vocational technical school for the visually impaired developed from chapter two and the case studies. A deliberate effort was made to provide effective physical accessibility for the targeted students. Physical accessibility features such as access ramps, well-designed staircases, physically accessible walkways, big corridors, and use of planting for orientation have been integrated into school. The designer also developed a design philosophy of making the school a centre of community use by making some facilities multi-functional (school/community). The facilities at the heart of the design philosophy were the library and the school/ community hall.

4.6.1 Conceptual site planning

Conceptual site planning has to do with initial design issues a designer consider to effectively place facilities on a particular site. The designer undertook the conceptual site planning to effective was to place facilities such as library, school (community hall), students' residence, dining hall, and teaching area on proposed site taken into consideration certain critical issues like good ventilation, adequate day lighting, vehicular accessibility and more importantly physical accessibility.

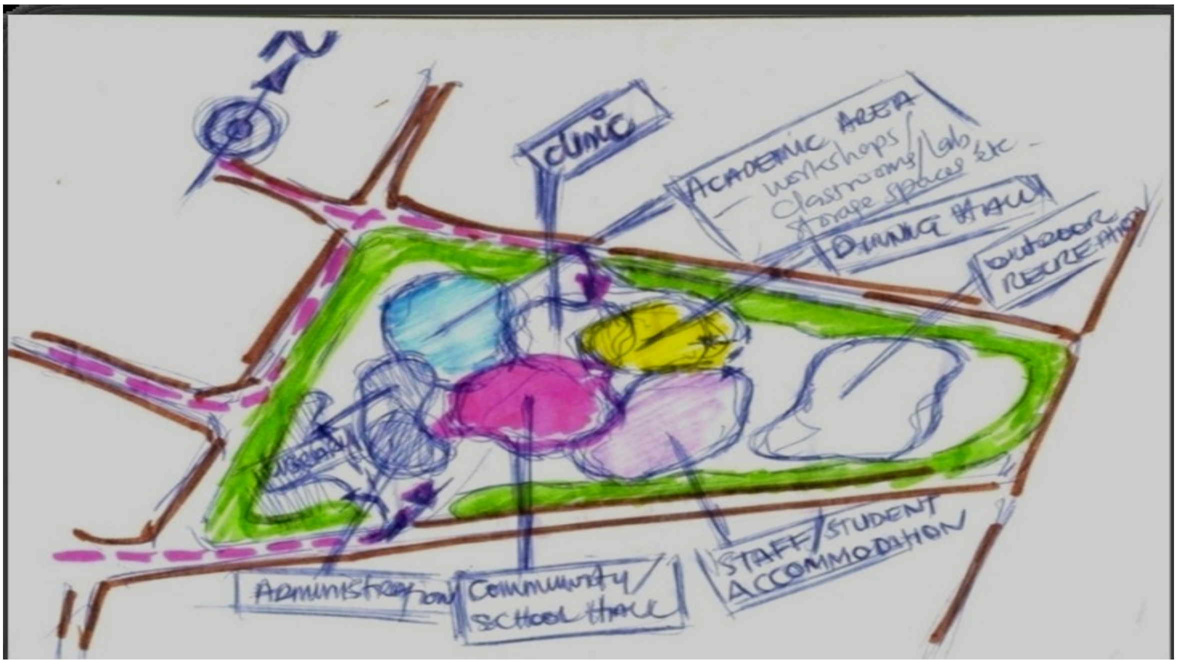


Fig.82-Conceptual site planning 1 (option 1, selected)

Some of the merits of conceptual site Planning 1 is that it reinforces philosophy, main access is at a good location, service access is at a good location and it reinforces the concept of proximity. Its demerits were minimal.

