# TECHNICAL -VOCATIONAL INSTITUTE FOR THE PHYSICALLY DISABLED: AN EXAMINATION OF CONFLICTING DESIGN REQUIREMENTS FOR PEOPLE WITH MOBILITY IMPAIRMENTS

**By**

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## DECLARATION

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

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## DEDICATION

To all potential designers and architects, I hope this research work will help to guide them come up with problem-solving designs.

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**ABSTRACT**

With the increasing world population paralleled by an increasing number of disabled people, more focus has been on the accessibility needs of people with disabilities in the society to ensure that their specific requirements are not ignored. Widely supported concepts such as universal design brought about by the fight for social inclusion of the disabled has had its own merits and problems. Experience gained by some designers in efforts to design for a wider-user group has revealed some design challenges. This research therefore takes a look at some accessibility conflicts resulting from the use of accessibility features and products by two or more groups within the disability circle which has the likelihood of affecting the mobility impaired person. A preamble to this research takes a look at some of the problem-solving approaches to issues on disability. The literature review takes a look at some of the possible accessibility conflicts discovered by some designers over the years and makes a comparative study from the historical point of view. Data sources to verify the existence of some of these conflicts were gained through case studies of some selected institutions and interviews. Discussions on some manageable solutions to architectural inconveniences which are unconsciously created in attempts to design for wider user-groups of disabled people reveals the significance of a biological, psychological and social approach to designing for the disabled. Lesson drawn from the studies helped in developing the concept and philosophy towards the design of a technical-vocational institute for the mobility impaired. The design which is described in details is intended to serve as a positive architectural model that reinforces the need of accessible environments which can serve the need of a wider group of persons in any mobility impairment domain.

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# CHAPTER ONE

## 1.0 INTRODUCTION

Physical disability is very unpredictable because a once vibrant able-bodied person can become physically disabled overnight due to an accident or as a result of the side effect of treatment of an illness. For reasons such as these, the UN Convention on the Rights and Persons With Disabilities (PWD) adopted on the 13th of December, 2006 estimates that the day to day life of around 25% of the world's population is affected by disability (UN, 2007). A preamble to the World Health Organization report on disability estimated that 600 million to 650 million persons making 10% of the total world populations of whom approximately 80% live in developing countries, are persons living with various forms of disabilities or impairments which reduce their ability to effectively or safely use many building facilities (WHO, 1997). In Ghana, a Community Based Rehabilitation Programme (CBRP), through the Department of Social Welfare estimated that over 2 million people making about 6% of Ghanaian population are living with some form of disability (Daily Graphic, February 28th, 2004).

Unfortunately, the built environment has been designed for the young, able-bodied, adult male which fits only a small percentage of the entire population of the world where in actual fact there is no guarantee for one becoming able for a lifetime. (Dobkin et al., 1999) This therefore has resulted to the creation barriers for the rest who do not fit the description of an able-bodied person. For reasons such as these, the 2006 World Health Organisation (WHO) Convention on the Rights of Persons with Disabilities does not explicitly define disability but rather describes disability as an evolving concept which results from the interaction between persons with impairments and attitudinal and environmental barriers that hinders full and effective participation in society on an equal basis with others (UN, 2007).

### 1.1.0 Definition for Disability

Definitions of disability vary widely. In some nations, only individuals with significant disabilities are identified; in others, even those with mild disabilities are included in surveys and census reports (Groce, 2007). Though United Nations Convention does not explicitly define disability, the preamble of its Convention states: 'Disability is an evolving concept, and that disability results from the interaction between persons with impairments and attitudinal and environmental barriers that hinders full and effective participation in society on an equal basis with others'. Article 1 of the 2006 UN Convention on the Rights of Persons with Disabilities states: 'Persons with disabilities include those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others (UN, 2007). For instance, persons using wheelchairs might have difficulties gaining employment not because of the wheelchair, but because there are environmental barriers such as inaccessible buses or staircases which impede access' (UN, 2007)

### 1.1.1 Initial Problem Solving Attempts

The initiative to rehabilitate disabled veterans in 1920 after the First World War through technical and vocational training spearheaded the quest to integrate the disabled into the society (Goldsmith, 1997). In the past, building codes and standards mandated a percentage of 'special' housing for handicapped people. While this was an attempt to acquire accessible housing for people with disabilities, it perpetuated the belief that accessible housing had to be ‘different’ (Reinholds, 1991).The American National Standard Institute’s publication of the first design standards on accessibility and specifications for making building facilities accessible in 1961 reinforced initial precedence for the need of awareness for children, the disabled and the elderly (Dobkin et al., 1999). In 1990, however, the American Disability Act (ADA) was passed with guidelines stipulating mandatory conditions for public spaces and changing the way we view the built environment. This was followed by other standards such as the Uniform Federal Accessibility Standard (UFAS) which is consistent with the standards published by the American National Standards Institute (ANSI) for general use.

These initial reforms set the pace for  new equality laws for disabled persons at the national as well as at the supranational and international level such that today, we have binding and non-binding international human rights instruments adopted by the General Assembly of the United Nations that explicitly protect the rights of disabled persons (Degener et al., 2001). Thus, with the paradigm shift from the medical to the social model of disability, disability was reclassified as a human rights issue under international law.

### 1.1.2 The Paradigm

Currently, due to cultural and behavioural trends, global economic change as well as educational and government policy reforms such as democratization and civil society development, initial misconceptions or prejudices about physical disabilities is gradually dying down whereas equal opportunity model has grown in status and authority at the international level. The U.N. Standard Rules of 1993 undoubtedly provided the key moral imperative for change on a worldwide basis, but there equally can be no doubt that the enactment of the American Disabilities Act (ADA) showed that change was both possible and practicable. Issues related to disability and accessibility have shifted from the micro level where focus is placed on individual needs and remedies to the macro level which cover a wider range of users. Hence, the emphasis on environments that support and adapt to a wider variety of people's. In this direction, a number of initiatives have been launched to promote macro-accessibility of people with disabilities in housing and other architectural products. Titles such as "Universal or Trans-generational Design" (ca.1950), "Accessible Design" (ca.1960), "Adjustable design" (ca.1980) and "Inclusive Design" (ca.1980), "Adaptable designs" among others have been suggested and tried (Newel et al., 2004)

### 1.1.3 Unanticipated Accessibility Conflicts

While all these aforementioned concepts have in no small way contributed in raising awareness on micro and macro-accessibility creation for the disabled, universal design concept which simply means designing all products, buildings and exterior spaces to be usable by all people to the greatest extent possible (Mace et al., 1991), has been one of the current and the most advocated design concepts which seems to merge the ideals of other concepts on macro-accessibility.

The "Universal Design" concept which has evolved since the 1950s has been very valuable in raising the profile of disabled users of architectural products, and has laid down some important principles. Nonetheless, skepticism has been expressed by some designers and theorist concerning its feasibility. For instance, Newel et al., 2004, remarked that except for a very limited range of products, "Design for all" is a very difficult, if not often impossible task, and the use of term has some inherent dangers. The Centre for Universal Studies in its manual on Universal Features in Housing (2003) admits that some features may work well for some needs but may be a problem for others. For example, smooth stovetops help many with hand or arm limitations cook more easily and safely by allowing for the sliding of pots on and off the heat element but may provide insufficient visual cueing for those with vision problems. Providing access to people with certain types of disability can make the product significantly more difficult to use by people without disabilities, and often impossible to use by people with a different type of disability. To this regard, problems such as

- possible conflict of interest on accessibility for people with different types of disability (Mace et al., 1991; Newel et al., 2004),
- Conflicts between accessibility, and ease of use for less disabled people (temporary able-bodied), for instance, floor texture can assist blind people but may cause problems for wheel chair users (Goldsmith, 1997), and
- Situations where "design for all" is certainly not appropriate, such as blind drivers of motor cars have also been identified (Newel et al., 2004).

## 1.2 PROBLEM STATEMENT

Degerner et al., (2001), in a survey of international comparative and regional disability law reform queried whether there could be opened doors to education, employment and political participation without conflicts**.** A key advantage of universal design is the fact that it addresses the scope of accessibility and suggests making all elements and spaces accessible to and usable by all people to the greatest extent possible (Mace, 1990). Shifting away from former misconceptions where rather isolated people with disabilities will now be given universal and inclusive recognition has exposed some possible conflicts resulting from incompatible demands placed in a single environment by all its potential users. However, information on these accessibility conflicts tends to be scattered and not given much attention because they are silenced or overshadowed by the zealous attempt to implement accessibility laws and concepts. To ensure efficiency and better implementation of these laws and concepts, these conflicts must be fished out and resolved or abated thereby necessitating this research.

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**1.3 RESEARCH QUESTION**

- What are the possible conflicts of interests identifiable in instances where two or more physically disable people are to be catered for at the same time in a particular environment?
- How can integrated design be made more functional for the mobility impaired?
- What are the common accessible features predominantly used by the mobility impaired.
- What are some mobility-impaired persons' perceptions or response and experiences of some accessible features in selected "accessible" buildings or institutions?
- How well do the various accessible features meet the needs of persons in the various categories of mobility impairments?

**1.4 JUSTIFICATION**

- The up-surging road and industrial accidents as well as the emergence of new forms of diseases paralleled by advancement in the field of medicine are increasing the possibilities of a lot more people who would have rather died to become physically disabled. This therefore justifies the need to research and identify better ways to design the built environment to meet the needs of the increasing disabled persons if all the above factors are to continue to increase the population of the physically disabled in the society.
- Most designers also conceive of disabled bodies as wheelchair users, with little perception of the wider range of physical and/or mental impairments which need

to be catered for in producing inclusive design (Imrie, 1996). There is therefore the need to reconsider better ways of removing or reducing any possible bottlenecks resulting from relegation of members of the other disability groups to the background and unobtrusively integrate their macro-accessibility needs into all designs.

## 1.5 OBJECTIVES

Demographics, legislation, public awareness and personal experience are pressing us to examine the basic assumptions we have used in design and sometimes, to replace them with what we learn, when we listen to the people we a designing for (Dobkin et al., 1999). The objectives of this study therefore are;

- to examine the accessibility requirements of various ambulant impaired people and some of their functional limitations.
- appreciate how the local education system as well as how some "players" involved in the empowerment of the disabled person serve the disabled population,
- to investigate some possible conflicting situations resulting from the use of accessible features in the built environment by different ambulant-impaired persons which affect their comfortable use.
- to inform the development of a better and /or alternative means of reducing or eliminating accessibility design conflicts which results from designing to suit a wider range of people with various forms of mobility impairments.
- to inform the design of a proposed technical-vocational school for the physically disabled by exploring ways to minimize major challenges in accessibility creation.

# CHAPTER TWO

## 2.0 LITERATURE REVIEW

### 2.1 Introduction

Architectural and environmental barriers have gained increasing attention in recent years in the wake of efforts made to improve the accessibility of the environment for people living with disabilities of all ages. In this literature review, laid-down measures to include the disabled person in Ghana's education as well as issues that go into the design of schools are discussed. Functional limitations caused by various forms of mobility impairments together with some accessibility conflicts which could arise naturally when incompatible demands are placed on a single environment by two or more groups are examined and discussed. This will encompass studies on possible conflicts encountered while designing accessible features from urban design perspectives to the design of individual building components.

### 2.2 Education and the Person with Disability in Ghana

For the vast majority of young people who have been born with a disability, their initiation into their own cycle of poverty begins early when they are unable to access needed medical and rehabilitation services, and when they are denied admission to school (Groce, 2003). Access to education for many persons with disability in Ghana is practically an urban phenomenon, which is even quite recent (Annor, 2002). Based on the 2000 census which puts the total school going age population (from pre-school to SHS) at 6.7 million, children with disabilities of the same age is calculated at 670,000. With this population, it was indicated that 0.6 percent of children with disabilities receive any form of education (Ghana Education Service, 2004). To address this specialized schools for the Persons with Disability (PWD) are provided in Ghana with at least one in each region (Department for International Development, 2008).

Unfortunately however, according to the National Report on Education presented at the International Conference in Geneva, 2004, the effort of the Government of Ghana to ensure social inclusion is fraught with numerous challenges of which one is the inaccessible nature of school environments to persons with special needs due to the fact that the architectural and construction industry fail to consider the disable person. This implies that a Person with Disability (PWD) cannot easily attend any school like any ordinary child within their locality. It will be of necessity that for a disabled child to be educated, one has to be separated for the family to attend a boarding school often located at the Regional Capital (Annor, 2002). Even to the secondary level of education, such is the situation since only specialized schools are equipped with the basic facilities to cater for Persons with Disabilities.

In Ghana, the disability bill drafted 13 years ago but signed into law in June 2007, have Articles 17, 24, 25, 29 and 38 with clauses advocating various rights for the disabled person in Ghana (The Constitution of the Republic of Ghana, 1992).  The Disability Act empowers the Ministry of Education to progressively establish rehabilitation centres in regions and districts to offer guidance, counseling and appropriate training for disabled persons who are unable to enter into mainstream of social life (Peoples Disability Act 715, paragraph 14). Article 29, Clause 8 of the Constitution of Ghana also makes the provision special access ways for the disabled mandatory for all public places since our architectural and urban barriers prevent persons with disabilities to participate in social activities.

In spite of the provision of these laws, its delineation, enforcement and usability of constructed accessibility features poses other challenges. Long ramps are found to be unattractive and tedious to use. This therefore calls for research into other means to ease vertical circulation such as the use of dumbwaiters and lifts.

**2.3 Design of Schools and its Challenges**

Education and its exemplification in buildings and environments have always been concerned with radical ideas set in new and stimulating settings. The blossoming of exciting new forms of school architecture has not only transformed the image of education but also affected the perceptions and pedagogical needs of all who inhabited those new structures (Dudek, 2000). This is because education was a system of mass education, constantly reinventing itself to provide more and more educational places of an ever-improving quality.

This implies that it is of fundamental importance that any school designer should anticipate the evolving nature of education within the society and make provisions for it in their architecture. This therefore calls for a type of architecture sensitive to both able-bodied and disabled people in all needs. Basic anthropometrics, colour, texture, acoustics and the principles of defining safe secure territories within the overall structure of the institution are all concepts which should apply to educational settings (Dudek, 2000).

Unfortunately, in many schools of architecture in Africa, no design assignments are planned and integrated into the academic programs to specifically address the accessibility factor (Wellington, 1992). Wellington further reveals that anthropometric studies, which form part of the basic first year architecture design studies, do not take into consideration the fact that there exists in many African communities a sizeable percentage of the population with physical disabilities. School buildings are routinely built with stairs, or far from community centers, making them inaccessible to those with mobility impairments (Groce, 2002). This revelation therefore calls for major research in architectural studies which takes into consideration the anthropometrical needs of the disabled person who are now regarded as indispensable group in accessibility creation in our normal daily lives.

Students with physical disabilities often benefit from the use of technology designed to increase their capability to participate in classroom activities. The Medical Model holds that disability results from an individual person's physical or mental limitations, and is largely unconnected to the social or geographical environments. (Connections for Community Leadership, 2005.). Fallon, (2007), asserts that the medical model of disability is one that is primarily concerned with the justification of disability because a disabled person is seen as faulty and in need of fixing or curing. Brisenden, (1986), also cautions us not to confuse 'disability' with 'disease', thus, emphasizing the removal of barriers which rather cause disabilities.

Although some people cite the medical model as unintended social degradation of disabled people, it must be noted that medical treatment of the disabled person to some extent is an indispensable factor of rehabilitation and should not be abandoned. The mobility impaired must be taught how to use available assistive devices to enable them use their environment effectively. Thus, it's important for architects to make provision for such treatment spaces in their design of schools for the disabled.

Unlike the medical model, the social model of disability sees the issue of "disability" mainly as an unequal relationship within a society in which the needs of people with impairments are often given little or no consideration (Carson, 2009).
Here, disability is seen as a socially created problem because there are environmental barriers such as inaccessible buses or staircases which impede access to employment facilities. This calls for curriculum made up of academic, cultural and practical subjects where elements related to basic skills, daily living skills and preparation for school leaving and future employment should be stressed (Goodship, 1990). For this reason, spatial requirements for such activities have to be provided for by the school designer.

In Ghana, in spite of challenges such as inaccessible school environments and inadequate structures and funds for pre-school and post-training programmes, a head-start to inclusive education have been made by inculcating the physically or motor – impaired in the mainstream and not in special schools (Ghana Education Service, 2004). Unfortunately, most mainstream schools do not have the necessary facilities to make them accessible for the physically challenged. Current research in Australia indicates that the mainstreaming of secondary school with disabilities into the regular classes (now called inclusion) has a significant effect on these students and helps them to develop better self-esteem, social understanding and interpersonal relationships (Waugh et al., 2007 from Noland, McLaughlin, Howard & Sweeny, 1993).

the way forward is a combination of both models, drawing on the best points of each, and also creating new ways of thinking to help overcome the barriers that disabled people still face.

## 2.4 Definition and Forms of mobility impairments

Mobility impairments are physical constraints that substantially limit movement and fine motor controls, such as lifting, walking, and transportation (Bullet, 2002). Mobility impairments can be permanent or temporary. A broken bone or surgical procedure can temporarily impact a student's ability to walk independently and travel between classroom buildings in a timely manner. Likewise, some students may be ambulatory with a walker for short distances within a classroom, but may need a wheelchair or scooter for longer distances (Disabilities, Opportunities, Internetworking, and Technology (DO-IT), 2001)

Apart from mobility impairments incurred as a result of domestic, vehicular and industrial injuries and diseases such as poliomyelitis and strokes, physical disabilities resulting from congenital deformities may be the result of;

- Muscular dystrophies- a medical condition in which there is gradual weakening of the skeletal muscles (National Institute for Numerological Disorders and stroke, 2001)
- Spinal bifida - abnormal development of the spinal chord resulting in final or full paralyses of the legs and difficulties with bowel and bladder control.
- Bone and joint deformities
- Cerebral palsy - damage to the parts of the brain which control movement during the early stages of a baby’s development, birth and from brain injuries resulting in weakness and poor muscle movement (Cornucopia of Disability Information, ca. 2005). Different forms of cerebral palsy are hemiplegia which involves muscle movements and weakness on one side of the body, diplegia which involves muscle movements and weakness in the lower part of the body,

quadriplegia which involves muscle movements and weakness in both arms and both legs and ataxia which involves problems with balance and coordination.

- Mobility impairments could also be caused by Arthritis (painful joint condition: a medical condition affecting a joint or joints, causing pain, swelling, and stiffness) and multiple sclerosis (loss of myelin in the brain or spinal cord and causes muscle weakness, poor eyesight, slow speech, and some inability to move (Very Special Arts, 2003)

**2.5 Functional Limitations Caused by Mobility Impairments**

There is a wide variety of disabilities and specific diagnoses of orthopedic or neuromuscular impairments that can impact mobility such that it is impossible to generalize about the functional abilities of students with mobility impairments (Disabilities, Opportunities, Internetworking, and Technology (DO-IT), 2001). Mobility impairments range from lower body impairments, which may require use of canes, walkers, or wheelchairs, to upper body impairments which may include limited or no use of the upper extremities and hands (Carlton et al., 2005). Of the persons using technical aids (crutches, canes, wheelchairs, etc.), wheelchair users often face the greatest barriers (Roy, 1991)

Problems faced by individuals with mobility impairments include poor muscle control, weakness and fatigue, difficulty walking, bending, lifting objects, climbing up on step stool , sensing or grasping due to pain or weakness (Bullet, 2002). People with spinal injuries may have difficulty reaching things, and difficulty doing complex or compound manipulations (push and turn). Twisting motions may be difficult or impossible for people with many types of physical disabilities such as cerebral palsy, spinal cord injury, arthritis, multiple sclerosis and muscular dystrophy (Thorpe, 2002; Peloquin, 1994).

