UNIVERSAL DESIGN OF TRANSPORTATION SYSTEMS: A CASE STUDY OF ACCESS AND MOBILITY OF PEOPLE WITH DISABILITIES AT SELECTED INTERSECTIONS IN DAR ES SALAAM

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ABSTRACT

The pedestrian facilities at intersections must be usable by pedestrians of all ages and capabilities. Intersections in particular must be designed to safely accommodate pedestrians of all ages and physical and mental abilities. Often, however, intersection designs fail to accommodate people with visual and mobility disabilities. In this regard, for pedestrians with disabilities, intersections can prove to be a challenge. Some of those challenges include provision of insufficient pedestrian clearance time due to use of inappropriate design pedestrian speed. Most importantly, the required facilities to enable People With Disabilities (PWD) to use the intersection without hindrance may be missing. Obstacles such as uneven surfaces, unstable surfaces, nonexistent curb ramps, road crossings, changes in height of sidewalks, nonexistent guidance systems, obstructions, vegetation overhanging sidewalks, poles in the sidewalk, holes, etc. can all be remedied. This paper presents the results of the study which was carried out in Dar es Salaam to evaluate the extent to which the design of intersections satisfies the mobility and access needs of people with disabilities. The results indicate that the design of 20 major intersections in Dar es Salaam, mostly does not pay due attention to the needs of PWD.

Key words: Universal design, Access, Mobility, PWD, PWRM

INTRODUCTION

According to Victoria Transport Policy Institute (VTPI, 2010), Universal Design (also called Inclusive Design, Accessible Design or just Accessibility) refers to facility designs that accommodate the widest range of potential users, including people with mobility and visual impairments (disabilities) and other special needs.

People with disabilities constitute a significant proportion of the poor in developing countries and Tanzania is no exception. Previous studies have shown that between 6 and 10% of people in developing countries are disabled (Despouy, 1993). In addition, it has been estimated that 20% of the world's poorest are people with disabilities of one type or the other (DFID, 2000).

Limited access to education, health care and employment opportunities make matters even worse. Invariably, with increased ability to travel, more benefits from interventions in the health care, education and social integration can be realized. It is therefore a living fact that transport is an important enabler to fight poverty and social exclusion. It should also be mentioned here that transport mobility and accessibility improvements could benefit a much larger population beyond those with permanent disabilities.

These may include people with temporary health conditions, expectant mothers, people accompanied by young children and those carrying luggage. On this note, studies have shown that at one given point in time, 20 – 30% of travelling public has mobility impairment of some kind (ECMT, 1999).

It has to be stressed that people with disabilities are mobility impaired because of the obstacles that they face in using the street system. Obstacles such as uneven surfaces, unstable surfaces, nonexistent curb ramps, road crossings, changes in height of sidewalks, nonexistent guidance systems, obstructions, vegetation overhanging sidewalks, poles in the sidewalk, holes, etc. can all be remedied.

This study aims at assessing the extent to which the design and construction of intersections satisfy the mobility and access needs of people with disabilities in Dar es Salaam city.

TYPES OF DISABILITIES AND CORRESPONDING NEEDS

Although people with disabilities have special needs, these needs differ from one type of disability to the other. However, in some cases the needs are common for all. Recognising this diversity of needs among PWD, it becomes imperative to categorise different types and extent of disabilities. In doing this, Ventel et al (2002) point out that if this categorization is not done with caution, it may trigger the concern of PWD to be categorized in a simplistic stigmatising terms. They therefore suggest that classification should be made in the context of social interaction, rather than of notions of individual condition.