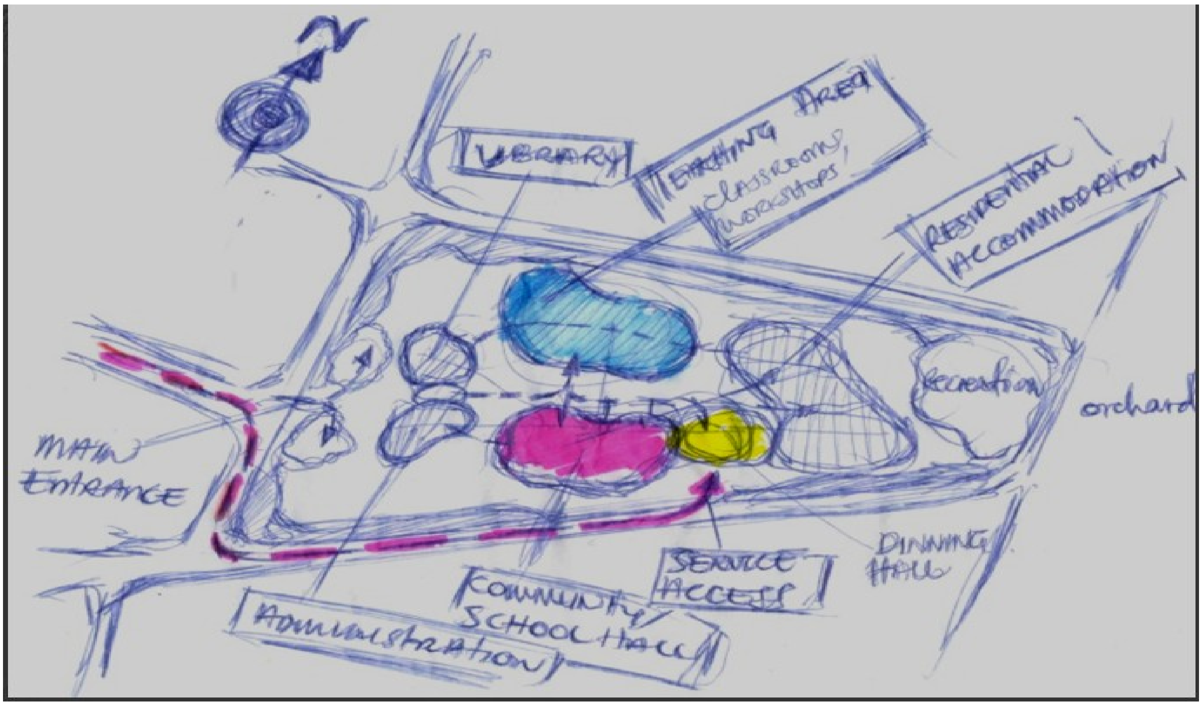


Fig. 83- Conceptual site planning II

With option 2, the demerits were found to be more than the merits. Some of the demerits included; main access road is too busy for a main entrance and the layout doesn't reinforce the philosophy where the community and school hall has to be in the centre.

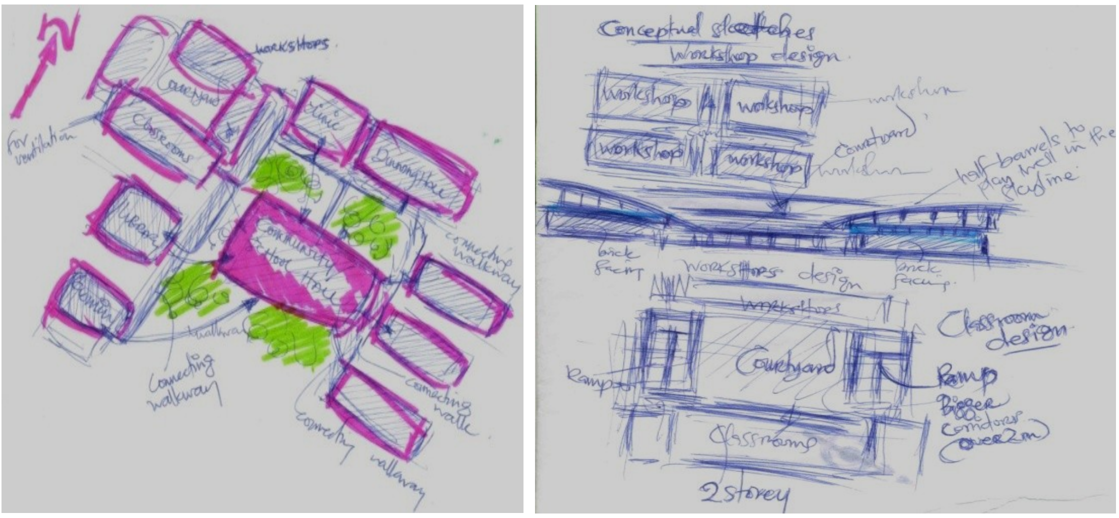


Fig.84-Early conceptual sketches

The researcher laid out the various facilities logically and simple in terms of its physical planning. This was done to ensure that the visually impaired person could easily navigate his or herself independently. Parking areas have been clearly defined and designed such that students are aware of the areas of vehicular access. The teaching area is close to facilities such as the dining hall, library whiles the community and school hall is placed centrally.