Individuals with spinal cord injuries may be unable to use their limbs and may use "mouthsticks" for most manipulations. Electric buggies or scooters can be significantly larger than the standard wheelchair range so openings and spaces based on conventional wheelchair dimensions may not be adequate (Neufert, 2002).

Some very severely disabled wheelchair users who cannot make unassisted transfers onto beds and toilet facilities require the assistance of an attendant who may lift the person or use several transfer techniques such as a mechanical lift for safety (Mace, 1991). These are supplemented by other assistive devices come in the form of stair lifts, portable ceiling lifts, mobile floor hoists, wall lift hoists and wheelchair platforms lifts (Disabled World, 2004). Some mobility aids used by the mobility impaired persons are canes, crutches, walkers, wheelchairs and scooters and rollators.

**2.6 Towards Universal Design**

The Centre for Universal Design (2003) describes universal design as the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. While accessible or adaptable design requirements are specified by codes or standards for only some buildings and are aimed at benefiting only some people, the universal design concept targets all people of all ages, sizes, and abilities and is applied to all buildings (Mace et al., 1991).

Universal Design may include design attributes such as the incorporation of kitchen counters in different heights for different users with ample leg room to accommodate a seated user , the use of lever handles in place of round door knobs (Mace 1990), accessible cupboards and drawers with devices that enable easy use of appliances and tools, installation of sinks with electronic eyes to detect movement and under counter space to accommodate a seated user, placement of grab bars discreetly but conveniently next to toilet and tub or shower to enable limited mobility users, the use of remote devices to lock and unlock the house and design areas for all activities to occur on one level, just to mention a few (Demesne, 2006).

Creative application of the universal design knowledge results in products, buildings and facilities that are usable by most people regardless of their level of ability or disability (Centre for Universal Design, 2003) . By incorporating the characteristics necessary for people with physical limitations into the design of common products and building spaces, we can make them easier and safer for everyone to use and more widely marketable and profitable. This implies that universal design approach goes beyond the minimum requirements and limitations of accessibility law.

### 2.7 A Review of Potential Conflict Causes

In spite of the numerous merits of the universal design concept, some designers have been able to discover a few weak points in its application. The underlying revelations discusses some conflicts which could results from design of accessibility requirements to suit various types of mobility impairments in a single environment such as a school.

#### 2.7.1 The Design and Use of Ramps

The United Nations Manual on Accessibility recommends that ramps be provided wherever stairs obstruct the free passage of pedestrians, mainly wheelchair users and people with mobility problems (UN, 2007). Mace (1991), though highly in favour of the universal design however recommends the avoidance ramps as much as possible for reasons such as difficulty to incorporate sloping handrails into the design of a house as well as conflict of interest arising when ramps with their handrails become very notable elements. This, according to Mace, tends to label a residence as ‘accessible’ or as ‘a house for people with disabilities, such that able-bodied people might prefer not to live in such a house.

Although his point might have been as a result of past misconceptions about disability, recent worldwide education and outreach programs is increasing awareness on disabilities and accessibility for all, thus, reducing misapprehensions on visual impression created by ramps and their accessories. Furthermore, modern development in the building industry has made the design and installation of ramps and handrails easy and aestheticized. It is also obvious that the construction of very gently sloping ramps may not necessarily necessitate the use of handrails, thereby preventing this conflict of interest.

Mace (1991) further asserts that ramps could be dangerous for many people especially the mobility impaired people who use crutches, walkers and canes. Ramps have also been found to be dangerous for everyone in ice and snow conditions such that where climates warrant, snow melting equipment or long roof over ramps will have to be considered which hence, adds to the overall building cost.

In tropical parts of the world such as Ghana, accidental slips caused by accumulation of dry sand on ramps and wet ramps during rainy seasons could be linked to such a problem. This is aggravated by smooth ramp surface finish on steep ramp gradients. It is in this direction that stairs with proper handrails are recommended alongside with ramps so walking people are not forced to use it (UN, 2007).

Curb ramps are critical to providing access between the sidewalk and the street for people who use wheelchairs (Federal Highway Administration (FHWA), 2007). Curb ramps are most commonly found at intersections, but they may also be used at other locations such as on-street parking, loading zones, bus stops, and midblock crossings. The use of flush curb ramps especially at crossroads and road-crossing zones for the benefit of the wheelchair user has also been found to pose a dangerous threat to those with visual impairment (Goldsmith, 1997). This is because upstanding curbs serve as demarcation for mobility for the visually impaired especially the independent cane user and dog owners. At road-crossing points, these tactile cues help the visually impaired from walking across roads without their knowledge. A problematic situation is therefore created in such an instance with regards to satisfying the wheelchair user and the independent blind without causing accidents.

In Ghana, it will not be much surprising for one to see instances of flush curb ramps at certain crossroad points for the reason that issues concerning accessibility are now being given much attention. For reasons such as this the Federal Highway Administration (2009), in the United States of America recommends clearly identifiable boundary between the bottom of the curb ramp and the street with a detectable warning. Unfortunately, though the disability bill has been passed, much research and publications are yet to be made concerning in dept urban accessibility. This calls for speedy research on macro-accessibility creation by designers and planners in Ghana if quicker solution is to be expected.

One major problem found with ramps is steep grade. Steep ramps grades are difficult for people who use walking aids and manual wheelchairs to negotiate because significantly more energy is needed to begin and travel on sloped surfaces; conversely, gradual grades are problematic for people with vision impairments because the transition between the sidewalk and the street is difficult to detect (Federal Highway Administration, 2007).

In view of this, the United Nations manual on accessibility recommends the maximum lengths and rises for various ramp slope ratios minimum and maximum ramp slopes. as shown in Table 1 in Appendix A and Appendix E respectively. It is recommended that, rather than using 8.3 percent for designing curb ramp grade, a grade of 7.1 percent is recommended to allow a construction tolerance as indicated in Appendix G.

Each type of curb ramp has advantages and disadvantages. Some advantages and disadvantages fundamental to the type of curb ramp as well as result from changes to the configuration of the components within each type or the curb ramp placement on the site. To help designers and engineers sort through the large quantity of potential designs, best practices for the use of various types of curb ramp is described and tabulated in Table 2, Appendix B and key issues related to accessibility are highlighted through the accompanying illustrations in Appendices G

### 2.7.2 Issues with Stair Positioning

Of all the normal features that the architect designs into a building, it is steps and stairs that pose the most common threat to the safety of users (Goldsmith, 1997). The positioning of stairs in the way of getting to frequented places such as public toilet pose a major disadvantage to wheelchair users, ambulant disabled people, pregnant women and people with luggage (Goldsmith, 1997). It has been the norm for some designers to place toilet facilities quite close to stairways to make it more visible easily accessible. To Goldsmith (1997), the creation of stairs in locations to avoid this conflict is very important because although these stairs might not pose inconveniencies for most able-bodied people, it has the likelihood of creating accident prone proximity especially when the lobby is narrow and improperly lit.

Although, Article 29 clause 6 of the 1992 Constitution of Ghana requires every place to which the public have access shall have appropriate facilities for disabled persons, as practicable, it is not uncommon to find design of such nature in several public buildings in Ghana. This makes proper planning, design and construction of facilities such as sanitary area in public spaces such as shops, schools and hospitals very pertinent in ensuring accessibility comfort for the person with disability.

### 2.7.3 Details of Tactile Pavement

Tactile paving is a system of textured ground surface indicators found on public environments to assist blind and visually impaired persons to distinguish locations and directions, identify potential hazards, and then to move and reach expected destinations (Lu et al., 2009). Different incompatible versions with confusing and sometimes contradictive standards of tactile paving can cause inconvenience to visiting blind and visually impaired persons to a city (Lu et al., 2009). Goldsmith (1997), further states that while sight-impaired people may be helped by distinctive colouring but not as a rule by tactile surfaces and  given that tactile surfaces could be uncomfortable for them, blind people, contrarily, may be helped by tactile surface which should be detectable and have to be knobbly, but not as a rule by colour distinctions. one of most serious problem that can be encountered with tactile paving is that incorrect use of a pattern can give misleading and potentially dangerous information to blind and partially sighted people (Loo- Murrey, 2005).  The tactile paving necessary for people with visual impairments can cause discomfort and difficulties for wheelchair users (Fraser, 2010; Goldsmith, 1997).

Bearing in mind that tactile surfaces need to be knobbly and distinguishable  to be readily detectable, the issue here is to ensure their good performance without causing discomfort to its users especially ambulant disabled people.It could be discovered that this type of conflicting situation does not only exist between the sight-impaired and the blind but rather, the able-bodied person in high-heel shoes, the toddler who is learning how to walk and users of crutches might find it uncomfortable walking on tactile pavements with high, detectable knobs (Goldsmith, 1997; Newel et al., 2000). The reasons for the change are the unsafe and slippery nature of the dome-shaped dot tile especially for the disabled persons, the indistinguishable nature of the oval-shaped bar tile by the blind and the difficulty in distinguishing zigzag arrangement dot tile is similar to the parallel arrangement of dot tile by the blind and visually impaired (Lu et al., 2009).

A general concern here could therefore be raised about means of compromising in such an instance without threading on the comfort to either party. This calls for in dept study, usage and assessment of some of these solutions adopted by the developed countries. For instance, Lu et al., (2009) remarked that only the United Kingdom and Japan have specially established tactile paving product standards. Many other countries and cities such as the United States, China and Hong Kong take tactile paving as only one part of documents related to barrier-free regulations and matters. Conducted experiments by the Transport and Roads Research Lab (TRRL) in Berkshire, to assess how textured surface could be used to assist blind pedestrians locate zebra and pelican controlled crossings proved helpful in assessing this hypothesis. The results of the experiments conducted with different tactile surfaces led the shaving off of patterns of round domes on tactile surfaces due to its uncomfortable nature to even pregnant mothers, walking toddlers and ambulant disabled people who use crutches and canes (Goldsmith, 1997). An example of tactile paveing patterns and details adopted by the United Kingdom is shown in Appendix F.

Uneven paving stones are also a great hazard particularly for people who are being pushed in a wheelchair (Instone, 2004). In our local settings, pedestrian pavements are one of the most neglected and poorly constructed sectors in road constructions. Cobbles, loose gravels stones as well as wet and smooth floor finishes are disadvantageous to the mobility impaired person (Mace, 1990). Unfortunately in Ghana, it is quite common to find the use of loose granite stones for pavements and foyers. Though its use might be of an advantage to the visually impaired, it has the potential of causing accidents to the mobility impaired especially when used on sloppy grounds and should be avoided in public grounds as possible.

### 2.7.4 The Real Numbers of Building and Product Users Who Are Disabled

The anticipated number of users of a particular building poses a major challenge to designers and even clients or developers. To Goldsmith (1997), fallacies come with the trick of extension. One is bound to stipulate that if about 10% of the total population is disabled, it may suppose that 10% of users of many public building have to be disabled people. This inference, according to Goldsmith is false as it is not the case that all disabled people use all kinds of public buildings and are uniformly spread around.

This observation, in my opinion is a true and important point for the designer to take note of. Although emerging legislations on accessibility in countries like Ghana makes it mandatory for public places to make necessary facilities accessible to persons with disability, care must be taken not to overproduce where there is no guarantee of their full usage or under produce for reasons of saving cost

This could also be augmented by providing unisex or separate toilet facilities but in any public rest room, so that at least one unisex compartment should be accessible to a wheelchair user who depend on someone else as cited by Godsmith (1997).

It is quite agreeable that women spend almost twice as much time in lavatories and will therefore need much more sanitary facilities than their male counterparts (Goldsmith, 1997). In institutions like the university where the number of males exceed females, a key problem in picking or setting a number is deciding who to leave out. The reason for discussing accessible design in the first place is that the standard design process currently only targets "most" of the people and then stops even if they could just have easily gone a bit further (Trace Centre, 2007).  To the designer, I think this is important to take note of since no product can be made completely accessible. Tough to accept or deal with, but a fact of life. The secret, then, is to go as far as one can in making the design accessible. Designers could also make good estimate of the real number of building users is to draw inferences from the map of a locality who make the highest on the disability chart and provisions made for them on buildings used by , as suggested by Goldsmith (1997).

For small office buildings where the floor area limits the provision of accessible rest rooms on each floor, one accessible rest room located adjacent to an accessible elevator. could be provided to serve the entire building. At least one room per new hotel or motel should be accessible to a wheelchair user. Bathrooms connected to these rooms have to be fully equipped. The layout should allow a lateral transfer to the toilet seat.

### 2.7.5 The Height and Position of some Facilities

In developed nations like the United States, the Research Institute for Consumer Affairs (Research Institute for Consumer Affairs (RICA, 2007) remarked that while clear minimum specifications exist for such things as the dimensions of a door or the height of controls on a lift, there is very little detailed and definitive guidance for product designers in a form which could be converted immediately into engineering specifications.

This problem could be seen to be typical to finding the standard heights of toilet seats, drinking fountains, wash hand basins and many domestic products. Modern technology is speeding up the break away from rigid standardization, thereby producing various shapes and sizes of such facilities. This has been brought about by problems such as low toilet seats being difficult for the walking impaired people who have trouble getting up on their feet especially without assistance, while high seats are better for walking people who have difficulty getting up (Mace,1990).

To Dobkin et al., (1999) flexibility in height should be the ideal but adjustable toilet height remains in the prototype phase, and is not available to most disabled people. The American Disability Act recommends the height for water closet to be 17 to 19 inches (430mm to 485mm) measured to the top of the toilet seat (Dobkin et al., 1999). Although various design standards have come out with various optimum heights for toilet facilities, it still remains a major issue as the full comfort of the various forms of mobility impaired people can never be readily guaranteed. Standardized toilet heights should will have to be augmented by adjustable toilet seats which come in various shapes and sizes as shown in Appendix I (Bizrate, 2010).

It is my view that, since people come in different sizes and heights, the school designer will be faced with the challenge of satisfying the needs of the various types of mobility impairments who may require the use of these adjustable seats. This will ultimately necessitate the creation of storage rooms close to sanitary areas where students can access their seats should the need be.

# CHAPTER THREE

## 3.0 RESEARCH METHODOLOGY

### 3.1 Introduction

The purpose of this study is to aid identify some accessibility conflicts and apply researched conflict control measures in the design of a technical-vocational institute for the physically disabled. The genesis of this research entailed literature study on accessibility conflicts discovered by some designers and accessibility theorists in some developed parts of the world. Existence of some of these accessibility conflicts were validated through primary and secondary data collection in selected institution for the disabled persons in our local setting. A qualitative data collection was done through the use of semi-structured questionnaires in a school for the disabled, extended case studies and desk studies.

### 3.2 Primary Data Collection

#### 3.2.2 Interviews

A sample of people living with disabilities from selected technical and vocational schools in the Ashanti Region as well as the some able-bodied people were interviewed to ascertain their response on environmental design, pedagogical and accessibility problems encountered in their educational premises. Interview questions sought information regarding space allocations for various activities, circulation and accessibility needs and conflicts of interest on the use of accessibility features by the inmates. Additionally, information was also gathered from heads and caretakers of institutions of these selected schools on the response of its users with regards to physical structures, environmental attributes and general accessibility features found within and outside their premises. Recommendations with specific reference to ways to improve accessibility and reduce or remove some conflicts were also gathered. Sample of questionnaire is shown in Appendix Y.

### 3.2.3 Questionnaire Construction

A qualitative face-to face interviewing using semi- structured questionnaires was combined with self-administered questionnaires for respondents to complete themselves. Questions were semi-structured as appropriate to field research.

### 3.2.4 Sampling

A simple random sampling was employed in selecting respondents to questionnaires. A sample size of 39 people within a population of 58 from the Jachie Sheltered Employment Centre was selected to respond to questionnaires. Thus, a sampling ratio of approximately 1.5 was obtained.

## 3.3 Secondary Data Collection

### 3.3.1 Case studies

Extended case studies were conducted on some local and foreign institutions serving the mobility impaired to help ascertain or disprove the existence of accessibility conflicts in our local settings. In this regard, case studies were conducted at the Jachie Sheltered Employment Centre for the Disabled and the Fukushima Prefectural Koriyama School for the physically handicapped.

Jachie Sheltered Employment Centre was selected because it is one of the few technical and vocational training centres in Ghana purposely set up to train mobility impaired persons. It also has some of the basic accessibility features for the mobility impaired. On the other hand, the Fukushima Prefectural Koriyama School for the physically handicapped as a case study from foreign source was selected because of its unique pedagogical, ergonomic and macro-accessibility design criteria adopted to facilitate education of the disabled person.

The case study took the form of site visits, personal observation and documentation of interior and exterior areas accessed by residents in addition to interviewing of inmates. In this direction, basic circulation features such as ramp gradients, maneuvering spaces for the motor impaired in facilities and their safety and comfort were documented. Notes were also taken of the ergonomic state of the environment in general. To buttress these observations, measurements and photographic documentation of facilities under studies were also taken.

### 3.3.2 Internet searches

The World-Wide Web served as the most informative source providing extensive information on the subject matter compared to scanty literature on barrier-free designs offered by the local libraries. This is due to the fact that awareness of accessibility creation in Ghana is

## 3.4 Research Challenges

Finding literary works on architectural accessibility pertaining to the local settings of Ghana was a major challenge. This was found to be non-existent or scanty. Lessons therefore had to be drawn from documentation from developed and developing countries where laws and concepts pertaining to disability and accessibility has been implemented over a long time.

# CHAPTER FOUR

## 4.0 FINDINGS, DATA ANALYSIS AND RESULTS

### 4.1 FINDINGS AND ANALYSIS.

#### 4.1.1 Preamble

The first part of chapter reveals the findings from conducted case studies on schools for the disabled. To this regard, the Jachie Sheltered Employment Centre in the Ashanti Region of Ghana and the Fukushima Prefectural Koriyama School for the Physically Handicapped in Japan were selected as case studies. These institutions were appraised based on standard macro-accessibility design criteria.

The second part of this chapter deals with data analyses of findings from semi-structured interviewing questionnaires taken with the inmates of the Jachie Sheltered Employment Centre as well as some interviews with ordinary able-bodied persons. The main objective of this study is to ascertain the existence of some accessibility problems and conflicts which resulting from the use of accessibility features with others. Finally, findings on a number of restitution measures recommended by some designers and countries to reduce the mitigating effects of some of the discussed conflicts are discussed.

### 4.2 SELECTION OF THE STUDY AREAS

The above mentioned facilities were selected based on their functions as schools for the disabled, proximity (in the case of Jachie Sheltered Employment Centre), and availability of data sources.

## 4.3 STUDIES ON STANDARD FEATURES OF ACCESSIBILITY DESIGN

Appraisal of institutions under case studies took the following minimum accessibility guidelines into consideration.

### 4.3.1 Entrances and parking spaces

- Short route to entrance and covered or protected with any ramps or steps carefully detailed (Mace, 1991).
- Avoidance of change in levels as possible (Thorpe, 2002)
- parallel parking space with outside limits aligned with the outside edge of the adjacent standard size parking space ( Peloquin, 1994)
- Accentuated doors for identification & personalization (Cohen et al., 1991).
- Accessible entrances should be clearly identified using the international symbol of accessibility including alternate locations of accessible entrances ((UN,2007)

### 4.3.2 Stairs

- Circular stairs and stepped landings should be avoided (UN,2007)
- Open risers are not recommended (UN, 2007)
- The length of the landing should be at least 1.20 m extending along the full width of the stairs (UN, 2007)
- Sharp edges and overhanging nosing should not be used for treads(UN, 2007)
- Nosing should be flush or rounded and should not project more than 40 mm (UN, 2007)
- On stairways, windows positioned less than 1.00 m from the landing should have railings. (UN, 2007)

### 4.3.3 Ramps and Railings

- The minimum width should be 0.90 m. and the maximum recommended slope of ramps is 1:20 (UN, 2007).
- The landing should have a minimum length of 1.20 m and a minimum width equal to that of the ramp (UN, 2007).
- A protective handrail at least 0.40 m high must be placed along the full length of ramps. (UN, 2007).
- A ramp with drop off that has a vertical change in elevation 2" or greater or a slope greater than 2 in 12 shall require a handrail (Peloquin, 1994).