In this regard, Mateo (2006) identifies four broad groups of impairment as functional and organic, mental visual and hearing. He goes further to identify their needs as follows:

People with physical disability

This group includes large groups of the population such as people with reduced mobility (PWRM) or severely reduced mobility, who move in manual or electric wheelchairs; people with physical or organic disabilities who move with the help of a stick, a crutch, or walking frames; people with limited or slow mobility; people of low stature, and those who have suffered amputations to their upper or lower limbs; and people with temporarily reduced mobility caused, for example, by post-traumatic sequels, etc. This group's needs are the most restrictive of all the types, and can be summarized as clearance widths, appropriate gradients, heights of operating, and provisions for operation in the event of absence of prehensile capacity through the use of actuators such as door handles with levers and pressure taps. When appropriate, services adapted with bars to facilitate movement, websites designed for use with head pointer-type keyboard actuators, etc., should be envisaged.

Visually impaired people

This group includes the blind, people with partial vision or different degrees of residual vision, with central vision, peripheral vision, and maculas, etc. The basic needs of this group are avoidance of projecting elements below a height of 2.10 metres that cannot be detected at ground level with a blind person's cane, which means urban furniture must be arranged appropriately. They also include the provision of traffic light sound signals at specific crossroads, alternative information systems, and an appropriate organisation of content in real or virtual spaces – such as websites read using Braille and voice synthesis in specialised

computers. People with residual vision contrast (particularly in areas where there exists a risk of falling), suitable letter sizes and tone contrasts, and magnification systems for specific goods and services.

Hearing-impaired people

This group includes the deaf with both total and partial deafness. The group has three areas of needs and assistance: assistance for people with sign culture who communicate using sign language, who experience different degrees of difficulty comprehending verbal culture. There are also people with oral culture, whether post-lingual or not (people who at some time in their lives have spoken yet who now suffer deafness), with diverse needs such as the visual use of words with written language support - subtitling, for example-, the need to read the lips of interlocutors, or needs of a more technological nature such as assistance with hearing aids, with magnetic loops, or alternative FM systems. Lastly, there is a whole series of people with cochlear implants adapted, to a lesser or greater extent, to high-or low-level noise environments.

People with intellectual or mental disabilities

These either have difficulties learning, understanding, and communicating or serious behavioural disorders. This group has rather heterogeneous needs that often require improvements in information and orientation systems and systems to enhance comprehension in different types of situations.

Other groups that benefit

To these four large traditional groups a further three may be added.

The first is the elderly, whose needs may to a lesser or larger extent coincide with the above four groups. This group is growing in importance as the population require adequate and appropriate colour ages because of longer life expectancy. There is also currently a trend towards single parent families and therefore more elderly people living alone. The need for personal autonomy is ever greater.

The second group is foreign citizens in general: these may be foreign citizens visiting on holiday or new citizens in a phase of adaptation to the new country who have come for the purposes of work.

The third group is albino. There is a significant number of people in Tanzania with skin defects (albino). This group basically does not suffer mobility problems as other groups save for their poor resistance to direct sun shine.

INTERNATIONAL REVIEW OF CURRENT PRACTICE

Ventel et al (2002) found out that the access barriers and needs identified by people with disabilities were remarkably similar in both developed and developing countries. They reveal that a large body of experience has been assembled in Europe and North America on how to address these barriers effectively. Given the similarities in character, if not in extent and detail, it is likely that many of the approaches and standards adopted in the developed world may be applicable, in part at least, to countries of the developing world. In fact, some countries of Latin America and middle/high-income Asia have started implementing accessibility improvements that are largely based on developed world standards. Home-grown experience is thus starting to emerge in some parts of the developing world, which may be very instructive in the search for appropriate solutions in others.

This paper also provides a summary of current practice in accessibility provision in Europe, America, some parts of Africa

and India. It therefore highlights the state

Legislative approaches

A good number of countries have put in place some laws or regulations. In some cases, the laws specifically instruct various sectors of government to improve the accessibility of services to people with disabilities. In other cases, the laws generally talk about anti-discrimination legislation as far as removing barriers to access is concerned.

A number of European countries have introduced legislation governing the rights of disabled people or concerning accessibility to public transport or the built environment (ECMT, 2000).