4.6.2 Administration

The administration was designed to be the first point of call to the school, from the main vehicular and pedestrian access to the school from the southern part of the site. The facility can be accessed from the main entrance through the entrance porch and the central walkway. The administration is a two-storey structure containing a conference room, career-counseling room, principals' office among others. Spaces were designed to ensure right-angled movement. An access ramp was placed together with a well designed staircase. Corridors

(2000mm) are large enough to facilitate easy movement.

4.6.3 Library

The library is the next building after the administration block along the central walkway. A gentle ramp takes you from the entrance porch to the entrance hall. It is also a two-storey structure containing an audio library, reading rooms, computer rooms, librarians' office, and access ramps. The design encourages the use of both school and community. The building has been designed to ensure maximum ventilation. There is a small courtyard in the centre to promote air movement. An access ramp is present for accessibility.

4.6.4 Teaching precinct

The teaching block is the third block after the library block along the central walkway. It is a two-storey block containing classrooms, workshop spaces, access ramps, sanitary spaces, storage spaces. First aid rooms, etc. The designer organized the spaces around a central courtyard to ensure spaces for mingling, good ventilation, etc. Worthy of mention is the design of the classrooms, which was done to ensure good acoustics. The octagonal shape is meant to ensure good reverberation of sound for effective teaching and learning. The workshop spaces are located about 25metres away to reduce disturbance. Well designed staircases and ramps to facilitate easy movement have been conveniently located.

4.6.5 Clinic

The designer added a clinic to the facility to provide for the health needs of the visually impaired students. It contains wards, physical fitness room, pharmacy etc. which are physically accessible. There is a ramp, well designed staircase, big corridors among others. It was designed such that its longest side faces the north-south (good orientation).

4.6.6 Dining hall

Next to the clinic is the dining hall, which can also serve as an assembly hall. It was designed to serve about 250 students; it has its own kitchen. There are food server points conveniently located. Wash hand basins have also been conveniently located. The building has been laid out to provide maximum ventilation and lighting. Furniture is laid out so as not to obstruct movement.

4.6.7 Student residential accommodation

The student residential accommodation is located to the west of the school and community hall. It is a three-storey structure. It contains spaces such as access ramps, sleeping rooms, a courtyard, study rooms and washing rooms. Furniture is laid out in the sleeping rooms to facilitate movement. There are high concrete and metallic balusters to prevent students from falling off.

4.6.8 The school and Community hall

This is the centerpiece of the school facility. The designer strategically located this space in the centre of the school to reinforce the design philosophy. The space contains offices, control rooms, changing rooms, access ramps, large aisles among others. It is intended that this space, which bring the community into the school for activities such as musical shows, fashion shows, film shows, exhibitions as well as other activities. It is the hope of the designer that with the school/community hall the community will feel a part of the school.

4.7 Materials

The various structural well as non-structural materials that the researcher employed in the architectural design of the school have been tabulated below;

Building Element	Structural Materials	Finishes
1.Sub-structure (foundation wall, Oversite, filling)	bricks for foundation wall, concrete as oversite, soil filling	
2.Super-structure (floor slab, walls roofing, windows, beams, door, columns, balustrades, staircases, ceiling)	reinforced concrete for all floor slabs reinforecd concrete for all columns and staircases long span aluminium roof, timber framed Louvre windows, timber doors,	semi smooth terrazzo for main spaces (dining hall,staircases, classrooms, sleeping rooms, community / school hall, unpolished ceramic tiles for offices, reading area in library, unpolished ceramic tiles for, stair treads, non-slip terrazzo for sanitary areas, design pavers for main connecting walkways, polished tiles for r.c roofs, industrial long span aluminium roofing sheets, brick for walls, embossed painted timber framed Louvre windows acoustic panels as ceiling finish

Table 1: Material schedule

4.8. Landscaping

As mentioned in chapter two, landscape design can assist mobility of visually impaired persons in the built environment. The designer employed both soft and hard landscaping. Walkways are finished with different textures whiles different shrubs and flowers are used to provide smells to guide students as to where they are or going. Examples of material for hard landscaping is the concrete paver which was used for the main walkways. The plants were planted around the students residential accommodation, library, teaching precinct and other facilities.