### 4.3.4 Edge Treatment and Thresholds

- Thresholds as near levels as practicable, with a maximum overall height of 15mm and with a tapered good section (Thorpe, 2002).
- changes in level one-quarter of an inch or less do not require edge treatment (Peloquin, 1994).
- changes in level greater than half an inch require ramped surface with a 1:12 maximum slope (Peloquin, 1994).

### 4.3.5 Doors and Doorways.

- Wide, passable doorways that provide at least a 32-inch, clear opening as shown in Appendix H (Mace et al., 1991).
- Accessible doors requiring minimal effort to close or open and requiring 30N maximum of opening pressure (Mace, 1991; Thorpe, 2002),
- The use of toggle, knurled, roughened or carborundum-epoxy coated round doors knobs are however acceptable for use in restricted or hazardous areas (Peloquin, 1994).
- The edges of a glass door should be apparent when the door is open (Demesne, 2006)

- Added second handle or pulling device (Mace 1991).

#### 4.3.6 Windows

- An accessible window with a minimum space of about 2'- 6"× 4'- 0" available at each window for maneuvering ( Peloquin, 1994).
- Window sills positioning between 18" (46cm) and 36" (91cm) above the floor so that a seated person can easily open or close the handle as shown in Appendix J (Mace, 1991)
- Windows to be used as fire exits, with at least 30" (76cm), wide enough to permit a person to go through in an emergency (Mace, 1991).

#### 4.3.7 Light and Gadget Controls

- Light switches, thermostats, electrical receptacles, faucets, and other controls should be mounted between 9 inches and 48 to 54 inches above the floor (depending on the direction of approach) and operable with one hand (Mace et al., 1991).
- The use of lever type or push-button faucets for especially people with limited use of hands and arms ( UN, 2007)

#### 4.3.8 Kitchens Worktops, Cabinets and Storage Areas

- A minimum clear floor area of 2'-6"×4'-0" (76cm×122cm to be provided in front of every appliance and cabinets to reach the knobs and controls.
- Minimum knee spaces of 30" (76cm) wide, 27" (69cm) high and 19" (48cm) deep is needed under sinks, countertop segments, cook tops allow them to pull up under the work surface, sit close enough to reach items and work comfortably (Peloquin, 1994).
- Provision of some counter segments at standard heights and some at lower heights as shown in Appendices L and N.

- . Drawers that are deep, extend the full depth of the base cabinets, and are mounted on full extension slides make the best use of available storage space.
- Swinging retractable cabinet door hardware can make it possible to conceal knee spaces (Peloquin, 1994).

**4.3.9 Bathrooms**

- Bathrooms should have slip resistant flooring, flush detailing of drainage and junctions between surfaces and spaces, easily reachable positions of controls and fittings as well as adequate space for maneuvering (Thorpe, 2002)
- 3 x 3 foot size with a seat to allow transfer, or a roll-in shower that can accommodate a person in a wheelchair as shown in Appendix K (Mace, 1991),
- Bathrooms with independent transfer units such as grab bars, transfer surfaces, hydraulic seats and renewable seats or assisted transfer units such as boom lifts or overhead track lifts (UN, 2007)

**4.3.10 Floor Finishes.**

- The use of flooring materials like solid hardwood, ceramic tiles, vinyl, linoleum , brick and stone (Peloquin, 1994)
- Carpets should be avoided in places where wheelchairs will be used (Peloquin, 1994)
- Non-slippery flooring surfaces (Cohen et al., 1991)

**4.3.11 Bedrooms**

- Adequate maneuvering space around beds as wells as appropriate assistive devices should be provided to facilitate access to all facilities as shown in Appendix M, (Mace,1991)

## 4.4 CRITERIA FOR APPRAISALOF CASE STUDIES

The case studies will be appraised based on the ‘Design Objectives of Whole Building Design’ (Prowler, 2009). Consideration will be taken of the following;

- Accessible: Pertains to building elements, heights and clearances implemented to address the specific needs of disabled people.
- Aesthetics: Pertains to the physical appearance and image of building elements and spaces as well as the integrated design process.
- Cost-Effective: Pertains to selecting building elements on the basis of life-cycle costs (weighing options during concepts, design development, and value engineering) as well as basic cost estimating and budget control.
- Functional/Operational: Pertains to functional programming—spatial needs and requirements, system performance as well as durability and efficient maintenance of building elements.
- Historic Preservation: Pertains to specific actions within a historic district or affecting a historic building whereby building elements and strategies are classifiable into one of the four approaches: preservation, rehabilitation, restoration, or reconstruction.
- Productive: Pertains to occupants' well-being—physical and psychological comfort—including building elements such as air distribution, lighting, workspaces, systems, and technology.
- Secure/Safe: Pertains to the physical protection of occupants and assets from man-made and natural hazards.
- Sustainable: Pertains to environmental performance of building elements and strategies.

All these points have been redefined concisely under climate modification, utilization of resources, facilitation of activities and finally meaning and delight.

## 4.5 CASE STUDY 1

### 4.5.1 The Jachie Sheltered Employment Center

#### 4.5.1.1 Background information

Jachie Sheltered Employment Center, established in 1984 and located on a 3.8 hectare land at Jachie-Pramso in the Ashanti Region of Ghana is one out of the four major rehabilitation centres in the region. The Project, funded by the Norwegian Society for the Physically Disabled was conceived as an African village, where wheelchair, crutch, and cane users live, work and train in industrial skills under micro-accessibility conditions.

#### 4.5.1.2 Activities and Facilities

The institute has a parking forecourt, administration block, accounts office , storerooms, and workshops for orthopaedic, leatherworks, tie and dye, carpentry, dressmaking and weaving purposes. It also has accommodation facilities for staff and students as well as ancillary facilities like common hall, gardens, showrooms, computer rooms and a multi-purpose hall.

Fig.4.1 The weaving section

Fig.4.2 Semi-enclosed carpentry section

#### 4.5.1.3 Climate Modification Measures

With the facility’s location in the tropical rainforest zone, some provisions that has been made to ensure micro-climate modification in the facility include the adoption of open courtyard system which facilitates free flow of air into room interior, the use of honeycombs walling for the common hall and around corridors to permit more ventilation and light into interior spaces the use of artificial ventilation systems to supplement natural ventilation systems and the use of glass louvres that is easy to regulate.

Fig. 4.3 Honey comb walling at the common hall for ventilation and daylighting

Fig.4.4 Roof gutter for rainwater drainage

**4.5.1.4 Resource Utilisation**

Materials used in the construction of the centre comprise sandcrete blocks for walling, wood for ceiling, glass for windows, steel reinforcement for the structure, porcelain tiles for finishes, stone chipping for external courtyard and cement mortar for floor and wall finishes.

**4.5.1.5 Facilitation of Activities**

All facilities in the centre have been planned on the ground floor thereby reducing the cost of providing ramps to upper floors. In addition, the centre has enough space serving parking and circulation purposes. The centre also has macro-accessibility provisions like ramps, balustrades and grabs bars in sanitary areas.

Fig. 4.5  Triple wooden-strip railing

Fig. 4.6  Lavatory with grab bar

Water, sewage, fire prevention, electricity and telecommunication services have been provided in the centre. The facility also has 10000 gallon water reservoir also serving as indirect water supply in addition to water supply from boreholes. Fire prevention equipment in the form of fire extinguishers has been strategically positioned in the facilities. A three-phase electricity distribution line supplies line supplemented by stand-by generator supplies electricity to the centre.

**4.5.1.6 Merit**

- Basic macro-accessibility provisions were considered especially in the planning and design of interior spaces.

**4.5.1.7 Demerits**

- There are no covered walkways linking each facility to the other thereby exposing the disabled persons to the mercies of the weather.
- Lack of recreational and therapeutic facilities like playing courts and swimming pools respectively has created imbalance in the centre’s curricula.
- Some newly constructed block has ramp with non-standard gradients.

## 4.6 CASE STUDY 2

### 4.6.1 FUKUSHIMA PREFECTURAL KORIYAMA SCHOOL FOR THE PHYSICALLY HANDICAPPED.

#### 4.6.1.1 Background information

With a design concept as flexibility and adaptability, the award wining design is and elementary and secondary school for children with physical disabilities. The school covers a gross land area of 13525 square meters and offers training to 170 students. Features such as light-courts, top-lights and clerestories have carefully integrated into the facility configuration to facilitate communication and interaction through visibility. Furthermore**,** The entire facility operates on a sequence of hierarchy form a small group size to a large school company.

Fig 4. 7 Extensive uses of glass and steel for construction
(Source: http://www.aij.or.jp/aijhome.htm)

Fig 4. 8Library with curvilinear indoor ramp
(Source:http://www.aij.or.jp/aijhome.htm)

#### 4.6.1.2 Constriction Materials

Materials used for construction were glass for windows, clerestories and roof lights, steel and wood for structural members and finishes, and porcelain and ceramic tiles for finishes.

#### 4.6.1.3 Merits

- The centre provides excellent safe learning environment with innovative circulation.
- Planned with and understanding of the diverse needs of children with disabilities, the facility has small classrooms with only three to eight students. As they move from classrooms to workrooms to a playroom or gymnasium, they can increase their size at will. This is enables them develop human relationship with one another.

#### 4.6.1.4 Demerits

- The use of circular ramp though aesthetically catchy occupies a relatively ample space in some room interiors

## 4.7 DATA ANALYSIS OF SURVEY

Secondary data collected from respondents of interviews was analyzed and presented in tables and charts. The main objective of this study was to ascertain and gather information on the existence of any accessibility conflicts experienced by the mobility impaired resulting from incompatible use of accessibility features together with other groups of people.

### 4.7.1 Educational backgrounds of respondents with Disabilities

Were classified into 2 main categories namely; literates and illiterates. All 24 respondents interviewed were literate. 20 of them had received education up to 1st cycle institutions, 2 had education up to the 2nd cycle institutions and 2 had a third cycle education qualifications.

On the other hand, of all the able-bodied respondents interviewed, 9 out of 15 had had tertiary education, 3 had senior secondary education, 2 had education up to junior secondary and 1 was illiterate. The number of respondents in the various educational levels mentioned above is shown in table 4.1

| **Physical Status** | **Education Background of Respondents** | | | | **Total** |
|---|---|---|---|---|---|
| | **illiterate** | **1st cycle** | **2nd cycle** | **3rd cycle** | |
| **Disabled** | - | 20 | 2 | 2 | 24 |
| **Able-Bodied** | 1 | 2 | 3 | 9 | 15 |
| **TOTAL** | | | | | 39 |

Table 4.1: Showing Educational Level of Respondents

### 4.7.2 Types and Assistive Devices used by Respondents with Disabilities.

All the 24 people interviewed had mobility impairments. Out of the 24 disabled people interviewed, 7 were wheelchair users, 4 were crutch users, 6 had braced legs, 2 were stack users and 5 limped without the use of assistive devices.

| **Disability Type** | **Assistive devices used and Functional limitations of the disabled** | | | | | Total |
|---|---|---|---|---|---|---|
| | **Wheelchair users** | **Clutch and Walker users** | **Braced legs** | **Stick users** | **Without Assistive Devices** | |
| **Mobility Impairment** | 7 | 4 | 6 | 2 | 5 | 24 |
| **Functional Limitation** | Inability to walk, difficulty in reaching heights, difficulty in mounting toilet facilities without aid | Difficulty in smooth movement Difficulty in bending | Difficulty in smooth movement, Difficulty in bending and sitting | Difficulty in smooth movement | Difficulty in smooth movement and difficulty in reaching heights | |

Table 4.2: Showing assistive devices used and Functional limitations of the Disabled

### 4.7.3 Awareness and Knowledge of Accessibility Features

All the respondents interviewed displayed knowledge about accessibility features and were able to mention a few. These ranged from the use of assistive devices such as wheelchairs, clutches and sticks to the provision of accessibility features such as ramps, stairs, large circulation spaces, car- parks for the disabled, hand and guard handrails, accessible toilet facilities, bathroom spaces, sinks and faucets.

Of all the accessibility design features mentioned during the survey, ramp had the highest tally followed by stairs, spacious rooms, accessible sanitary room features, and hand /guardrails respectively.

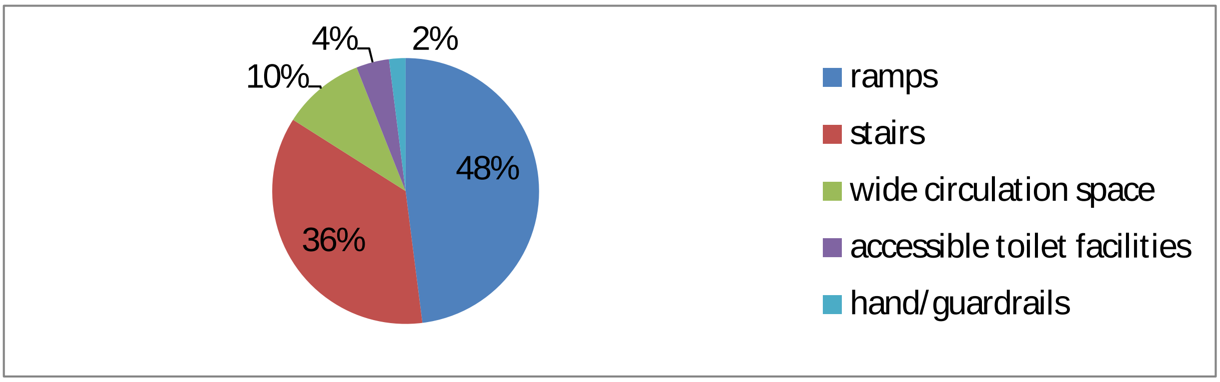


Fig 4.81 A chart showing respondents' awareness and knowledge on accessibility features

### 4.7.4 Knowledge on Specific Accessibility Design Concepts

The following was obtained when both able-bodied and disabled people were ask about knowledge of some accessibility design concepts such as Universal, Barrier-Free Living, Inclusive Design and Adaptable Design Concepts:

Out of the 24 respondents who were disabled, only 2 had knowledge about Universal and Inclusive Design concepts. Only 1 able-bodied respondent out of the 15 had knowledge about Inclusive Design Concept.

| Physical Status | Knowledge on Specific Accessibility Design Concepts | | TOTAL |
|---|---|---|---|
| | **Had Knowledge** | **Had no Knowledge** | |
| Disabled | 2 | 22 | 24 |
| Able-bodied | 1 | 14 | 15 |

Table 4.3: Showing Respondents 'Knowledge of Specific Accessibility Design Concepts

### 4.7.5 Problems with the use of Accessibility Design Features

Problems with the use of some accessible features given by the respondents were;

- Difficulty faced by the wheelchair user with the use of improperly designed ramps
- Problems with broken-down and obsolete features like accessible faucets.
- Sections of the non-slip tiles on the corridors had undergone wear and tear over the years of exposure to the weather thereby posing movement problems to wheelchair users.

### 4.7.6 Possible Conflict of Interests from the use of Accessible Features with Others

The conflicting areas revealed by respondents with the use of accessibility features and products are as follows;

- Steep ramp are difficult for the mobility impaired to negotiate but are quite manageable for mobility impaired people whom do not use assistive devices,
- Access to certain heights of storage areas pose problems to the wheelchair while low storage pose problem to the person with spinal deformity.
- Stone-chippings and exposed loose stones in front of the administration block and forecourt compels the wheelchair user to exert more energy to gain

momentum. At the same time, while able-bodied people and a section of walking mobility impaired find no problem with them, they tend to pose problems to the crutch users who walk on them.

### 4.7.7 Recommendations from Respondents

Recommendations on accessibility features proposed by respondents were:

- The need for gently sloping ramps,
- The need for sheltered walkways,
- The need for more spaces to expand their technical-vocational training scope,
- The need for funds to rehabilitate broken down facilities

## 4.8 DISCUSSIONS

The discussions summarize issues on general findings from case studies and survey research. Recommendations from users of accessible features in the institute under study, any conflicting accessibility situations as well as lessons to be drawn from the studies are also discussed.

Firstly, the Jachie Sheltered Employment Centre was found to have a limited quantity of accessibility features. Accessibility facilities such as walkways linking all building facilities on site and ancillary facilities like basketball playing areas, swimming pool and therapy centres to cater for the health, recreational facilities were found to be non-existent. There was also the problem of improper design of some accessibility features in addition to broken down accessibility features requiring maintenance.

Most access ways were found to be not conforming to laid-down standards. Therefore new designs should demonstrate strict adherence to anthropometrical, construction and engineering standards. The need to design accessible spaces with adjustable furniture, accessible equipment and user friendly finishes was also realized. An interview with the administrator revealed inadequacy of funds as the main challenge to the provision of modern accessibility facilities for the institute.

Lessons that could be taken from case study of the Fukushima Prefectural Koriyama School for the Physically Handicapped include the use of indigenous materials in our local designs. A survey of the location of Jachie Sheltered Employment Centre revealed abundance of laterite-soil in the area which could have been used to produce bricks for construction, thereby giving the sheltered centre an organic look. In addition, the involvement of all stakeholders, mainly the design team together with the users of the Fukushima Prefectural Koriyama School for the Physically Handicapped presents another lesson regarding sensitivity to accessibility, ergonomic and pedagogical needs of building users.

On the other hand, a survey research to find out the knowledge base of both able-bodied and people with disabilities on accessibility design issues revealed limited knowledge on issues regarding architectural model of accessibility creation. In addition, the fact that most respondents were not aware of accessibility concepts and some standard on design guidelines means that much education on accessibility has to be made. Although it is hard to find most accessibility products and design features such as tactile pavements in our developing world, the respondents who were disabled seem to be aware of the few basic ones such as ramps, stairs, guardrails and sanitary facilities which they see around them. Common accessibility features mentioned by able-bodied respondents were assistive devices such as wheelchairs and crutches. Facilities such as ramps and lifts were mentioned by very few. Comparatively, over 95% of respondents within the Jachie

Sheltered Employment Centre were found to be more informed on issues of accessibility design features while able-bodied respondents showed the least knowledge on it. This may be attributed to the fact that most able-bodied respondents received little or no education on accessibility issues. It was also clear that the type of information received were matters concerning social and ethical issues towards the disabled rather than accessibility features provision oriented.

Data regarding conflicts of interest regarding the use of accessibility design features and products were found to be so meager to be ignored by the inmates of Jachie Sheltered Employment Centre. A few notable ones were related to ramps and height of certain facilities. This could be attributed to the inadequate accessibility features in the institute.

**4.9 RESULT PRESENTATION**

In view of the studies conducted and data analysed, this chapter gives detailed presentation on a proposed technical-vocational institute of advanced studies at Jachie.

**4.10 SCHEME DEFINITION AND PROJECT LOCATION**

The scheme entails a systematic study and analyses of special institutions leading to the design of an Institute for Advanced Technical and Vocational Studies for the physically challenged. The proposed project will be located at Jachie in the Ashanti region of Ghana.