In the UK the Disability Discrimination Act (1995) created statutory rights for people with disabilities for access to employment, education, transport, goods and services and facilities. Further, regulations governing Rail Vehicle Accessibility, Public Service Vehicles Accessibility have been put in place.

India introduced Equal Opportunities, Protection of Rights and Full Participation Act, 1995 to protect the rights of people with disabilities.

Americans Disability Act (ADA) of 1990 provides minimum design standards to all public environments, including the public right of way. The Americans with Disability Act Accessibility Guidelines (AWDAAG) are the foundation for designing all pedestrian environments.

In Malawi, there is a policy that recognizes the absence of transport services for people with disabilities and suggests the need for rapid progress in developing a public transport system that is flexible and accessible.

of the practice across the world.

The transport policy identifies the following groups of disabled people as experiencing high levels of discrimination:

- Women with disabilities
- Children with disabilities
- People with learning disabilities
- Elderly with disabilities

The Mozambican constitution addresses the issue of disability. Furthermore, The Policy for people with disabilities was established in Act 20 of 1999 which is based on the constitutional principle of non-discrimination, and takes note of the following existing specific rights of people with disabilities:

Remarkably, the Mozambican Automobile Transport Regulation, 1989 (Act 24 of 89), establishes three important rights relating to people with disabilities. These are:

- people with disabilities are exempted from paying any tariff in urban transport;
- people with disabilities benefit from a reduced rate in inter-urban transport; and
- in urban transport, there will be reserved seats for people with disabilities.

CURRENT ACCESSIBILITY CONSIDERATION IN TANZANIA

The Situation of People with Disabilities in Tanzania

The Population and Housing census of 2002 indicated that Tanzania has approximately 3,346,900 people with disabilities. Of these 28% were physically impaired, 27% visually impaired, 20% hearing impaired, 8% intellectually impaired, 4% multiply impaired, and 13% suffering from other impairments (World Bank, 2003).

Furthermore, a more recent survey done by the National Bureau of Statistics (2009) reveals that around 7.8% of the Tanzanian population are people with some form of disability, 20% of which reported problems with access to transport. The same study revealed that illiteracy was highest among persons with disabilities. About half of them (47.6 percent) were illiterate compared to 25.3 percent of the persons without disabilities.

Transport and Road Safety Policy

Over the years, the Government of the United Republic of Tanzania through the Department of Social welfare provided services to people with disabilities without a comprehensive policy. The country has been actively involved in both international and local initiatives that address disability issues (MLYDS, 2004).

At the international level, Tanzania is a signatory to various disability specific United Nations instruments which include the declaration on the Rights of People with Disabilities (1975), Convention on the Rights of the Child (1989) and the Standard Rules on the Equalization of Opportunities for Persons with Disabilities (1993).

At the continental level Tanzania is a signatory to the Plan of Action for the African decade of Persons with Disabilities and a member of African Rehabilitation Institute (ARI). Currently is working with the international community to realize the finalization of a Comprehensive and Integral International Convention on the Protection and Promotion of the Rights and Dignity of Persons with Disabilities.

Locally, Tanzania has taken measures to address the problem of disability from various angles including the national health initiatives to eradicate childhood diseases that cause disablement such as polio, enactment of disability legislations, inclusion of a question on disability in the 2002 National Population and Housing Census and the ratification of the United Nations standard Rules on the Equalization of Opportunities for Persons with Disabilities. After many years of consultation amongst disability stakeholders, Tanzania adopted a National Policy on Disability (NPD). The Policy recognizes the fact that disabled persons experience difficulties in the use of transport facilities. Most facilities, for example buses and roads are not easily accessible to disabled persons (MLYDS, 2004). The policy therefore states that:

(i) The government in collaboration with stakeholders shall take measures to ensure that transport facilities are accessible to people with disabilities.

(ii) The government in collaboration with other stakeholders shall ensure that roads have necessary facilities to allow for convenient use and passage by disabled persons.

This study tries to evaluate the extent of the implementation of the above policy insofar as intersection design and construction in Dar es Salaam city is concerned.