4.9 Fire safety provision

The designer gave a thoughtful mind to the provision of fire safety in the design of the model school. The need to minimize fire risks cannot be over-emphasized in the design of a model school for the visually impaired. Some of the fire safety design measures integrated into the design of the school included; provision of fire hydrants at corridors, audible fire alarm systems. There are also enough open spaces around classroom areas, students residential accommodation, clinic, dining hall and the school / community hall. Also fire escape routes have been adequately provided in the facilities in the proposed school. Fire doors are to be fitted to doors of classrooms and workshops. Finally, corridors are wider (1500mm-2000mm) to aid free movement

CHAPTER FIVE

5.0 RECOMMENDATIONS AND CONCLUSIONS

5.1 Conclusions

It is the authors' sincerest belief that all the intended objectives have been satisfied. Some carefully thought out conclusions have been enumerated below;

- The researcher hopes this thesis material will go a long way to serve as a guide in the modification of existing school environments (educational buildings) for the use of visually impaired students to make them more physically accessible.
- Also, it is hoped proposed school designs for the visually impaired student importantly will be inspired by this literature so that such environments also promote maximum physical accessibility. When this becomes the case, it will go a long way to address the concerns of the Disability Bill (2007), which asks schools and other buildings to be made physically accessible to all manner of persons, notwithstanding their physical states.
- It is also the hope of the author that the thesis has to a greater degree highlighted architectural barriers present in some existing schools in Ghana. The author hopes that issues of physically accessibility problems of visually impaired students have been brought to all stakeholders.
- The model architectural design of the school should also show that physical accessibility features can be easily incorporated into school designs when a conscious effort is made in this direction.

5.2 Recommendations

Some carefully thought recommendations have also been enumerated below;

- It is recommended that municipal as well as district assemblies in Ghana should enforce a strict adherence to the provisions of the Disability bill (2007) which calls for, among other things, mainstream and special schools (buildings) to be made physically accessible to everyone. Therefore, ramps, staircases, floor finishes, wall finishes, furniture layouts, street design, playgrounds, should be designed with the peculiar needs of especially visually impaired persons (students) in mind. As such architectural drawings forwarded by prospective building developers should be well vetted against a vigorous physical accessibility criterion.
- It is recommended that existing special schools and other buildings be evaluated in terms of their capability to provide physical accessibility for physically challenged persons (the visually impaired) and appropriate remedies put in place. Architects, educationists as well as other stakeholders can assist in this regard.