**4.11 SITE SELECTION AND ANALYSES**

**4.12 SITE LOCATION**

The proposed site for the technical and vocational institute is located at Jachie, a town in the sub-urban part of Kumasi in the Ashanti region. Jachie is located in the Bosomtwi

Atwima-Kwanwoma district, approximately 30 minutes drive from the Kumasi Central Business District and lies within Latitude 1º 15" N and 1º 45" N and Longitude 6 º 15" W and 7 º 00 "W. Jachie is bounded in the east by Pramso and in the west by Abidjan Nkwanta. The total land size allocated for the site covers approximately 101000 square meter area.

Fig.4.9 North-eastern view of the site

Fig 4.10 The Kumasi-Lake Bosomtwi road bordering the northern part of the site

**4.13 SITE’S PERIPHERAL STUDIES**

The site is bounded in the north-east by the Atonsu-Lake Bosomtwi road and the Jachie Senior High School and in the north-west by the Jachie Sheltered Rehabilitation Centre and a string of commercial facilities. To the south-eastern and south-western fringe of the site is a stretch of undeveloped semi-deciduous forest. The site is about 200 meters off the east of old Jachie town which has a population of approximately 2000 (insider source). A few meters away from the site are rapid development of new residential and commercial buildings.

## 4.14 SITE INVENTORY

### 4.14.1 Site's Topography and Geology

The site falls within the forest dissected plateau physiographic region. The site slopes gently with slight undulations towards its southern and eastern direction. The lowest point on site is about 6 meters below the highest point. The soil type found on the regions where the site is located is the forest ochrosol. The underlying bedrocks are granite and pre-cambrian rocks of the Tarkwaian and Birimian formations which have good bearing capacity. This makes the area very good for strip and pad foundations.

### 4.14.2 Rainfall and vegetation

The district in which the site falls experiences tropical bi-modal rainfall pattern and wet semi-equatorial climate with mean annual rainfall ranging between 1200mm and 1500mm.The site and its environs is located within the semi-deciduous forest region of Ghana characterized by double maxima regime rainfall pattern. In the past, massive deforestation has resulted in the forest gradually giving way to savanna.

### 4.14.3 Relative Humidity and Temperature

Relative humidity of 70% and 80% is recorded. Relative humidity is fairly moderate but quite high during the rainy season.Warm temperature is recorded around the district in which the site falls ranging between 20 C in August and 32 C in March

## 4.15 SITE SELECTION CRITERIA AND JUSTIFICATION

Reasons why the site is deemed suitable for the proposed project are as follows;

The site earmarked for the facility has a long history of being developed as part of the existing sheltered employment centre. Its proximity to the current sheltered employment centre is seen as an advantage.

The topography of the site permits advantageous planning and reasonable economic construction of facilities on site.

Infrastructure and utility services such as electricity and water are already available around the site.

## 4.16 SITE SERVICES

### 4.16.1 **Electricity, Water and Sewage Disposal**

The Jachie Township and its surrounding towns are already connected to the national electricity grid. The main electricity supply lines are located along the Lake Bosomtwi road. The main source of water to the site is from the Barekese dam. This is supplemented by water from boreholes and harvested rainwater. As part of sewage and waste water disposal, sewage treatment and recycling plant will be sited on site to treat waste water.

## 4.17 SITE ANALYSIS

**Strengths**

- The site has a gently sloping topography to facilitate planning of facilities and circulation routes.
- The site is easy to access from the major Kumasi- Lake Bosomtwi road.
- The site is easy to locate.

**Weaknesses**

- Part of the site forms a gentle valley with adjacent areas and could thereby be prone to erosion.

**Opportunities**

- The site is located in an area with infrastructure such as potable water and electricity already developed. It also has good soil for landscaping purposes

- Advantage could be taken of the slope to discharge sewage.

**Threats**

- The site is bordered by a major road and could be prone to noise pollution from passing vehicles on busy days.

## 4.18 THE DESIGN PRESENTATION

This section gives a detailed presentation on the design of the proposed Technical-Vocational Training Institute of Advanced Studies at Jachie.

## 4.19 DESIGN PHILOSOPHY

Since the disabled populace constitutes one of the most marginalized groups in the system, there has to be mechanisms to instill the habit of independent living into them and empower them to be able to merge into the mainstream system. There was therefore the need to bring out design layout that corresponds to topographical site features, aesthetically blending macro-accessibility creation with the landscape and creating a visible landmark that will stands out to attract more physically disabled people from accepting the challenge to educate.

Thus, adoption of the design philosophy '***Empowering people through accessible and a socially interactive architectural environment***' will be made visible.

## 4.20 DESIGN CONCEPTS

Based on the design philosophy, the concept of proximity was adopted. This is depicted by the close linkage of spaces thereby reducing wheeling or walking distances from one facility to the other. The multi-purpose hall located at the core of the facilities is to serve as a focal and a convergence point for all major activities. On the other hand, the concept of zoning is made visible through efforts to separate likely noisy areas from quiet zones.

The core building is meant to act as the frame for the architectural composition buildings in the institute encapsulates. The core building will serve as a central convergence point and relate to the other structures in mass, form and style. The inherent symbolic content of the campus plan further symbolizes the concept of unity through the proximity of buildings close to one another. Safety as one of the concepts is portrayed by firstly adopting classroom layout that ensures the creation of minute lay-bys for safe wheelchair entry and exits to and from classrooms. In other areas, double swing doors in recessed doorways and landscaping elements is being used to ensure safe circulation of especially wheelchair-users.

The design also takes into account the indigenous culture, climate, and construction technology and materials. Culturally, the design is based on the traditional courtyard system. These courts are strategically created to serve as concourse for relaxation, interaction and entertainment. It is also to serve as a climate modification feature or an access point for ventilation and daylight. Lastly, the design concept takes into account measures of reducing possible conflicts affecting comfort levels of the various forms of physical disability as they use common accessibility features. This will be achieved by adopting the recommendations from the study.

The brief for the proposed institution will comprise car parking zones and main reception points, administration block, library block, classroom and workshop areas, dining and recreational areas, staff and students' accommodation, a multi-purpose hall and other ancillary facilities such as infirmary, gymnasium and recreational grounds. Details of it is shown in Table 3, Appendix C.

## 4.21 CONCEPTUAL SITE PLANNING

The first stage constituted zoning of the facility into three major zones which are noisy areas comprising workshops, students accommodation and outdoor recreational areas and dining area, semi-noisy areas comprising the classrooms and multi-purpose hall and quiet areas comprising the library and administration area. At the second stage, issues of circulation and orientation were laid out. Picking the main entry point from the Kumasi-Lake Bosomtwi Road, an access road was proposed at the south –eastern part of the site to be linked by the service route located at the lowest part of the site's terrain. This was then followed by the final stage of the conceptual planning which dealt with the linkage of proposed building units to form a unified whole.

### 4.21.1 Alternative 1

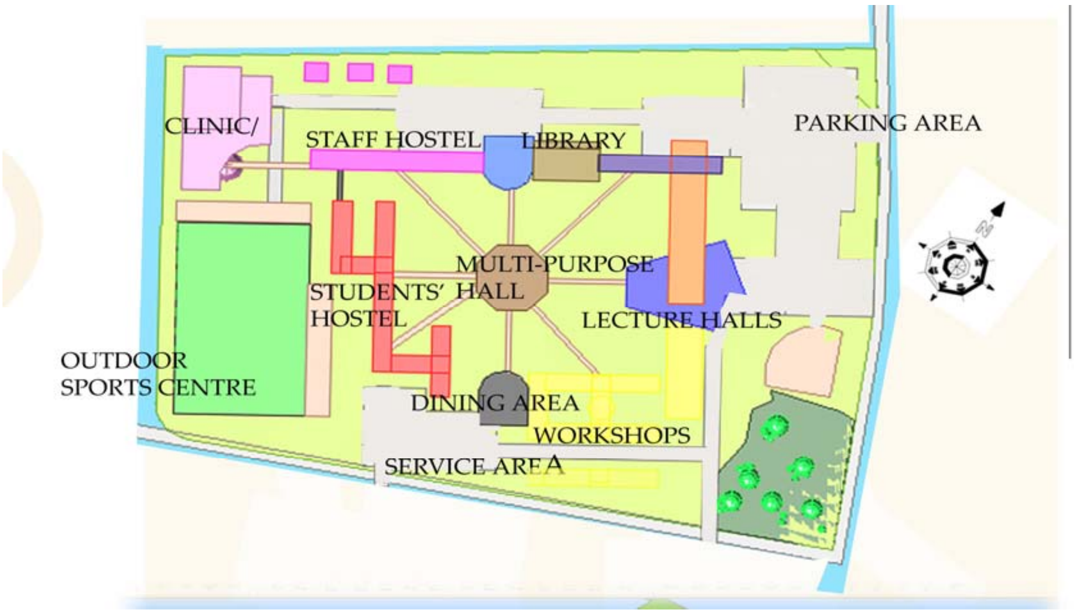


Fig 4.16 Conceptual planning for the first alternative

### Merits

- There is straight and direct rout to facilities
- The creation of a piazza will serve as an additional and recreational grounds during break
- More shortcut route to multi-purpose hall

**Demerits**

- Part of outdoor sports centre has to be leveled to make it more functional.
- Long distance to each facility due to their sparsely spaced nature.
- Orientation might pose design problems.

**4.21.2 Alternative 2**

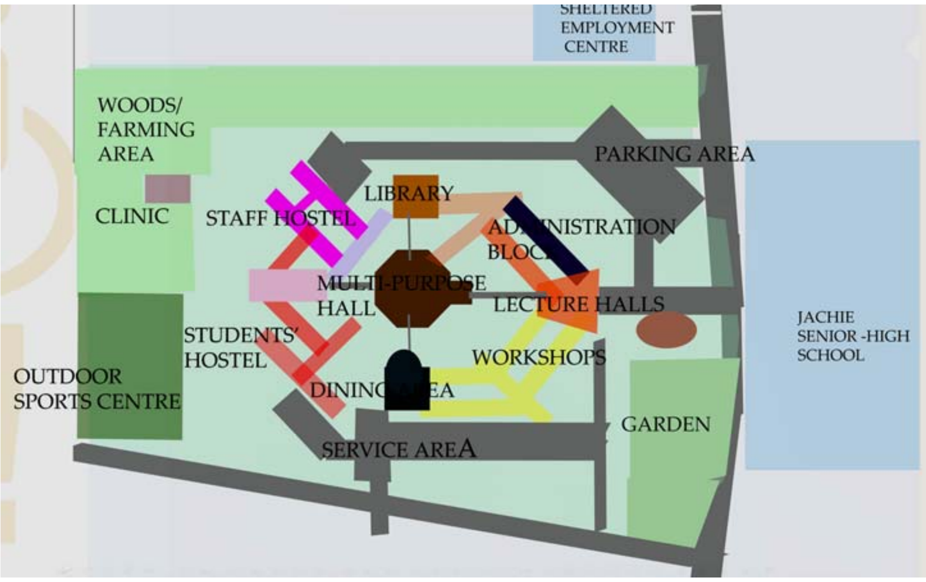


Fig 17 Conceptual planning for the second alternative.

**Merits**

- Better orientation of buildings in relation to north-south position is achieved
- Aesthetically convenient due to the harmonious arrangement of building facilities around the central hall

**Demerits**

- Lesser straight-forward or direct route to facilities on campus.
- Extensive site layout consumes large tract of land.

**4.21.3 Alternative 3 (selected)**

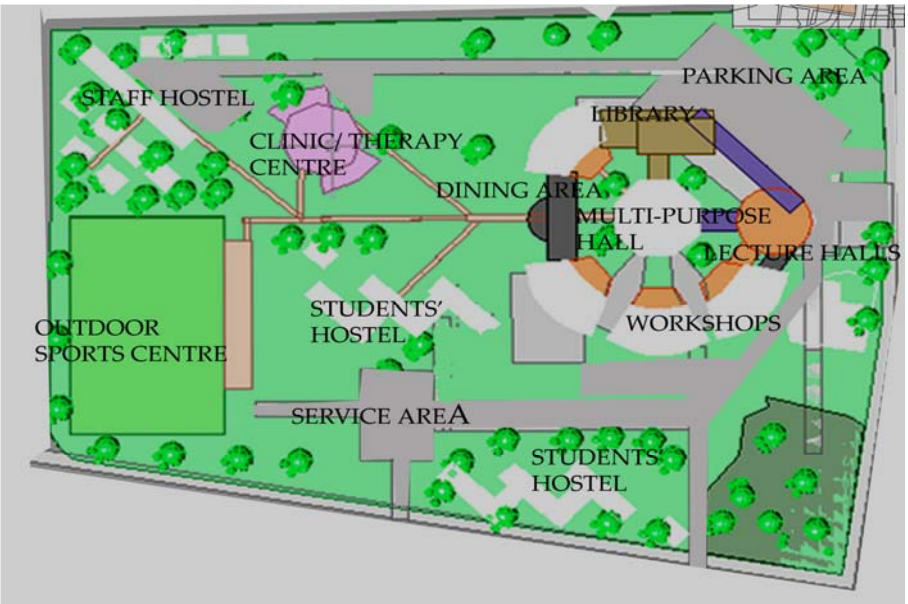


Fig. 33 Conceptual planning for the selected alternative

**Merits**

Site layout and planning suits the concept of proximity and proper zonig

Staff enjoys comparatively more privacy due to their location far off from students' hostel.

Excellent linkage of teaching and non-teaching areas

Balanced zoning of quiet and noisy activities

**Demerits**

Long walking and wheeling distance of staff to academic facilities.

## 4.22 THE DETAILED DESIGN

### 4.22.1 Site layout

Buildings within the core are directly affected by a concentric juxtaposition of the others. Since the core is the most dominant central geometric element on the campus, siting of buildings around the core has naturally been affected by the core's "lines of force.

In designing the facility, ways to develop student's full potential through specialized education, therapeutic interventions, family involvement and independent living were deeply considered.

## 4.23 CONSTRUCTION TECHNOLOGY

### 4.23.1 The substructure

Due to the high bearing capacity of the underlying soil, strip foundation combined with pad foundation will be used for spaces such as the administration, library, multi-purpose hall and students' hostel which occupies more than a single floor. Strip foundation will be used on facilities occupying single floor areas.

### 4.23.2 The super-structure

Different forms of structural supports have been used in the design of the facility. The workshop has portal frame system for structural support while areas such as the administration block, library and accommodation facilities has reinforced concrete post and beam structural system. In the workshops where the portal frame is used, castellated steel members, each sharing a common steel column is used.

### 4.23.3 The roof structure

The roof structure for the facilities is made of steel–section purlins on castellated steel portal frame or steel truss and wooden purlins on wooden truss members. In areas where roof lights are used, steel roof members are recommended for accurate joints.

## 4.24 CONSTUCTION MATERIALS

The predominant exterior building material throughout the campus is brick, occasionally accented by certain architectural elements that are rendered in either stucco, painted or stone faced. Other materials such as wood have been used for roofing structures, doors and window openings and balustrades. Transparent glass has been used for door and window panels to promote inter-space interaction and communication through visibility. Special reinforced but slightly tinted and solar reflective fibre-glasses will be used for roof-lighting purposes thereby creating an illuminated arcade effect in certain spaces.

Asphalt finishes and pavement blocks are used in varied ways for driveways and car parks respectively. Interior spaces will be of finishes that are durable, wear, scratch and stain resistant, comfortable, and cleanable and non-slip. For the safety of wheelchair and crutch users, a non-slip porcelain tiles having slightly textured surface will be used for all horizontal circulation routes. To minimize the back-movement of wheelchairs during ramp ascents, a slightly textured terrazzo surface is recommended.

Different shades of bricks mixed with stone, sandcrete and concrete masonry are employed as walling materials as well as to distinguish the use of each building form the others. Water and oil-based paints of different shades are also being used to blend with these brick colours thereby creating a sense of unity and harmony. This also constitutes a significant distinguishing factor to aid identification of places for the visually impaired visitors.

Polished wooden tongue and groove (T&G) will be used as ceiling materials for the administration library and accommodation facilities. Suspended acoustic ceiling panels will be used for classrooms, workshops and multi-purpose hall areas to keep sound within the spaces.

## 4.25 FACILITIES ON CAMPUS

### 4.25.1 The parking area

A wide parking area paved with concrete pavement bricks has been provided for the school with spaces for able and disabled vehicle users. Accessible parking ways for the disabled measuring 3.5m by 6 m have been clearly marked with adequate access aisle for wheelchair users. To ensure safety of wheelchair users and to provide a clear space for incoming and outgoing vehicles, a central walking/ wheeling aisles have been created between opposite parking bays.

### 4.25.2 The administration block

The administration block being the first point of call as one enters the facility form the main entrance has been given an attractive façades offering good views to the surrounding landscape. Facilities in the administration block are offices of the staff, reception hall, ancillaries such as staff lounge, first-aid room, storage areas, sanitary facilities and waiting areas have been provided. The Information Technology Centre and the conference centre projects over the main façade, thereby forming a porte-cochere which serves as a drop-off point for vehicles

#### 4.25.3 The library

The community library offers spaces for general bibliographies, journals and periodicals, serials, references, and discussions. Ancillaries such as photocopying rooms, sanitary facilities, administration offices, lifts and storage areas have also bee provided. Among special features visible in the library is an indoor ramp overlooking a central landscaped court, illuminated by roof-light.

#### 4.25.4 The classrooms, lecture theatres and Workshops

Twenty student capacity classrooms, eight in number and two lecture theatres with 80 student capacity each have been designed for the institute's academic needs. Classrooms have skewed orientations to create minute lay-bys at their entry point for safer entry and exits onto the main corridor. A large workshop area comprising eight working zones have spaces for fashions and dressmaking, jewellery making, computer and electronics repairs, phone repairs, pottery, carpentry, leatherworks and orthopaedics. For sound control reasons, wood-craft activities have been separated; about 50 m away form the main workshop area. Ancillaries such as a spaceous warehouse, sanitary facilities and service spaces were also provided.

#### 4.25.5 The dining area

A dining area of optimum size has been provided for use especially during study hours. Facilities for the dining area are store rooms for dry and wet goods, kitchen hall, and kitchen yard, serving area, scullery and pantry, eatery and an office for the matron.

#### 4.25.5 The multi-purpose hall

A large 350-seater multi-purpose hall is located at the core of the facility. The hall which forms the heart of the facility is to serve as the central and immediate point of concourse for both formal and informal activities such as exhibitions, fora, general assembly, religious and community gatherings. Facilities in the hall are control rooms, seating hall, changing rooms and storage and sanitary facilities.

### 4.25.6 The students' hostel

Two hostels to accommodate 132 students each and a have been provided close to the academic facility to house students with partial mobility impairments. Each hostel floor has been provided with facilities such as kitchens, reading rooms, sanitary facilities, television rooms with cafeteria and a mini shop. Facilities attached to the hostel include an infirmary and a gymnasium. Severely disabled people who are partially independent and thus require permanent care have also been catered for. For such people, four double-bed self-contained apartments with share living and dining area have been of provided. Extra spaces have been provided for automated wheelchair maneuvering and for storage of their lifts have been provided.

### 4.25.7 The staff accommodation

For reasons of privacy, the staff accommodation has been separated about 80m off the main academic facilities. A three bedroom self-contained block has been proposed for the principal. Two bedroom self-contained blocks, five in number have been provided for the senior staff whilst three 2-storey flats containing single bedroom self-contained apartments have been provided for junior staff.

## 4.26 SERVICES

### 4.26.1 Water Supply

Fortunately, proximity of the site to adjoining areas with developed potable water supply will facilitate its supply for drinking, cleaning, cleaning, washing, heating, and fire fighting purposes. This will be augmented by indirect water supply from overhead tanks to be redistributed by gravity.