BASIC DESIGN CONSIDERATIONS

For universal design, which takes into account the needs of those who are visually impaired or who have physical disabilities, there are some simple but important considerations that must be included in a transportation system. Wallwork (1993) summarises these considerations as follows:

- Sidewalks that provide a flat and stable surface with clearly defined edges;

- Curb ramps where the sidewalk meets a curb so they can walk or wheel
- A guidance system to help them negotiate roundabouts, audible-tactile signal to help them identify that they have reached a signalized intersection and which will then assist them to cross the street;
- Compact intersections to minimize their exposure to vehicles and which somewhat limit the speed of vehicles;
- A public transit system that will take them to and from their destination.

However, for pedestrians with disabilities, intersections can prove to be a challenge. Some of those challenges and design recommendations to better accommodate pedestrians with disabilities include the following (FHWA, 2009):

- The assumption of pedestrian walking speeds of 1.2 m/s is often inadequate.
- The pedestrian clearance time should be sufficient to allow a pedestrian crossing in the crosswalk who left the curb at the end of the WALK signal indication to travel at a walking speed of 1 m/s to the far side of the travelled way or to a median of sufficient width for pedestrians to wait.
- A walking speed of up to 1.2 m/s may be used to evaluate the sufficiency of the pedestrian clearance time at locations where equipment such as an extended push button press or passive pedestrian detection has been installed to provide slower pedestrians an opportunity to request and receive a longer pedestrian clearance time.
- Where pedestrians who travel slower than 1 m/s routinely use the crosswalk, a slower walking speed should be used in determining the clearance interval.
- The total of the walking interval and pedestrian clearance time should be themselves up and down from the sidewalk to the road;

  sufficient to allow a pedestrian crossing in the crosswalk who left the pedestrian detector (or, if no pedestrian detector is present, a location 1.8 m back from the face of the curb or from the edge of the pavement) at the beginning of the WALKING PERSON signal indication to travel at a walking speed of 1 m/s to the far side of the travelled way being crossed.

METHODOLOGY AND STUDY AREA COVERAGE

Major signalized junctions with four approaches in the city were studied. These junctions have crossing points for pedestrians on each intersection leg. They are signalized intersections constrained by many road side activity facilities which result into problems of mobility. 50% of the junctions were free in terms of space and they could easily be revised or improved in order to accommodate PWD. Likewise in some of the junctions there was road furniture on one approach which constrained open space where otherwise signs and marking for PWD could be indicated. Crossing points of all these junctions were of paramount importance for the study.

The study was done through direct site observations, road side interview and round table discussion with institutions dealing with the affairs of PWD. Information compiled includes type of facilities for PWD present, number of the facilities per junction, condition and location, time which PWD can use to clear the junction, number of PWD accessing and crossing the junction per day and mode of crossing used by disabilities to cross the junction. Also included was information on number of

PWD accessing the junctions in case study area, their views through road side interview, and finally views from institutions dealing with issues of PWD. Furthermore, available facilities for PWD, their condition, location and descriptive measures were documented.

RESULTS

Direct observation and measurements

The results from direct observation and measurements are presented in Table 1.

Table 1: Results of Direct Observation and Measurements

S/N	Item	Results	Remarks
1	Signs and Markings	▪ Zebra markings on crossing points available ▪ Special markings and signs for disabled are non-existent	Improvement is required by providing special markings and signs for disabled.
2	Width of Crossing Points	▪ Ranges between 3.2 and 4.0 m (more than 60% with 4.0 m)	Meet minimum requirements of 2.5 m specified by AASHTO
3	Side walk ramps	▪ 70% of intersections have dropped sidewalk ramps ▪ Width ranges from 1500 – 1700 mm long transversely towards carriageway on one leg of the junction ▪ Rise of the ramp between 120 and 150 mm	Dropped kerbs are required to assist wheel chair users
4	Sound Signal	None	No sound signals in all junctions to alert people with visual impairments
5	Tactile Paved Surface	None	No tactile paved surface in all crossing junctions for blinds
6	Number of PWD crossing the junctions	2 - 3% of total pedestrians	The number of PWD crossing the junctions is very low

Results of Road Side Interview

It was recognized that while some PWD and PWRM manage to cross the intersections, they do so with great difficulty and risk.