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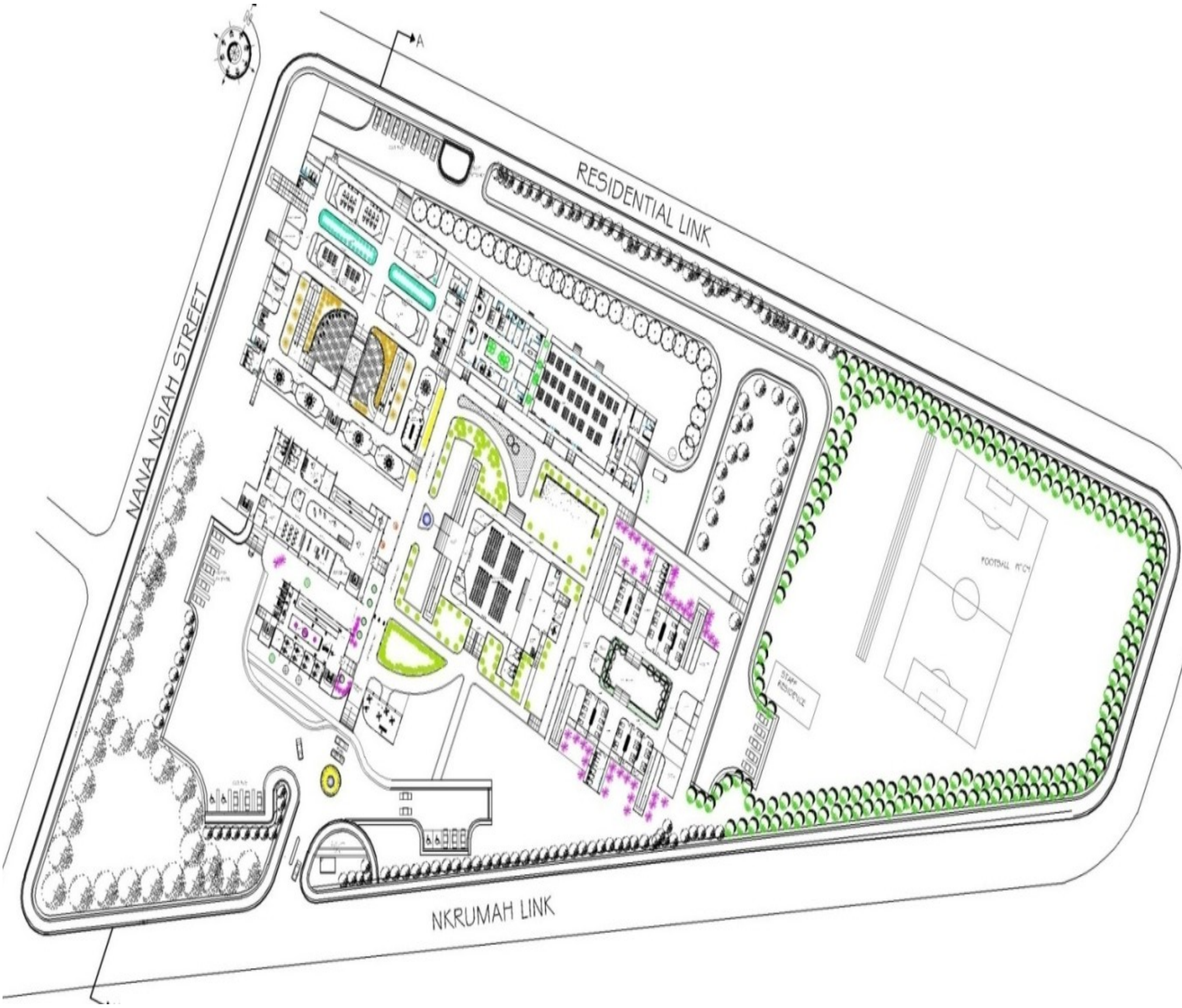
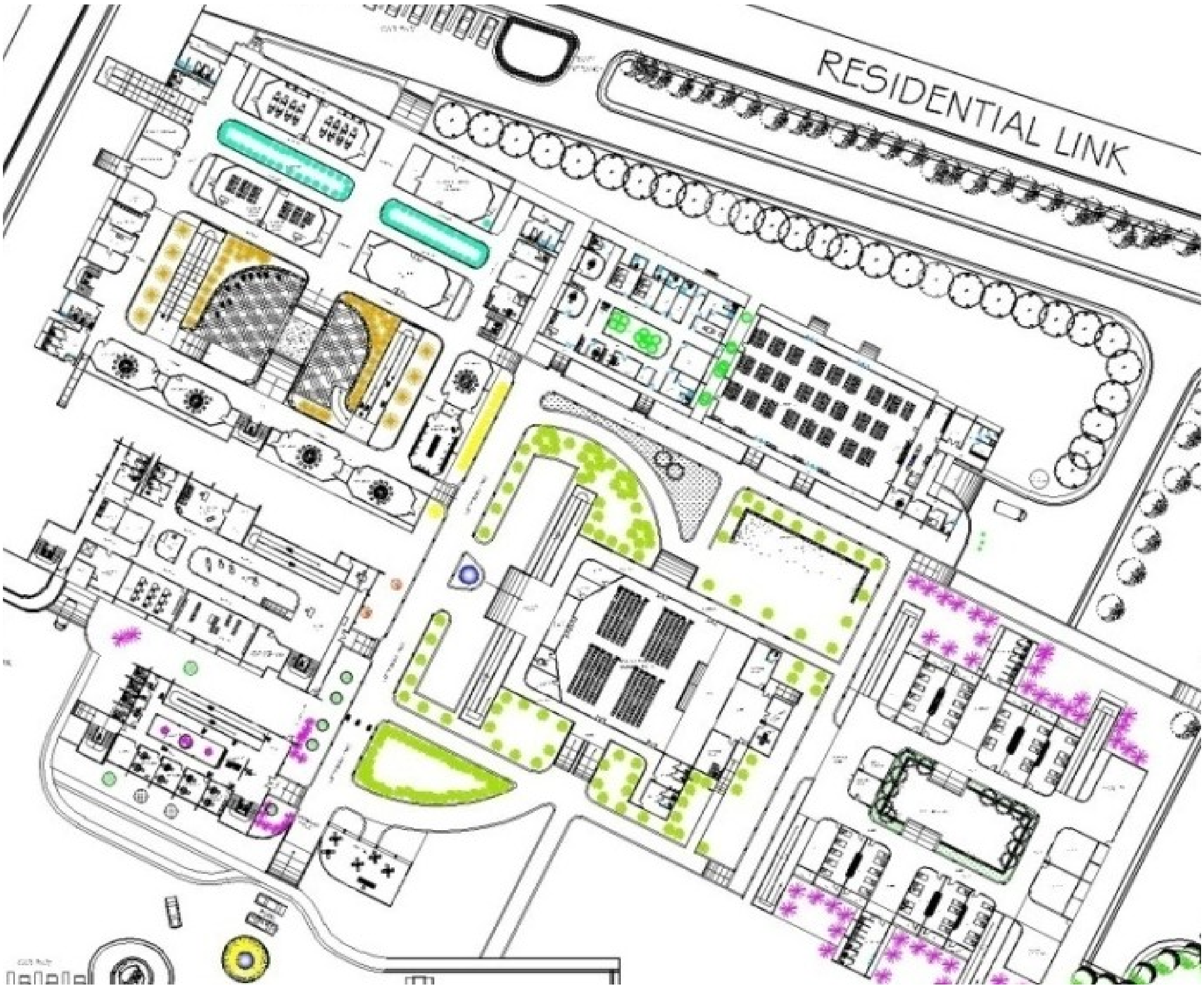
APPENDIX