#### 4.26.2 Electricity

A three-phase transformer is to be located on- site by the developer to ease connection of the proposed development. The building will therefore obtain its main power supply from the transformer. Two on site generators with an automatic start and stop equipment has also been provided for.

#### 4.26.3 Fire protection and control

As fire protection measure, fire resistant door will be installed at probable fire-catching areas such as offices, workshops and library. Sprinkler heads and hose reels supplied by water from both direct and indirect sources are placed at strategic location within the facility for fire-fighting purposes. Automatic fire alarm systems and fire extinguishers are located at strategic intervals within the facility. Fire hydrants are also to be strategically located on site. In addition, fire escape exits have been provided at specific locations with accesses to open spaces. The creation of courtyards is also to serve as an immediate escape point in the event of fire outbreak.

#### 4.26.4 Drainage and Waste Management

A network of covered gutters, have been provided to take care of run-offs, as well as rainwater from roofs and parking decks. Intercepted water is channeled into drains that run along the site periphery.  The hierarchy of drains is strategically located to take advantage of site topography. A central waste collection point is to be sited at the service yard located at the south-eastern part of the facility. Each facility is to be provided with waste collection bins at vantage points. Waste water from kitchen areas and bathrooms are to be channeled through ground drains to the main drain to be located at the site's peripheries. The academic and the students hostel sector are to have their sewage from sanitary areas flow from various levels down by gravity through a100mm diameter pipes into an on-site central receptor tank with soakaways located at the southwestern portion of the site. Inspection chambers are located at specific centres along the sewerage lines

### 4.27 LANDSCAPING

Soft and hard landscaping elements have been selected to create a sense of arrival at campus entrance, enhance and screen views, act as windbreaks, reduce erosion, improve ventilation and cooling, act as glare control elements and serve therapeutic purposes. A therapeutic garden imbued with soft and hard landscaping elements is being proposed at the north-eastern corner of site. This area is to be provided with statuaries, rockeries and seating facilities and a pond. Some specimen plants are used for aesthetics in the garden include Roystonea Regia (royal palm), Salix Babylonica (weeping willow),Ficus Benjamina, Terminalia Catappa, Hydrangea, Cacti, Eucharia and Rosa Hybrids. Grasses such as Paspalum notatum and Chrysopogon is to be planted to reduce glare and heat generation in open areas. Selection of site furnishings such as bench, trash receptacle, and light fixture shall consider durability, ease of maintenance, and harmony with the overall campus concept. Bollards for restricting vehicles from walkways are also provided.

### 4.28 CIRCULATION AND ACCESSES

The main entrance into the facility is taken from the Kumasi- Lake Bosomtwi road located on the north, north eastern part of the site. Separate entry/ exit route have been provided for both vehicles and pedestrians. Access route for services is also proposed at the southern part of the site.

### 4.28.1 Ramps and Stairs

Low gradient ramps with handrails and aisle width large enough to accommodate double wheelchairs have been provided to ease access to upper floors. Preferably, stairs with proper handrails have also been provided along some ramps for crutch users and able-bodied people. In areas such as the administration, library, staff and students accommodation facilities, lifts have been provided for use on special occasions.

### 4.28.2 Doors and Doorways

For the purpose of speed and convenience, classroom and administration and dining blocks will be provided with glass-paneled see-through doors with double swings. Commuters' safety will be ensured against doors swinging into pathways by adopting recessed doorway systems with level or minimal thresholds. Minimum door width of 900mm will be designed for. Doors requiring minimal operating force of 20N are to be provided with auxiliary door handles.

### 4.28.3Windows

At least an 80cm wide minimum maneuvering space has been left around windows for accessibility purposes. Side hung casement windows that are at easy-to-reach heights and are easy to control by wheelchair users are recommended for administration and IT centres that are likely to be air-conditioned. Transparent glass louvers in aluminium frames are recommended for classrooms, workshops and accommodation facilities.

### 4.28.4 Cabinetries

Cabinetries in the facilities have adjustable storage heights. In kitchens, the arrangement of the storage, preparation, cooking and washing areas have been streamlined and placed close together as possible. Optimal and adjustable working heights ranging from 75cm to 90cm is desirable for reach of wheelchair users.

#### 4.28.5 Lavatories

The provision of accessible sanitary areas is a serious concern for many people with disabilities. Different sanitary room spaces have been provided for use by both able and disabled people if the institute.  Lavatories have been provided with vertical, horizontal grab bars and adjustable levers for the physically challenged. Adjustable seats for bathing areas have also been catered for. Since it is an institution designed mainly for the mobility impaired, sanitary facilities of varying heights will be installed in all sanitary areas.

#### 4.28.6 Drainage

A network of covered gutters, will be provided to take care of run-offs, as well as rainwater from roofs and parking decks. Intercepted water is channeled into drains that run along the site periphery.  The hierarchy of drains will be  strategically located to take advantage of site topography.  Landscaped areas, which are of considerable distance from the main drainage lines, are sloped gently in accordance with site topography to discharge water into drains.

#### 4.28.7 Telecommunication

The wide use of mobile phones nowadays has reduced the wide use of landline telecommunication services. Since the Ghana Telecom has serviced the site with telecommunication lines along the streets adjoining the site, taping telephone communication line into the facility will be easy. Direct lines will be available for areas such as security block and administration areas which are close to the main distribution lines.. Students' accommodation is to be provided with mobile telecommunication services in individual shops. As part of means of information transfer, a central satellite dish is to be installed close to the IT centre to facilitate information transfer via internet.

**4.28.8 Waste Management**

A central waste collection point is to be sited at the service yard located at the south-eastern part of the facility. Each facility is to be provided with waste collection bins at vantage points. Bins are also to be provided at vantage points around the compounds of the facilities. These bins are to be emptied everyday by sanitary workers to forestall bad environmental odour.

Waste water from kitchen areas and bathrooms are to be channeled through ground drains to the main drain to be located at the site's peripheries. The academic and the students hostel sector are to have their sewage from sanitary areas flow from various levels down by gravity through a100mm diameter pipes into an on-site central receptor tank with soakaways located at the southwestern portion of the site. Inspection chambers are located at specific centres along the sewerage lines. The staff accommodations are to have shared septic tanks to be located at vantage points.

**ACCESSIBILITY CONFLICTS RESOLUTION MEASURES**

- covered ramp ways over ramps with gradients as low as 8%
- creation of ramps with durable non-slip surfaces
- Avoidance of change in levels as possible
- Inclusion of stairs with properly design handrails together with ramps
- Creation of storage room close to sanitary facilities to accommodate adjustable toilet seats

- Avoidance of loose stones or cobbles as hard landscaping elements at circulation areas
- Doors and window ways designed slightly above standard
- Provision of some counter/worktop segments at standard heights and some at lower heights
- Provision of hardware such as cabinets with adjustable features where necessary
- Adequate maneuvering spaces at circulation points
- Provision of wide and well lit corridors around stair areas

## 4.29 PROJECT COSTING AND PHASING

The costing and phasing of the project to final completion will be as follows**:**

### 4.29.1 COSTING

Using the cost per unit area, the following estimates will be obtained:

**Parking area and pedestrian ways**

Total Area………………………. 9075 Sq. metres

Total Area + 10% Circulation…….9982.5 Sq. metres

Cost per area for good finishing….. GH ¢ 30

Total Cost ………………………… GH ¢ 299,475

**Administration block**

Total Area……………………….. 1013 Sq. metres

Total Area + 10% Circulation…….1114.3 Sq. metres

Cost per area for good finishing….. GH ¢200

Total Cost …………………………GH ¢ 222,860

**Library**

Total Area……………………….. 787 Sq. metres

Total Area + 10% Circulation…….865.7 Sq. metres

Cost per area for good finishing….. GH ¢200

Total Cost …………………………¢ 173,140

**Staff accommodations**

Total Area……………………….. 3330 Sq. metres

Total Area + 10% Circulation…….3663Sq. metres

Cost per area for good finishing….. GH ¢200

Total Cost …………………………¢ 732,600

**Multi-purpose hall**

Total Area……………………….. 1969 Sq. metres

Total Area + 10% Circulation…….2165.9 Sq. metres

Cost per area for good finishing….. GH ¢250

Total Cost …………………………GH ¢ 541,475

**Students' accommodation**

Total Area……………………….. 8427 Sq. metres

Total Area + 10% Circulation…….9269.7 Sq. metres

Cost per area for good finishing….. GH ¢220

Total Cost …………………………GH ¢ 2,039,334

**Dining area**

Total Area……………………….. 956 Sq. metres

Total Area + 10% Circulation…….1051.6 Sq. metres

Cost per area for good finishing….. GH ¢210

Total Cost …………………………GH ¢220,836

Workshops and classrooms

Total Area……………………….. 1930 Sq. metres

Total Area + 10% Circulation…….2123 Sq. metres

Cost per area for good finishing….. GH ¢200

Total Cost …………………………GH ¢ 424600

**Landscaping**

Total Area……………………….. 2480 Sq. metres

Cost per area ……………………. GH ¢20

Total Cost ………………………...GH ¢ 49,600

GRAND TOTAL ESTIMATE …………….GH ¢ 4,703,920

**4.29.2 PHASING**

The first phase of the project's construction will constitute ground preparation, the construction of the entire substructure and laying-out of service lines. The construction of the superstructure of the multi-purpose hall will also commence at this stage. The second phase will begin with the construction of the superstructure of the other facilities. Construction of the administration block and accommodation facilities up to the second floor will make up the third phase. This phase will also see the commencement of hard and soft landscaping elements. The fourth phase will be the construction of students' accommodation to the final floor. The final phase will entail maintenance, completion of the entire landscaping elements and putting of finishing touches to make the project ready for handover.

# CHAPTER FIVE

## 5.0 RECOMMENDATIONS AND CONCLUSION

### 5.1. RECOMMEDATIONS

Planning to address architectural, physiological, and psychological and service needs of People with Physical Disabilities should adopt a 'biopsychosocial' approach, emphasizing the importance of biological, psychological, pedagogical and social factors in the management and care of such people. It should entail the combined efforts of resourced personnel such as architects, engineers, psychologists, therapists as well the potential users of the facility who are People With Disabilities (PWDs).

The concepts of integration and equalization can only be achieved, if our governments could devise progressive community-based rehabilitation and educational programs that are aimed at changing societal attitudes and behaviors towards disability. There is a great need for the professionals, politicians and the public at large to re-examine our own attitudes, since we seem to spend a lot of time on molding disabled people to cope with their environments instead of spending more time on changing the attitudes of the able-bodied persons

Accessibility principles must be followed when planning, designing and building infrastructure and vehicles. These require full accessibility to approved standards or recognised best practices, with approval by experts, minimum accessibility requirements for wheelchairs, features for people with walking difficulties, and facilities to assist the blind, deaf or hearing impaired people.

It is also important to re-echo the advice of Mace (1991), that the demand for accessible housing should be met while still maintaining and demonstrating sensitivity to aesthetics and marketing value. To achieve equality, however, disability does have to be taken into account when providing accessibility requires such changes as architectural modification or program adjustments. Granting equal access to all members of societies requires acknowledging the differences that exist among these members. (Degener et al., 2001)

## 5.2 CONCLUSION

The concept of "independent living" is now beginning to trickle into the minds of the government and the population as large. In the future, increased access to educational opportunities will hopefully promote such concepts of independent living in all areas of the country. It is in this direction that architects are to play important role in ensuring the viability of this vision by proclaiming the message on universal barrier-free concept in our designs. Efforts by designers to come out with a universally accessible design for all have been an arduous task. Although this design aims at providing accessible spaces for people with mobility impairments in particular, some disable people interviewed have predicted that ultimately, universal design which is not about age or ability but about creating a usable design for the broadest number of users to offer years of increased utility, comfort, and safety will gain the centre-stage in the very near future. The “Design for all” / “Universal Design” movement has been very valuable in raising the profile of disabled users of architectural products, and has laid down some important principles. Nonetheless, skepticism has been expressed by some designers and theorist concerning its feasibility. Though it may be difficult at this early stage, it is however hoped that when designers and manufacturers seize this concept at this early stage, universal design will become common, convenient, more marketable and profitable.

Cultural and behavioural trends, global economic change as well as educational and government policy reforms such as democratization and civil society development has affected the educational systems around the world in diverse ways. In developing counties like Ghana, a head-start towards universal education has been made. This goal is gradually being brought into reality through the help of non-governmental organizations, local and foreign donor agencies, philanthropists as well as through the government's own initiatives. The proposal of a technical-vocational institute for advance studies at Jachie will serve as an important educational facility where disabled students can acquire advanced technical–vocational skills to enable them compete with their able-bodied colleagues in the modern world.

Apps (1973) states 'a working philosophy is never completely developed and the ultimate working philosophy never reached. "*We're always moving toward, hopefully, a more complete, and thus more useful, working philosophy*". Each educational decision that must be made and each new educational experience can assist the individual educator in developing a more useful working philosophy (Spurgeon 1994). It is the author's hope that this educational facility will assist disabled people in gaining greater control of their lives and assist them in regaining valued roles in society.

Completely tackling issues on barrier-free design is a complex, burdensome and sometimes unreasonable, even for specialist, many in the design professions (Mace, 1991). This implies that what is barrier-free for someone in a wheelchair may not be for someone who is blind or deaf. This therefore calls for a revisiting and revision of some design guidelines if barrier-free design is to be achieved. Manufacturers and standards bodies should always involve and consult with representatives of disability organisations and other consumer groups to ensure that users are sufficiently involved in the design process (Research Institute for Consumer Affairs (RICA), 2007). Disability, consumer and other organisations should provide practical help to make it easy for manufacturers to consult with their potential older and disabled customers

In view of this difficulty faced by designers, I agree with Newel et al., (2000) who recommend the use of the term “inclusive” rather than “universal” which reflects the view that “inclusivity” is a more achievable, and in many situations, appropriate goal than “universal design” or “design for all”. The word “sensitive” replaces “centered” to underline the extra levels of difficulty involved when the range of functionality and characteristics of the user groups is so great that it is impossible in any meaningful way to design a product that truly is accessible by all potential users.

The experience of other countries should be shared in the formation of access legislation, and their enforcement shared with a common interest and goal. A regular monitoring exercise should be carried out in all developing countries with the idea of recording the extent of enforcement of access legislation. Prizes or rewards should be offered to the countries giving the best example and performance for a barrier-free environment.

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# APPENDICES

## APPENDIX A

**Table 1: Showing the Maximum Lengths and Rises for Various Ramp Slope Ratios (UN, 2007)**

| Maximum slope | Maximum length | Maximum rise |
|---|---|---|
| 1:20 i.e., 9% | - | - |
| 1:16 i.e., 6% | 8 m | 0.50 m |
| 1:14 i.e., 7% | 5 m | 0.35 m |
| 1:12 i.e., 8% | 2 m | 0.15 m |
| 1:10 i.e., 10% | 1.25 m | 0.12 m |
| 1:08 i.e., 12% | 0.5 m | 0.06 m |

# APPENDIX B

## Table 2 : Best Practices for Curb Ramp Design (Federal Highway Administration (FHWA), 2007)

| Best Practice | Rationale |
|---|---|
| Provide a level maneuvering area or landing at the top of the curb ramp. | Landings are critical to allow wheelchair users space to maneuver on or off of the ramp. Furthermore, people who are continuing along the sidewalk will not have to negotiate a surface with a changing grade or cross slope. |
| Clearly identify the boundary between the bottom of the curb ramp and the street with a detectable warning. | Without a detectable warning, people with vision impairments may not be able to identify the boundary between the sidewalk and the street. |
| Design ramp grades that are perpendicular to the curb. | Assistive devices for mobility are unstable if one side of the device is lower than the other or if the full base of support (e.g., all four wheels on a wheelchair) are not in contact with the surface. This commonly occurs when the bottom of a curb ramp is not perpendicular to the curb. |
| Place the curb ramp within the marked crosswalk area. | Pedestrians outside of the marked crosswalk are less likely to be seen by drivers because they are not in an expected location. |
| Avoid changes of grade that exceed 11 percent over a 610 mm (24 in) interval. | Severe or sudden grade changes may not provide sufficient clearance for the frame of the wheelchair causing the user to tip forward or backward. |
| Design the ramp that doesn't require turning or maneuvering on the ramp surface. | Maneuvering on a steep grade can be very hazardous for people with mobility impairments. |
| Provide a curb ramp grade that can be easily distinguished from surrounding terrain; otherwise, use detectable warnings. | Gradual slopes make it difficult for people with vision impairments to detect the presence of a curb ramp. |
| Design the ramp with a grade of 7.1 ± 1.2 percent. [Do not exceed 8.33 percent (1:12).] | Shallow grades are difficult for people with vision impairments to detect but steep grades are difficult for those using assistive devices for mobility. |
| Design the ramp and gutter with a cross slope of 2.0 percent. | Ramps should have minimal cross slope so users do not have to negotiate a steep grade and cross slope simultaneously. |
| Provide adequate drainage to prevent the accumulation of water or debris on or at the bottom of the ramp. | Water, ice, or debris accumulation will decrease the slip resistance of the curb ramp surface. |
| Transitions from ramps to gutter and streets should be flush and free of level changes. | Maneuvering over any vertical rise such as lips and defects can cause wheelchair users to propel forward when wheels hit this barrier. |
| Align the curb ramp with the | Where curb ramps can be ahead, people using |

| | |
|---|---|
| crosswalk, so there is a straight path of travel from the top of the ramp to the center of the roadway to the curb ramp on the other side. | wheelchairs often build up momentum in the crosswalk in order to get up the curb ramp grade (i.e., they "take a run at it"). This alignment may be useful for people with vision impairments. |
| Provide clearly defined and easily identified edges or transitions on both sides of the ramp to contrast with sidewalk. | Clearly defined edges assist users with vision impairments to identify the presence of the ramp when it is approached from the side. |

## APPENDIX C

## Table 3: Design Brief and Accommodation Schedule

QUIET ZONES

**SPACE** **AREA $m^2$**

| | |
|---|---|
| **MAIN RECEPTION POINT** | |
| **Entrance foyer** | **35** |
| **Reception lobby** | **49** |
| **Washrooms ( male and female)** | **25** |
| **Store room** | **12** |
| **TOTAL** | **112** |

| | |
|---|---|
| **ADMINISTRATION BLOCK** | |
| **Entrance lobby** | **50** |
| **Reception area** | **37** |
| **Offices for clerical staff (10)** | **200** |
| **Offices for lecturers ( 20)** | **240** |
| **Conference room** | **40** |
| **Books store** | **40** |
| **Equipment store** | **50** |
| **archives** | **25** |
| **Staff lounge** | **24** |
| **Kitchenette** | **12** |
| **Washrooms (male/female)** | **25** |
| **Balconies/corridors** | **120** |
| **Computer room** | **120** |
| **Service space** | **30** |
| **TOTAL** | **1013** |
| | |

| | |
|---|---|
| **LIBRARY BLOCK** | |
| **Library foyer** | **24** |
| **Reception lobby** | **42** |
| **Computer centre** | **100** |
| **Library halls (5)** | **140** |
| **Offices (3)** | **36** |
| **Washrooms (male/female)** | **35** |
| **Store rooms** | **35** |
| **TOTAL** | **787** |

| | |
|---|---|
| **STAFF ACCOMMODATION** | |
| **8 Single bedroom apartments (3)** | **2400** |
| **Double bedroom houses (5)** | **750** |
| **3 bedroom house** | **180** |
| **TOTAL** | **3330** |