In order to understand and document experiences and needs of these groups, a

questionnaire was designed and administered with the following considerations/aims:

- Gathering user perspectives
- Assessing independent mobility issues
- Finding out how easy or difficult use the road infrastructure
- Establishing the extent of accessibility
- Assessing road safety perception by PWD

A total of 76 respondents were interviewed and the results of their responses are summarized in Table 2. This was done through road side interviews as well as visiting several organizations, schools, residences and work places.

Table 2: Results of Questionnaire Interview (Percentage opinion)

S/N	Item	Results (%)	Remarks
1	Always need assistance to cross the intersection	73%	Road infrastructure not friendly
2	Getting prompt help from other users	24%	Other road users show very little interest in helping PWD
3	Experiencing conflicts from other road users	51%	Other road users do not pay attention to PWD when crossing the junctions
4	Missing assistive infrastructure	79%	Design of Road infrastructure very rarely considers needs of PWD
5	Getting problems due to uneven road surface	35%	Uneven surface makes some PWD walk with difficulty.
6	Requires audible signals	63%	Audible signals are required for vision impaired people
7	Do not have sufficient time to cross the intersection (requires central refuge island)	56%	Some intersections provide little time for PWD and PWRM to cross the junctions
8	Situation limits the movements (trips)	83%	PWD think twice before deciding to make any trip because of the unfriendly road infrastructure
9	Roads Intersections are safety hazards and dangerous	92%	Most PWD and PWRM consider road intersections as safety hazard.
10	Markings are not adequate	79%	More markings for PWD are required

As can be seen from Table 2, the results of opinion survey clearly indicate that the road infrastructure is not friendly since most of PWD are dependent i.e. they require assistance to cross the intersections. It is also observed that majority do not use the road infrastructure because the situation is not favourable and road intersections are very dangerous.

Discussion with Organisations Dealing with PWD Matters

This was done by visiting organizations/institutions which deal with issues concerning people with disabilities. These organizations include CHAWATA (*Association of disabled people in Tanzania),* SHIVYAWATA (*Federation of Disabled People Organizations*), National Committee for People with Disabilities on Road Safety (T) NCPDRS, and Yombo college for the disabled. Generally, all personnel interviewed in these organizations were of the opinion that the Government of Tanzania is not doing enough to help people with disabilities in using effectively the transport systems and related facilities.

DISCUSSION

The situation shows that the number of people with disabilities accessing and crossing the intersections is very low. The main reason is lack of important facilities which can help them to cross the junctions. As a result, PWD perceive the intersections as hazardous and unsafe. In this regard, several suggestions to improve the situation are hereby given.

Mobility Improvement

The study shows that mobility of people with disabilities in our crossing junction is limited due to lack of assistive facilities to all people with addressed physical problems.

Improvements are required in the existing road junctions in order to facilitate mobility. Such improvement includes; introduction of 1.5m to 2m wide tactile paved surface out of 4m of the whole section on each crossing section.

This will help to accommodate those using sticks with sensor which will be detected by the surface and brings alarm which guides them to cross. At the same time tactile paved surface will be used as special separate crossing section for all people with disabilities without scrambling with non disabled pedestrians.

Also tactile surfaces have to be sufficiently “rough” or “rigorous” for blind people to feel them through their shoes. In general, tactile paved surface guide paths and dedicated queuing space for People With Disabilities.

Dropped kerbs

Dropped kerbs are of great help to wheelchair users. It was found that location of the dropped kerbs towards the carriage way in the crossing junction was a problem in some of the junctions. These should be provided at all pedestrian crossing points.