APPENDIX A - SITE LAYOUT OF MODEL SCHOOL



(Note: drawing not to scale)

APPENDIX B – GROUND FLOOR PLAN OF MODEL SCHOOL



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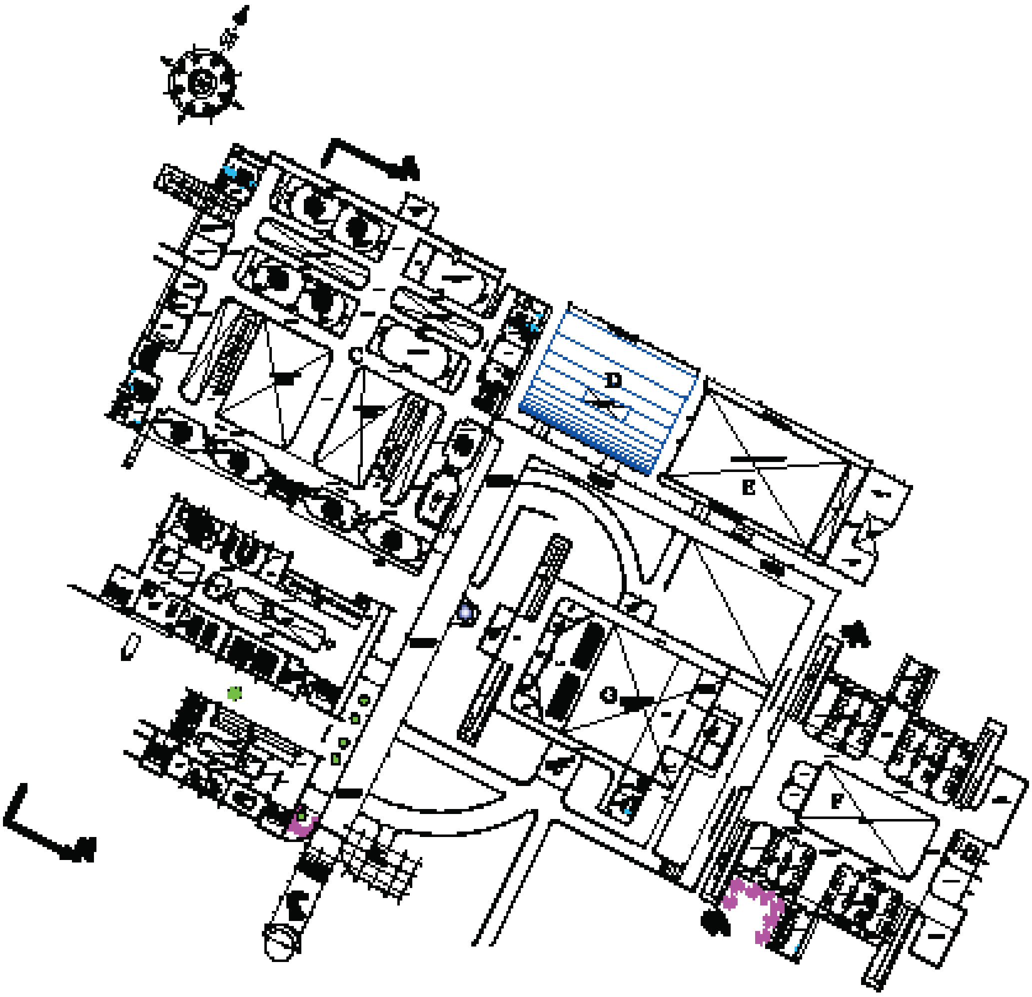
APPENDIX C – FIRST FLOOR PLAN OF MODEL SCHOOL