NOISY ZONES

| | |
|---|---|
| **DINING AREA** | |
| **Entrance lobby** | **35** |
| **Offices (2)** | **24** |
| **kitchen** | **48** |
| **Kitchen yard** | **40** |
| **Dining hall** | **644** |
| **pantry and scullery** | **80** |
| **Washrooms** | **35** |
| **Store rooms (wet and dry)** | **50** |
| **TOTAL** | **956** |

SEMI-NOISY AREAS

| WORKSHOPS AND CLASSROOMS | |
|---|---|
| Workshops (10) | 720 |
| Warehouses (2) | 360 |
| Washrooms | 50 |
| Classrooms (10) | 800 |
| TOTAL | 1930 |

| MULTI-PURPOSE HALL | |
|---|---|
| entrance foyer | 40 |
| Multi-purpose hall | 1600 |
| stage | 75 |
| Backstage | 40 |
| Changing rooms (4) | 50 |
| Offices (2) | 36 |
| Washrooms (male and female) | 96 |
| Store rooms (2) | 32 |
| TOTAL | 1969 |

| STUDENTS' ACCOMMODATION | |
|---|---|
| Entrance lobby | 20 |
| Waiting area | 20 |
| Porter's lodge | 12 |
| Shops (3) | 75 |
| Bedrooms with washrooms (50) | 6300 |
| Shared kitchen spaces ( 24) | 600 |
| Shared reading rooms ( 24) | 600 |
| Cafeterias ( 8) | 160 |
| Shared television rooms (8) | 640 |
| TOTAL | 8427 |

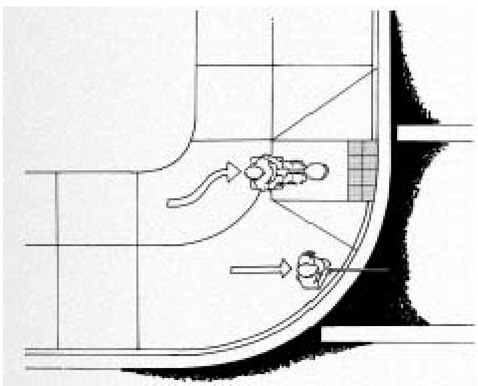
| | |
|---|---|
| **ANCILLARY FACILITIES** | |
| **Car parks and pedestrian walkways** | **9075** |
| **Football/basketball field** | **13500** |
| **gymnasium** | **200** |
| **Security office** | **9** |
| **Infirmary** | **35** |
| **TOTAL** | **22944** |

**TOTAL AREA** = 42823 $m^{2}$ + 10% circulation

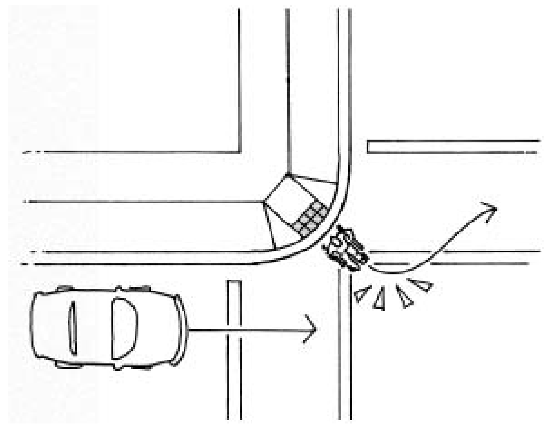
**GRAND TOTAL AREA** = 47105.3 $m^{2}$

# APPENDIX D

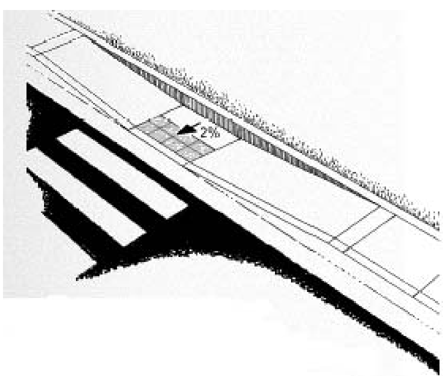
## Types of curb ramps (Federal Highway Administration (FHWA), 2007)



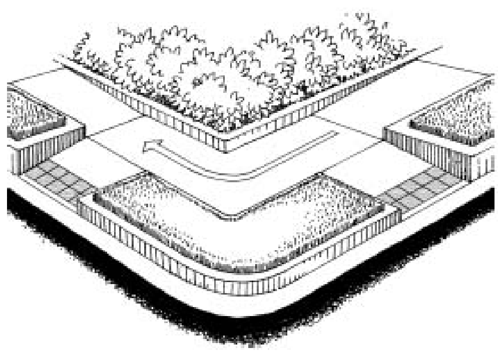
**Perpendeicualr curb**



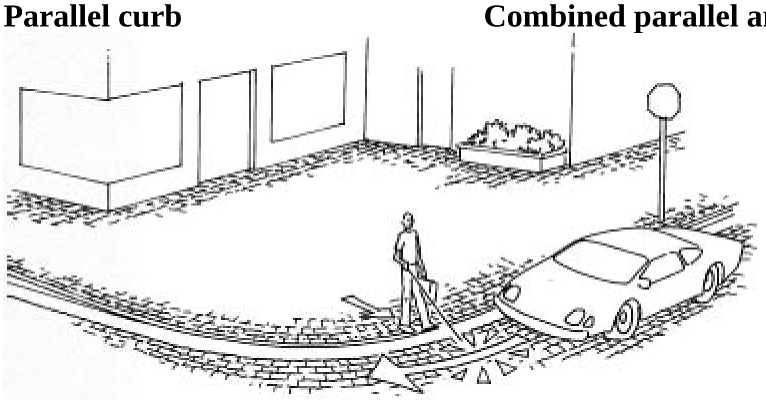
**Diagonal curb**




**Parallel curb**



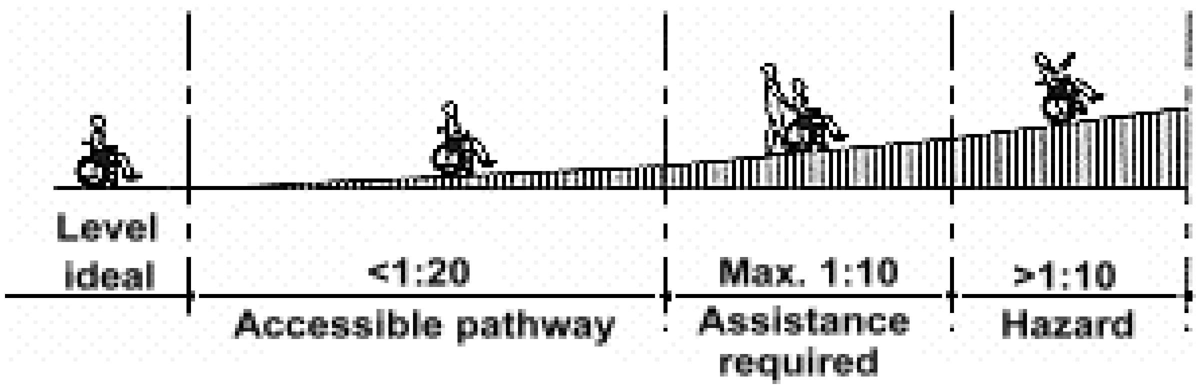
**Combined parallel and perpendicular curb ramp**



**Depressed corners**

## APPENDIX E

### Minimum and Maximum Ramp Slopes (UN, 2003)

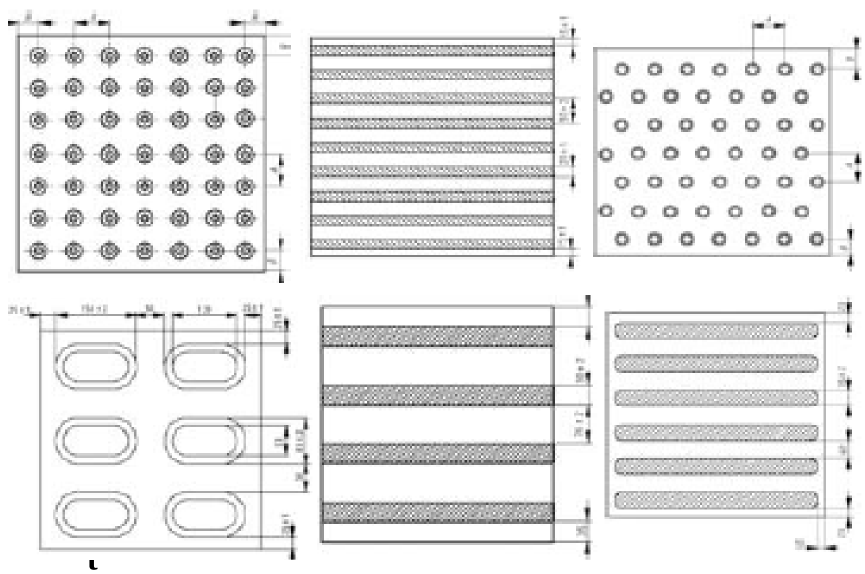


## APPENDIX F

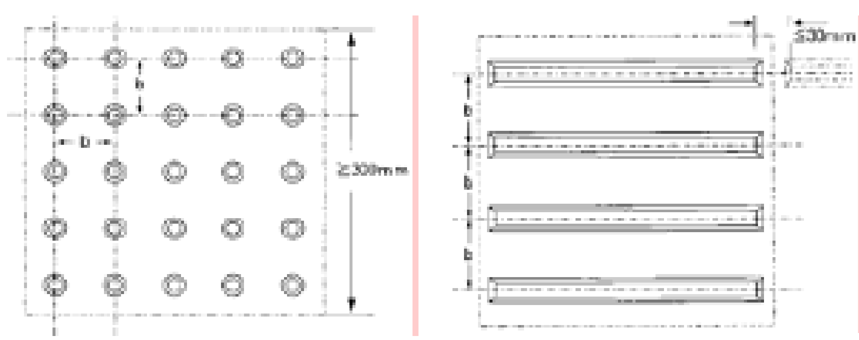
### The Patterns of Some Accepted Tactile Paving in Some Countries

**A) The Patterns of Tactile Paving in the United Kingdom**

Lu, J.Y., Siu, K. W. M. and Xu, P.A (2009)

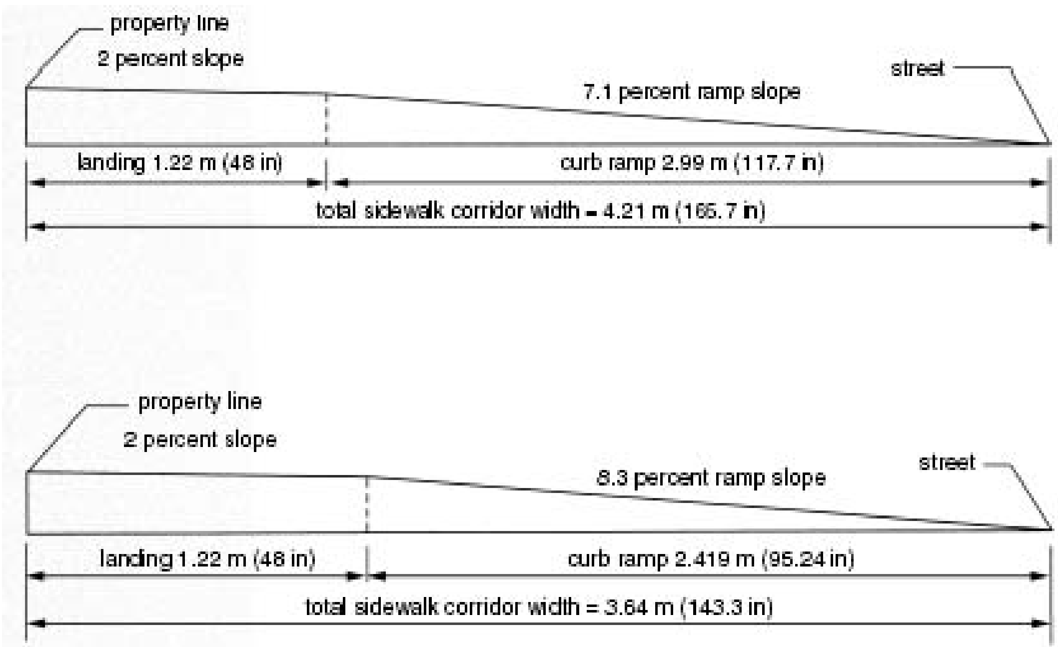


**C) Patterns of Tactile Paving According to Japanese Standards**



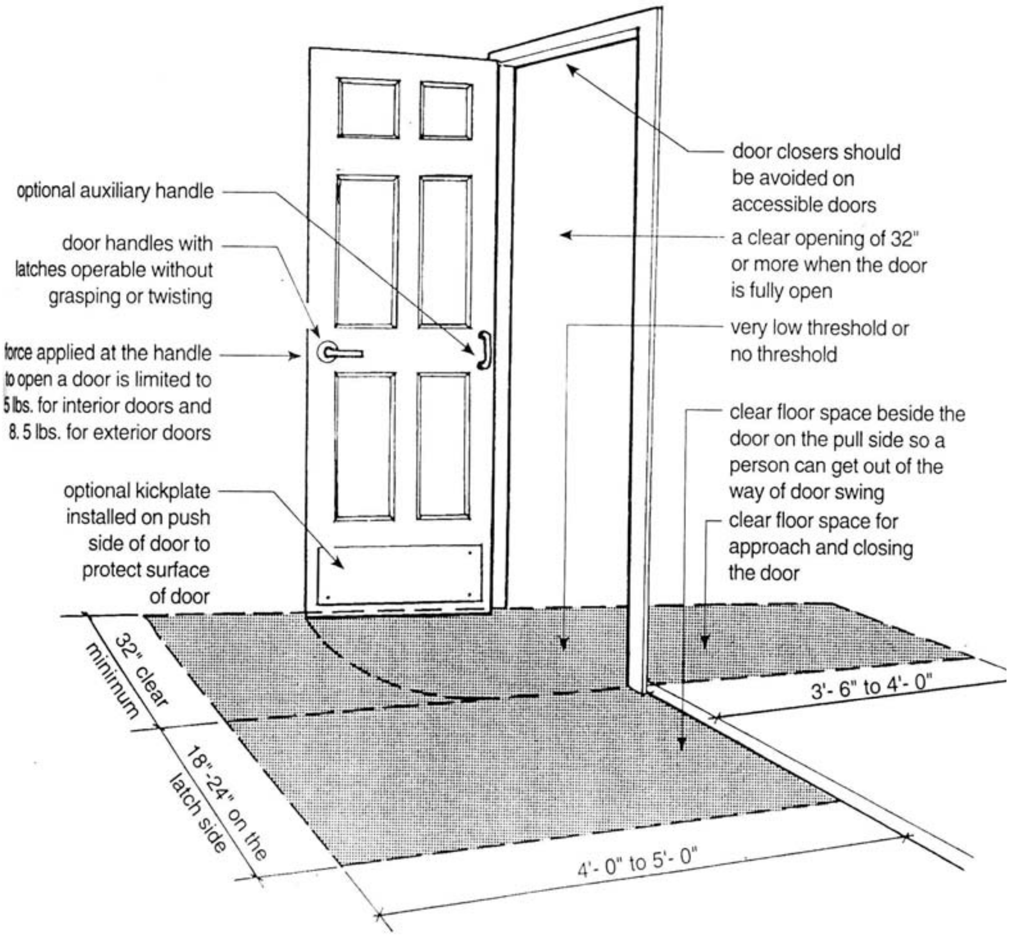
**APPENDIX G**

**Accessible Curb Ramp Gradients**
**(Federal Highway Administration (FHWA), 2007)**



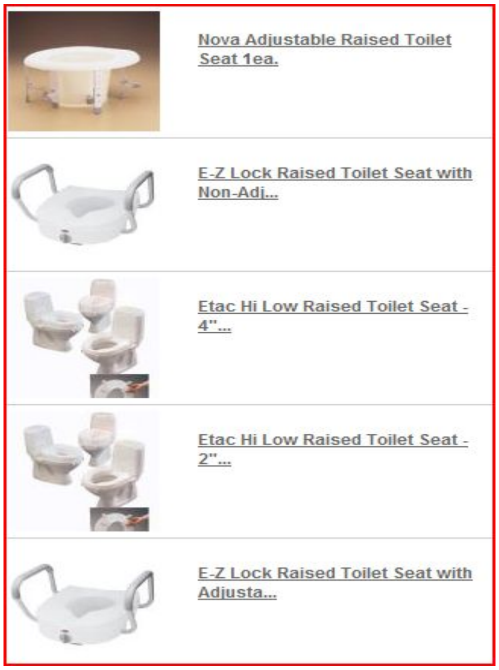
**APPENDIX H**

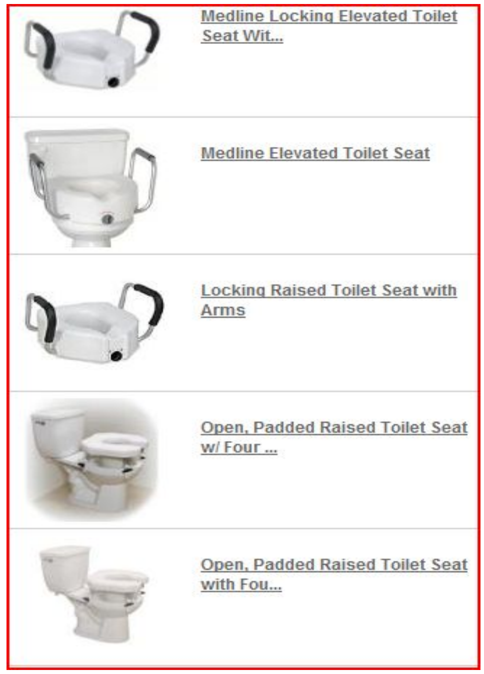
**Features of an Accessible Door, (Mace, L. R., 1991)**