The dropped kerb or (kerb cut) should be flush with the carriageway; 2 metres wide (more if it is a heavily used crossing point) and the gradients associated with it should be gentle.

Busy junctions require some form of control to assist pedestrians across the road. This may be just a pedestrian crossing (zebra) or a controlled crossing (traffic signals with a pedestrian phase and various other forms of control such as “pelicans” and “puffins”).

Again all these crossings should have dropped kerbs. Further help can be given to visually-impaired pedestrians at controlled crossings by means of audible and tactile (or haptic) signals.

To help visually-impaired people, a dropped kerb should be in direct line of travel. In addition tactile surface should be laid in a contrasting colour to the surrounding pavement.

Sound signal
No sound signals in all crossing junctions in the case study area. Some of the junctions have signals to allow or to stop pedestrian to cross the junctions.

Green signal of the pelicans can be synchronized with alarm /sound which can help to alert blind to use the junctions when vehicles have stopped and it is safe for pedestrians to cross. Combining tactile paved surface and sound signals would improve mobility of people with visual impairment.

Signs
All junctions have no signs which display or alert pedestrians to give priority to people with disabilities when crossing the junctions so that they can cross safely. Crossing points miss all signs. There is therefore need for improvement to make the junction friendly to people with disabilities in terms of accessibility and mobility.

Near the tactile paved surface, signs for disabled have to be marked so that other pedestrian can give them right of way (priority) to cross without scrambling.

Markings
Tactile paved surface has to be marked different from zebra crossing mark. This will help guide other pedestrians to respect the people with disabilities walkway.

Also near the crossing sections, where tactile paved surface starts has to be marked with disabled signs and to inform pedestrian by writings such as (**FOR DISABLED).**

Education
Children with disabilities in developing countries have restricted access to education. According to CHAWATA (Association of Disabled in Tanzania), only 1 to 2% go to school.

The road safety education should be continuous while placing more emphasis on driver responsibility through physical measures and advertising campaigns.

Road safety knowledge should be imparted at a young age (from around 5 years old) in order to make them aware of the situation. In addition, these skills should be taught in schools of various levels.

Drivers
The effects of vehicle speed on the severity of pedestrian casualties have been a recurring theme. To address the problem, drivers also have a special responsibility for the safety of people with disabilities. Therefore drivers have to be informed to respect people with disabilities and other pedestrians when crossing the junctions. Strict enforcement of no parking rules near the entrance of the road crossing junctions and on walkways has to be seriously affected. Severe punishments are required, supported by education to other road users in order to raise awareness of these anti-social practices.

CONCLUSION AND RECOMMENDATIONS

Tanzania adopted a National Policy on Disability (NPD) which recognizes the fact that disabled persons experience difficulties in the use of transport facilities. However, the results of the study presented in this paper indicate that the intersection design of 20 major intersections in Dar es Salaam, mostly

does not pay due attention to the needs of PWD.

It is therefore recommended that PWD need to be considered at the planning and design stages of infrastructure projects to provide pedestrian facilities that are accessible to PWD and thus the whole population.

In this regard, roads authorities should undertake road safety audits and accessibility audits to assess the performance in a particular area on providing access to a whole range of users. Road safety audits are an important part of any new schemes put forward by the highways authorities from the start of the design process, through to the completion and opening of any new roads.

A road safety audit would make recommendations that would ensure greater accessibility for the physically disabled and visually impaired users. In some areas there are not enough flush kerbs and there is uneven and cracked paving. These things can pose a hazard for people in wheelchairs and those with sight problems. An accessibility audit will identify areas that need tactile paving in order to alert the visually impaired that they are approaching a road. In addition, a road authority will also undertake mobility audits to assess whether highways are properly accessible to users with a range of mobility problems and then make recommendations to address the issue. Any new schemes brought in by the highways authority have to ensure that roads and other public areas are suitable for everyone, including those people with a range of mobility and visual problems.

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