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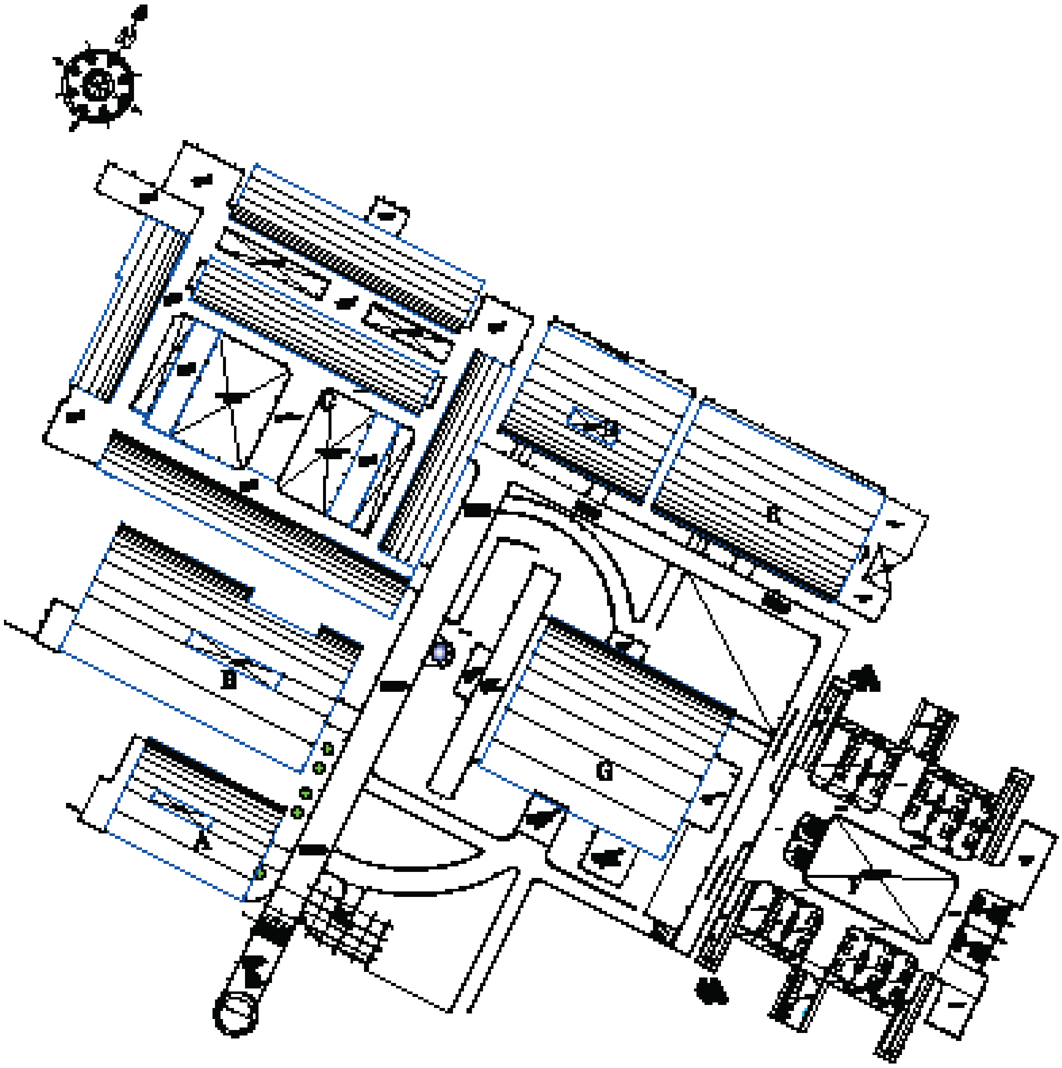
APPENDIX D – SECOND FLOOR PLAN OF MODEL SCHOOL



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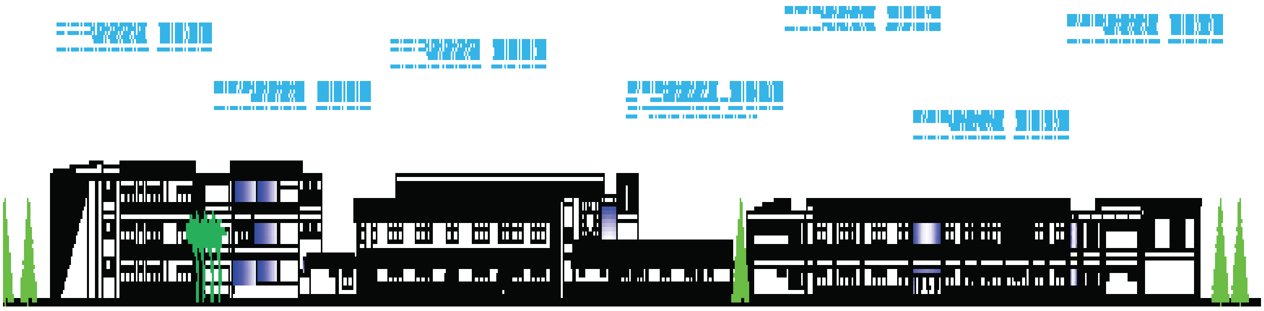
APPENDIX E – ELEVATIONS OF THE MODEL SCHOOL