## APPENDIX I

## Features of Adjustable Raised Toilet Seats (Bizrate, (2010)

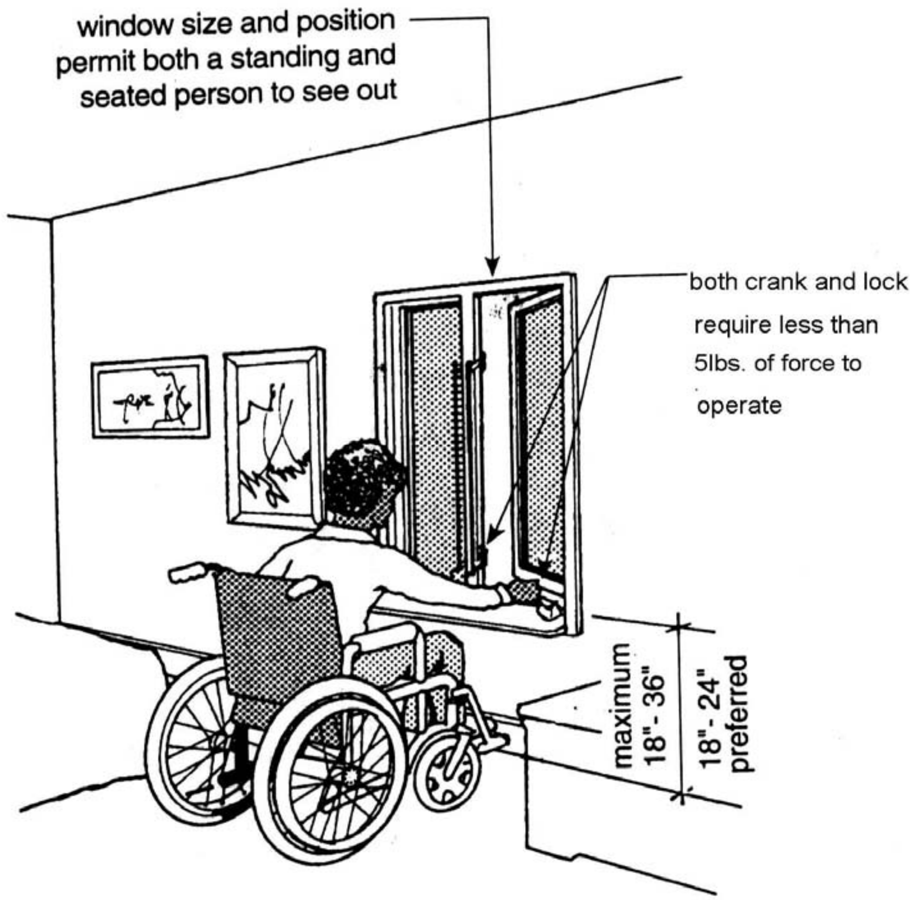




## APPENDIX J

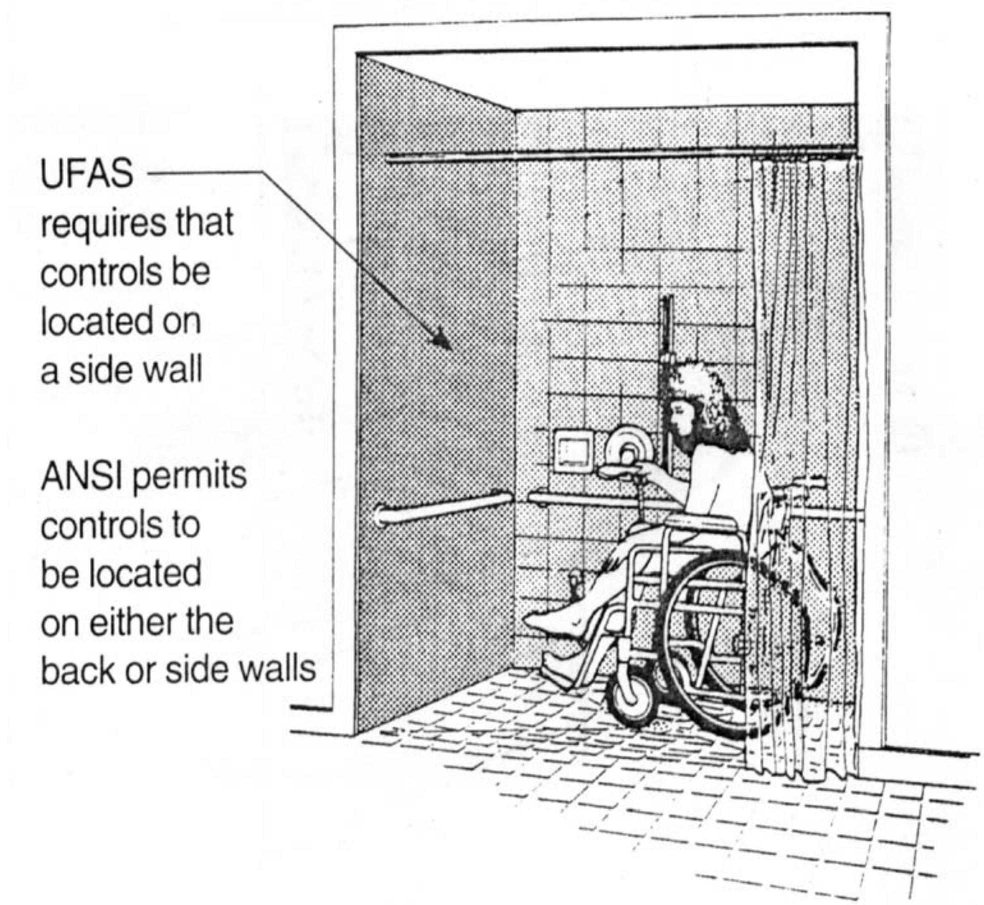
**Recommended window heights for wheelchair users, (Mace, L. R., 1991)**




Source: Accessible Housing Design File

**APPENDIX K**

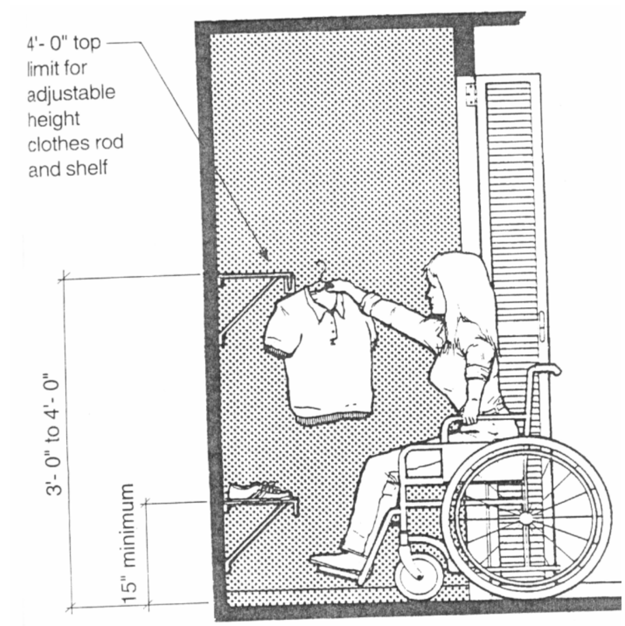
**Roll-in shower with no curb, (Mace, L. R., 1991)**

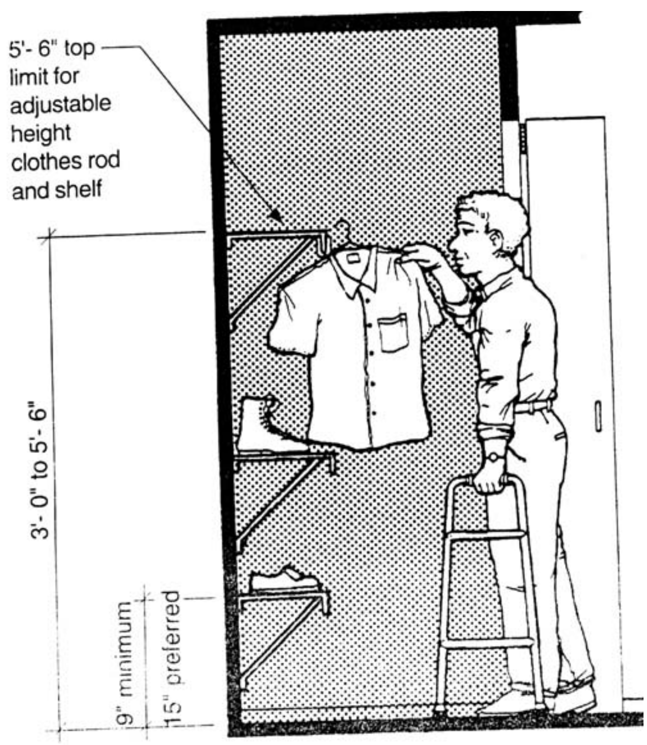


**APPENDIX L**

**Storage Height for a Wheelchair User and a Standing Mobility-Impaired Person**

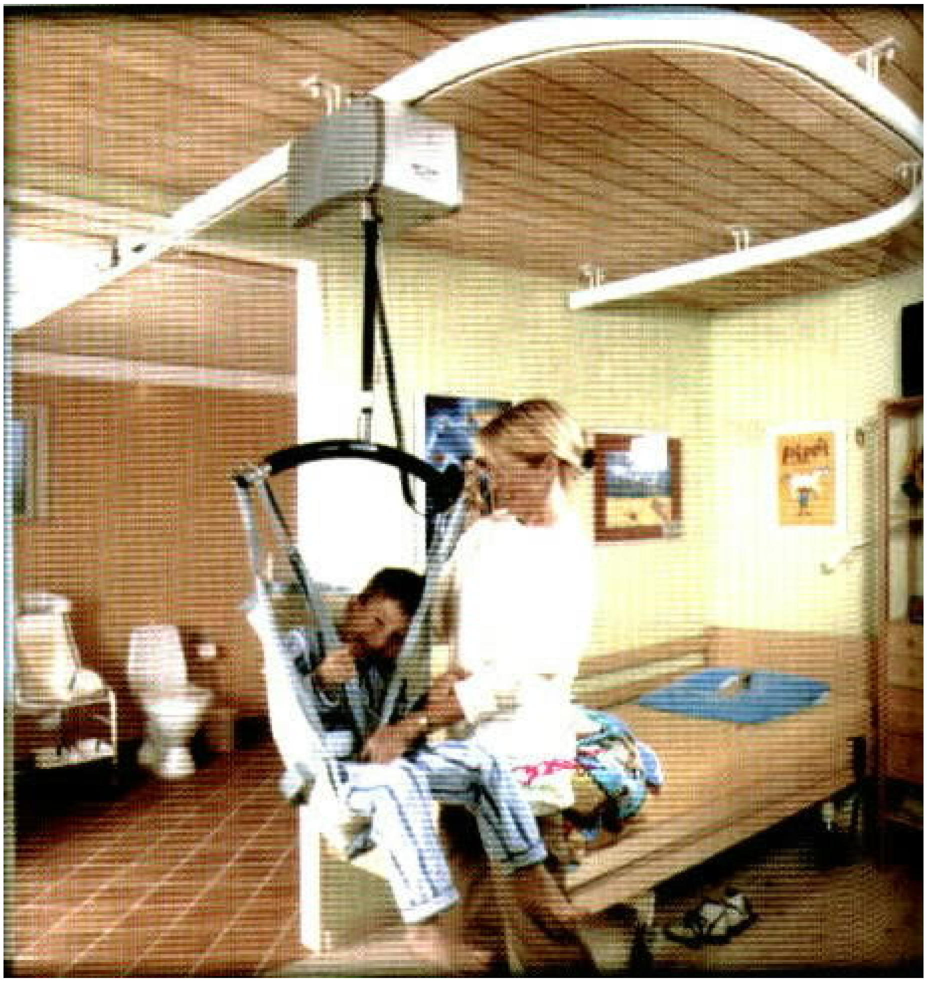
**(Mace, L. R., 1991)**



## APPENDIX M

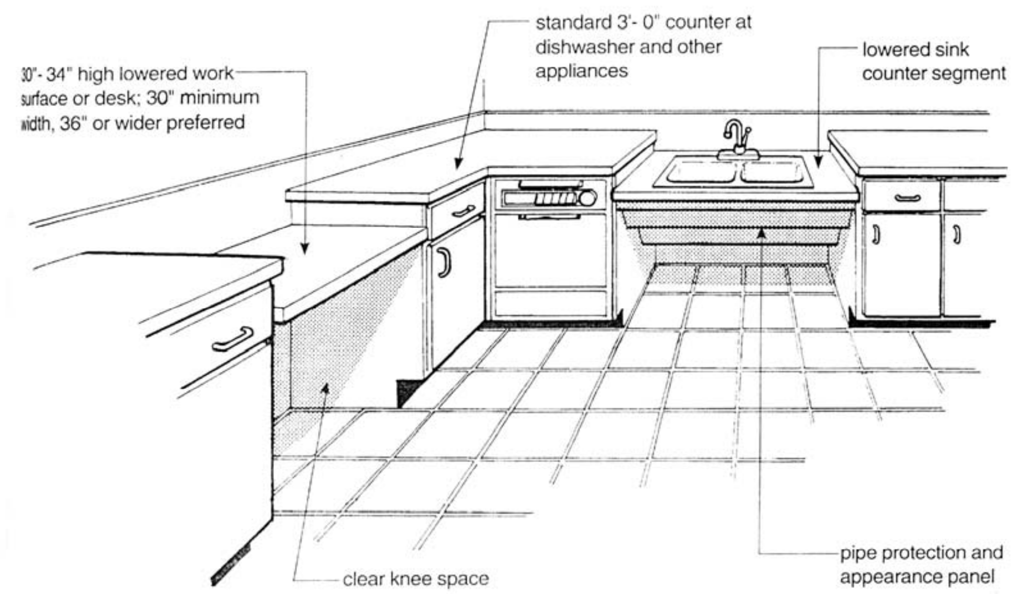
**Room with overhead track –lift**
**(The Adaptable House,**
**http://www.gov.saanich.bc.ca/business/development/plan/adaptable.html)**



**APPENDIX N**

**Accessible Kitchen Worktops at Different Heights**,

**(Mace, L. R., 1991)**



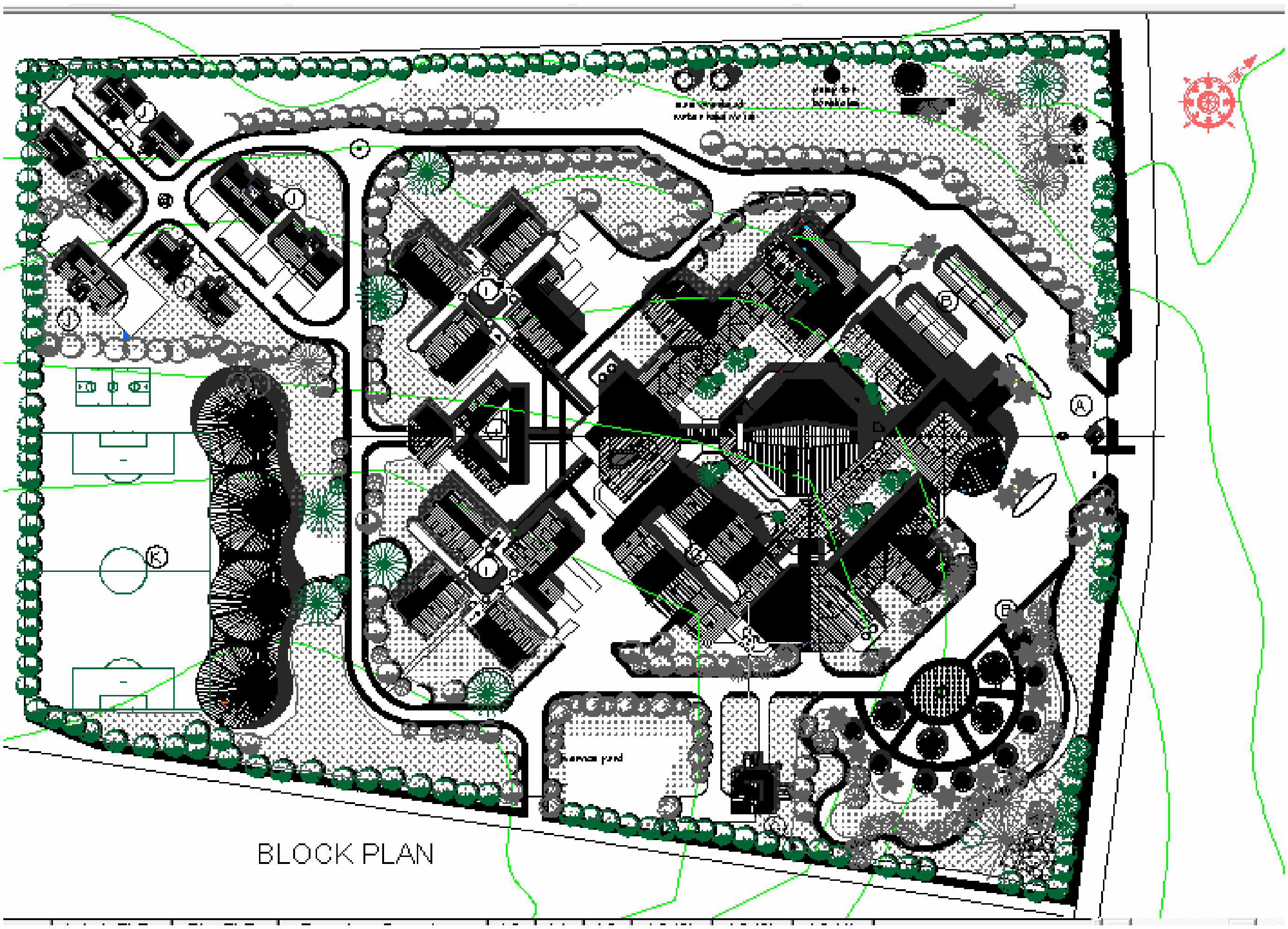
## APPENDIX O

### Site plan for the proposed Technical – Vocational Training Institute


Fig.4.11 Site location map

## APPENDIX P

## Block plan of the institute

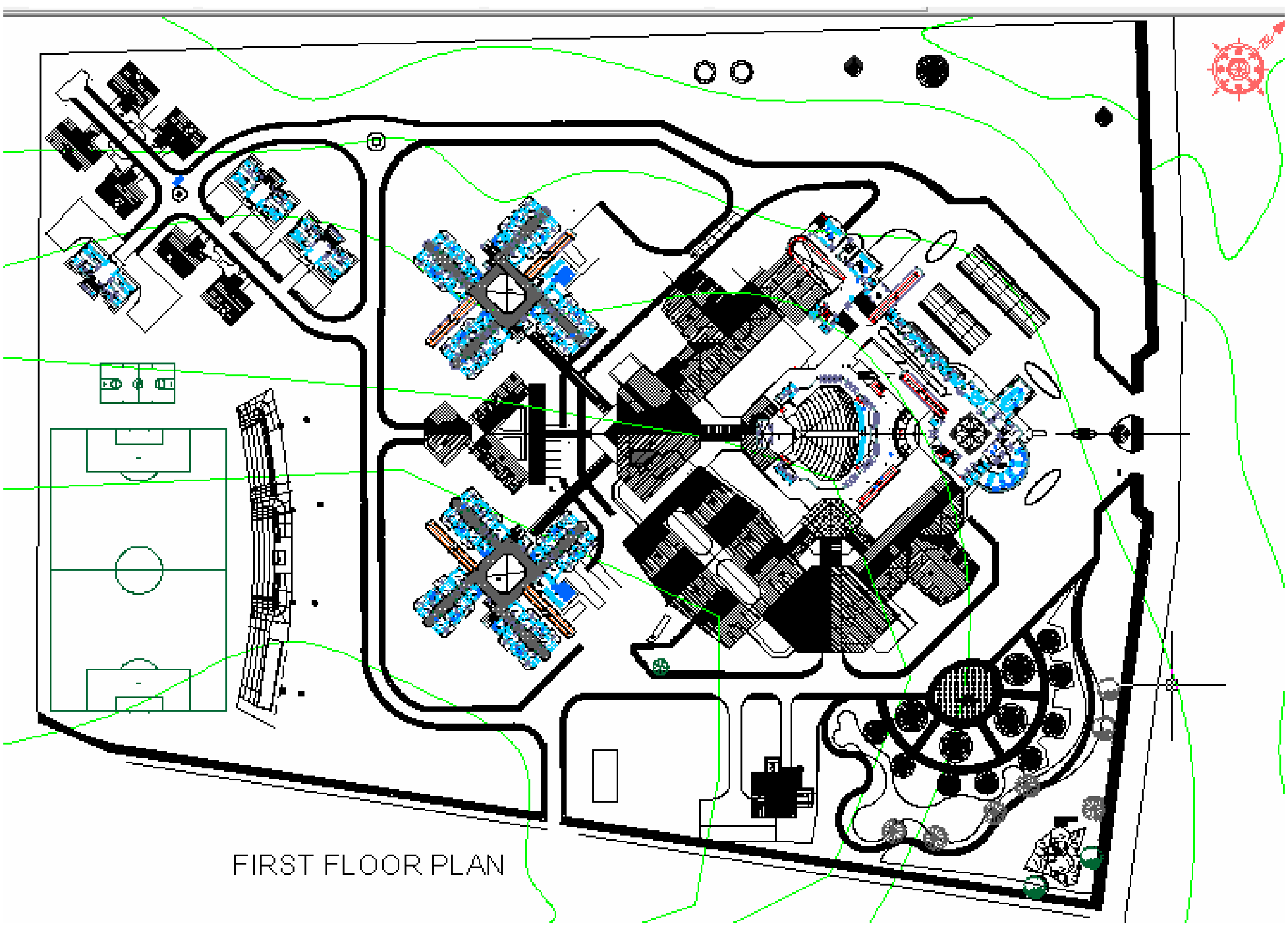



LEGEND

- (A) MAIN ENTRANCE
- (B) PARKING AREAS
- (C) ADMINISTRATION AREA
- (D) LIBRARY BLOCK
- (E) CLASSROOMS / LECTURE THEATRES
- (F) MULTI-PURPOSE HALL
- (G) WORKSHOPS
- (H) DINING AREA
- (I) STUDENTS' ACCOMMODATION
- (J) STAFF ACCOMMDATION
- (K) OUTDOOR RECREATIONAL FIELDS
- (L) THERAPUETIC GARDEN