(Note: drawing not to scale)

APPENDIX F - 3D VISUAL IMPRESSIONS OF THE PROPOSED SCHOOL

VIEW OF CENTRAL WALKWAY

VIEW SHOWING COMMUNITY SCHOOL HALL AT CENTRE OF SCHOOL

(Note: drawing not to scale)

APPENDIX G – QUESTIONNAIRE FOR SAMPLE UNITS I.E STUDENTS

(Note: this questionnaire was administered to only students of the Akropong School for the Blind, Akropong)

1. What are some of the general architectural barriers that your visually impaired state put on your ability to move about in the school or do other things for yourself?
2. What are some of the architectural barriers that you encounter when using classrooms in the school?
3. What are some of the architectural barriers that you encounter in using walkways and footpaths in the school?
4. What are some of the architectural barriers you encounter in using steps and staircases in the school?
5. What are some of the architectural barriers you encounter in using corridors and other circulation areas in the school?
6. What are some of the architectural barriers you encounter when using the main road and street?
7. What are some of the architectural barriers you encounter when in the dining hall?
8. What are some of the architectural barriers that you encounter in the use of the playground and the football pitch?
9. What are some of the architectural barriers that you encounter when using windows and other controls and furnishings?

APPENDIX H – PRESENTATION OF ANALYSIS OF QUESTIONNAIRE AND RESPONSES

Analyzed questions	Analyzed sample unit responses to questions			
	Male (20)		Female (30)	
	Yes (100%)	No (0%)	Yes (100%)	No (0%)
1. Architectural barriers at staircases (lack of tactile clues, same color for treads and others)	♦		♦	
2. Architectural barriers with the street design (fear of accidents, uncovered drains on the shoulders of the streets)	♦		♦	
3. Architectural barriers at the dining hall (columns, lack of tactile clues on floor and wall surfaces among others)	♦		♦	
4. Architectural barriers at the playground (debris tripping students, lack of tactile clues on the ground to warn users of metallic play equipment among others)	♦		♦	
5. Architectural barriers at the classrooms (padlocks on doors, lack of room embossments on doors, door thresholds, lack of tactile clues on walls and floors etc)	♦		♦	
6. Architectural barriers at corridors and circulation areas (Lack of tactile clues on the ground, fixtures in corridors, lack of curbs, poorly defined walkways etc)	♦		♦	

Table 2: Presentation of analysis of questionnaire and responses

APPENDIX I - LIST OF CRITERIA FOR PHYSICAL ACCESSIBILITY FOR THE PROPOSED SCHOOL

Street

- Guard rails at side of street
- Tactile clues at shoulders of street
- Covered drains along shoulders of street

Walkways

- Fit visual signs and tactile clues (eg. Braille blocks)
- Finishes of different colors and textures
- Plants to emphasize pavement edges

Wall and ceiling design

- Light colored ceiling for walls and ceilings
- Textures on walls to facilitate movement
- Non-injurious finish on walls

Floor finishes

- Matt finish for floor surfaces
- Highly reflective floor surfaces
- Good placement of changing floor textures at strategic points to help mobility

Doors

- Simple operational doors
- Door with signs and door handles (i.e. simple lever)
- Extra pull handle for doors
- Kick plate for doors

- Door handles at good height
- No thresholds at doorways

Planting for landscaping

- Different types of plants and shrubs at different locations to help in orientation for the visually impaired

Windows

- Simple operation windows
- Free area in front of windows to aid easy use
- Windows should be located at a good height for easy reach and use

Corridors and circulation areas

- Recess of appliances and fittings on corridors
- Large corridors

Controls, facilities and furnishings

- Easy to reach and use (i.e. levers, switches, knobs, taps and others)

Ramps

- Tactile markings at vantage points to aid ramp use
- Non-slip floor finish
- Gentle slope

Parking spaces

- Locate on shortest accessible route of travel from adjacent parking to an accessible entrance
- Textual clues at intersections between parking spaces and building entrances