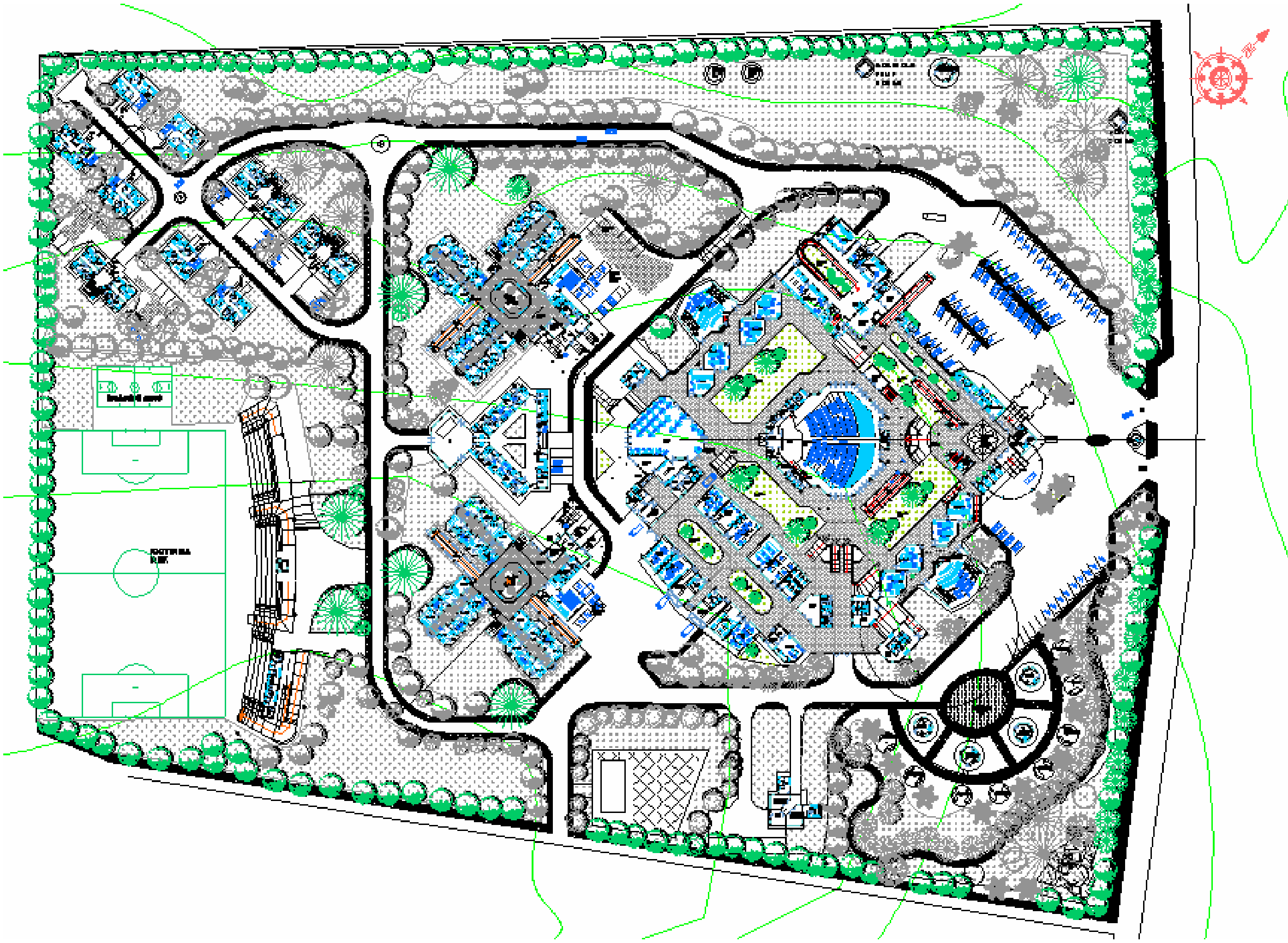
**APPENDIX Q**

**Second floor plans of the Facility**



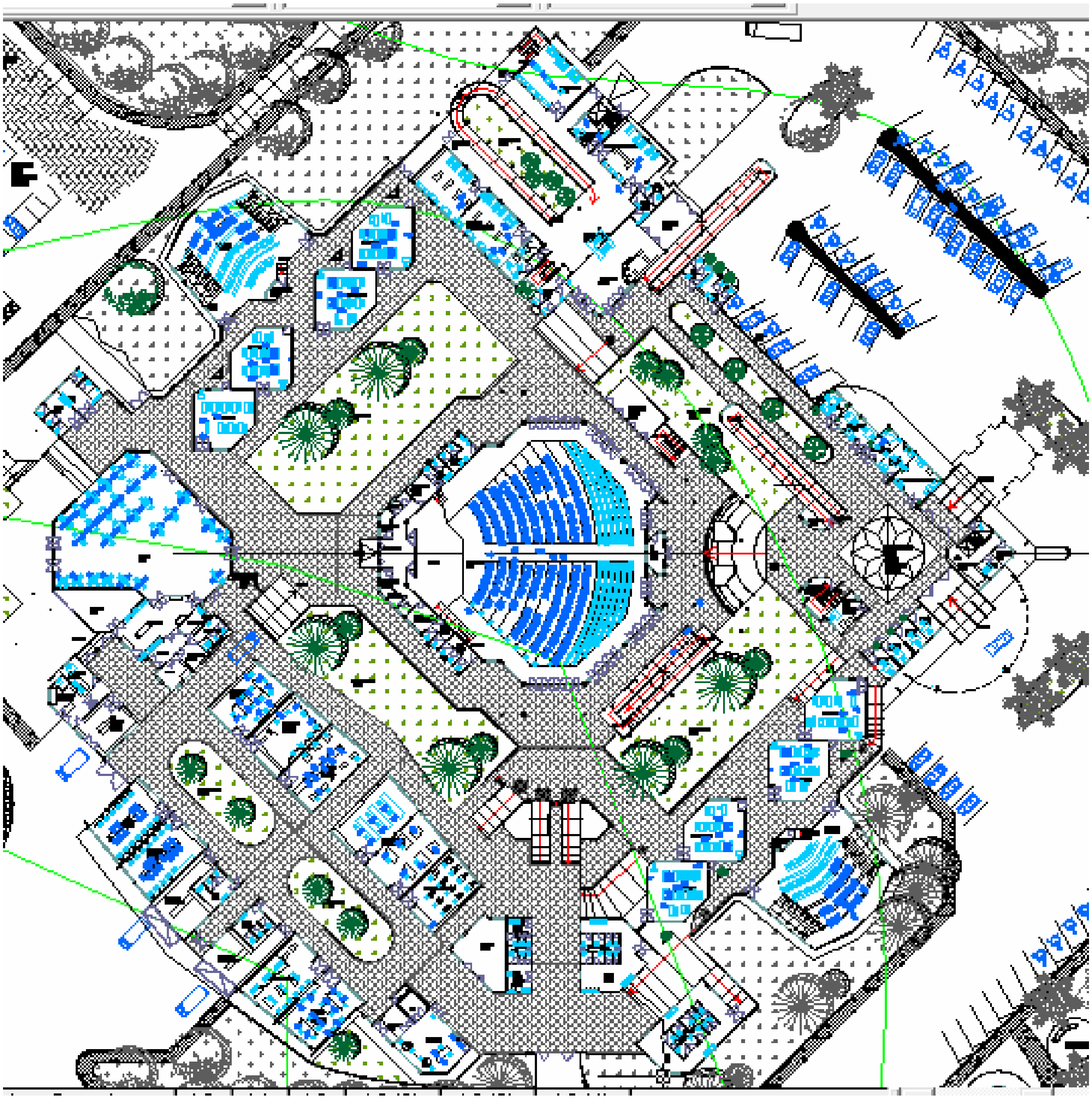
## APPENDIX R

## Site plan



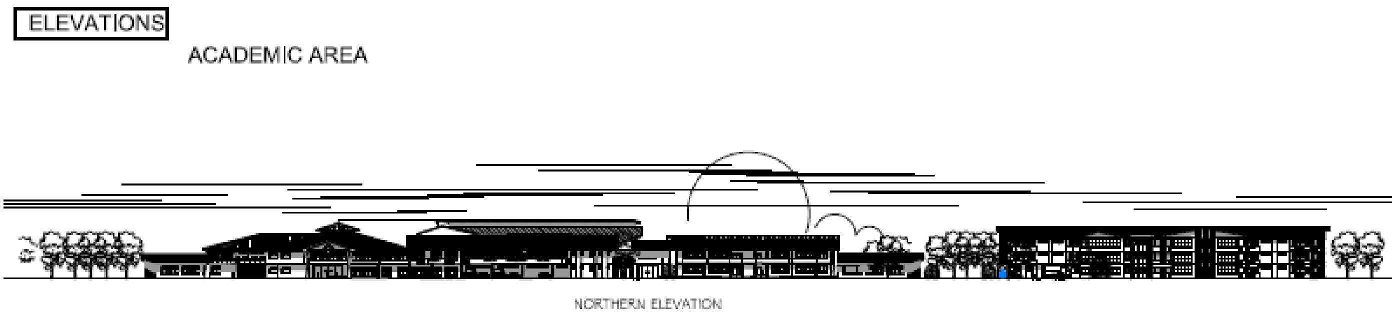
**APPENDIX S**

**Blow-up of the academic core**

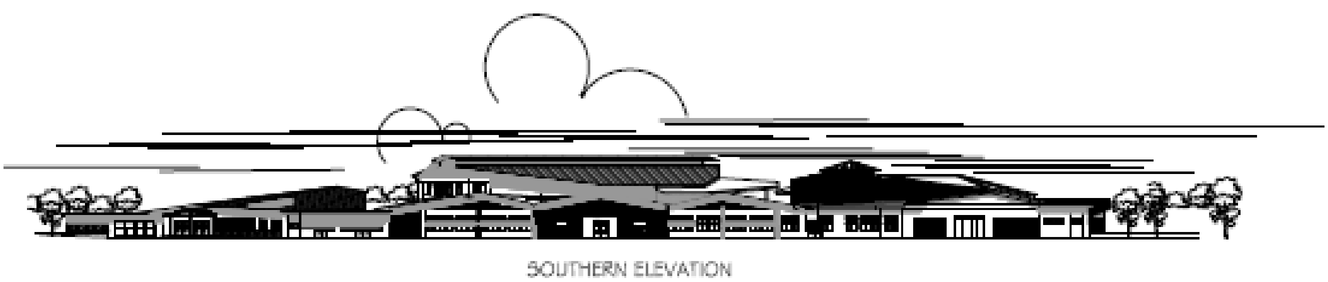


# APPENDIX T

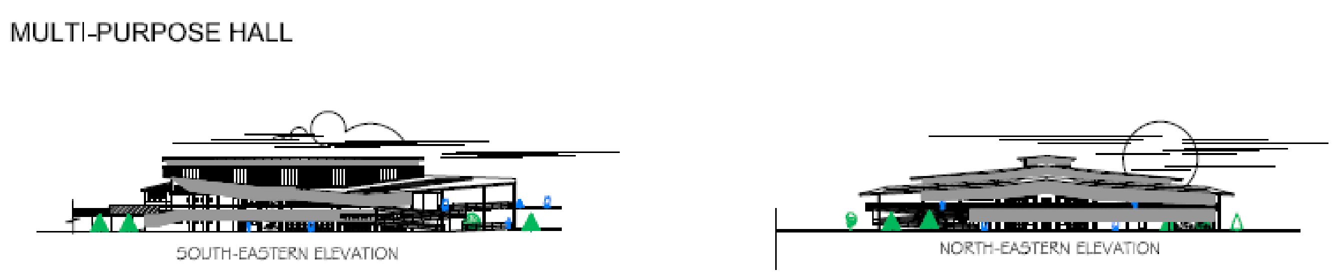
## Elevations of the Technical-Vocational Training Facility




**North Elevation**

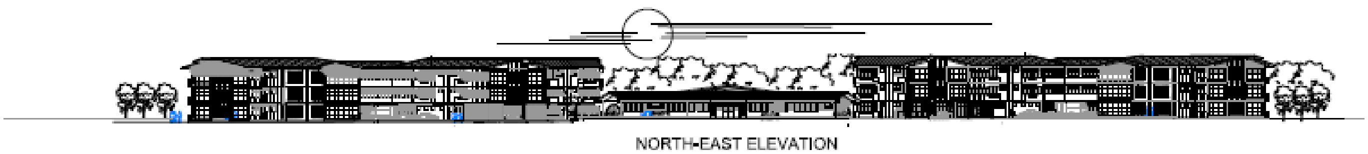



**South Elevatiom**



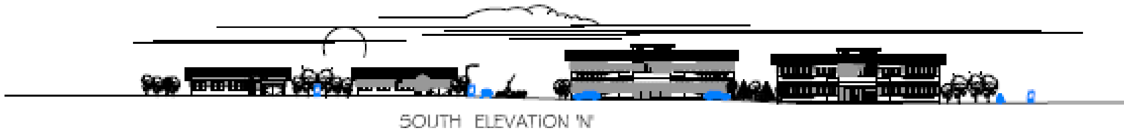

**South-eastern and North-eastern Elevations of Auditorium**

STUDENTS' HOSTEL




**North-eastern Elevations**

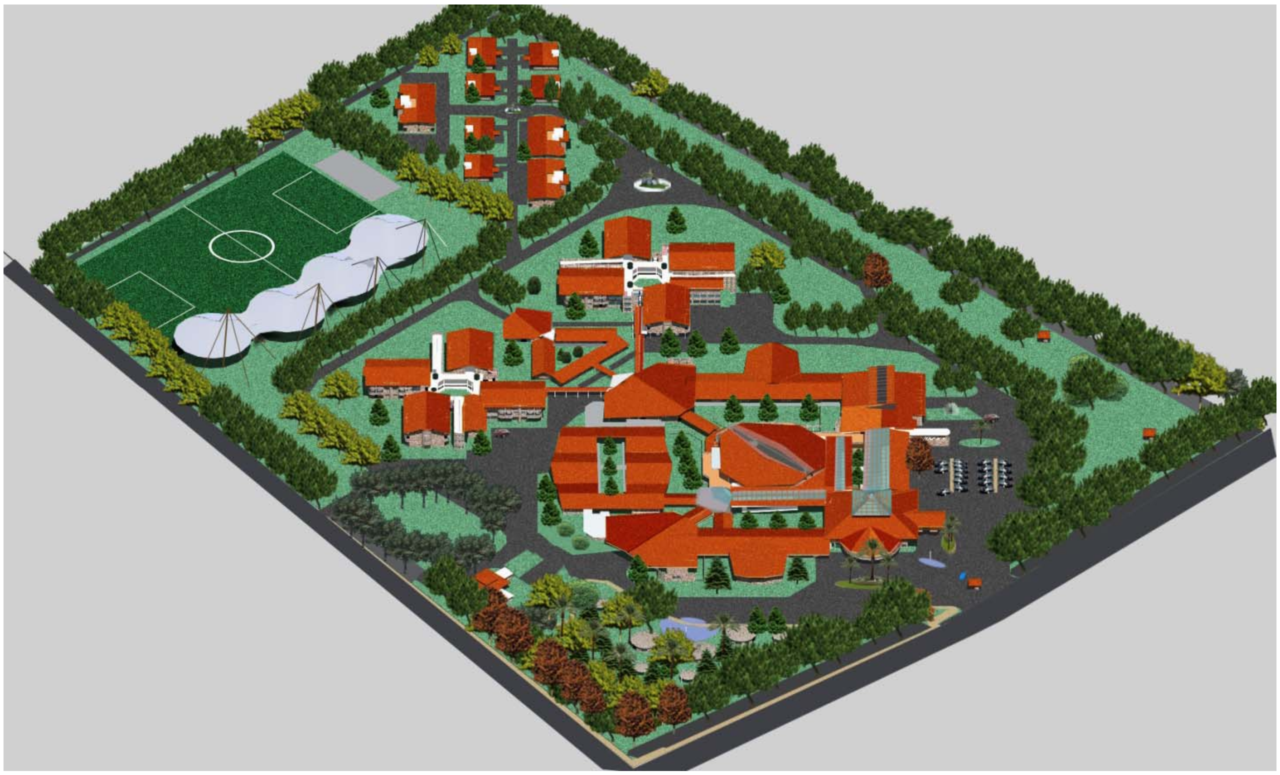
STAFF ACCOMMODATION




**South Elevations**

**APPENDIX U**

**Isometric View of the Technical-Vocational Training Facility**



**APPENDIX V**

**Perspective Views of the Administration Block and Classroom Block respectively**

**APPENDIX W**

**Interior Perspective Views of Students' Accommodation and the Administration Block respectively**

## APPENDIX X

**Perspective View of the Students Accommodation and Workshops respectively**

## APPENDIX Y

**A SAMPLE OF INTERVIEW QUESTIONS FOR ABLE-BODIED, DISABLED STUDENTS AND ADMINISTRATORS**

1. Name………………………………………………………………………………
2. Community ………………………………………………………………………..
3. Age………………………………………………………………………………….
4. School……………………………………………………………………………….
5. Type of physical disability………………………………………………….......
6. List some of the functional limitations or challenges you face with your disability ………………………………………………………………………………………… ………………………………………………………………………………………… ……………………………………………………………………………………….
7. Do you know anything about accessibility? a) yes [ ] b) no [ ]
8. What do you know about accessibility? ………………………………………………………………………………………..

……………………………………………………………………………………..

9. Give examples of some accessibility feature you know

…………………………………………………………………………………………...
…………………………………………………………………………………………

10. Do you know anything about inclusive/ universal design? a) yes [ ] b) no [ ]
11. What do you know about universal design?
12. What are some of the problems you find with accessibility design concepts?

………………………………………………………………………………………
……………………………………………………………………………………….

13. What are some of the accessibility conflicts resulting from the use of a single accessibility features with others?

…………………………………………………………………………………………
……………………………………………………………………………………..

14. What do you think could be done to solve or minimize the effect of such a problem?

……………………………………………………………………………………………..
…………………………………………………………………………………………

15. Who are the main stakeholders in the education of the disabled

…………………………………………………………………………………………

16. What are the stakeholders' contributions to the education of the disabled?

……………………………………………………………………………………………….
……………………………………………………………………………………………….

17. How are the disabled people able to access education in this community?

…………………………………………………………………………………………………
……………………………………………………………………………………………….

***** Please refer to Chapter four, Page 39 – 42 for the response to questionnaires.***