

4 THE IMPACT OF AN INADEQUATE ROAD ENVIRONMENT ON THE SAFETY OF NON-MOTORISED ROAD USERS

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ABSTRACT

In South Africa, as is the case in most other developing countries, a significant proportion of the population walk or cycle on a daily basis to their places of work and to other destinations. Road accident casualties (fatalities and injuries) among these vulnerable road users (VRUs) have always been high and in 2004, they constituted about 41%, i.e. 5 309 of the 12 727 road fatalities on South African roads. Non-motorised road users (NMRUs) comprise a variety of road users, mostly pedestrians or cyclists. The objective of this chapter is to highlight the research findings and those strategies and guidelines (which have been developed regarding the road environment) that should be addressed in order to improve the challenges that NMRUs have to face on a daily basis. The chapter also lists the human requirements that would ensure that people used safe facilities. Issues within the road environment that contribute to casualties among NMRUs are highlighted. These include the lack of a holistic approach to network planning; the inadequate and inconsistent provision of non-motorised transport infrastructure; poor integration of transportation and land-use planning; as well as the inadequacy of public transport planning aimed at reducing risk and exposure. Furthermore, strategies/countermeasures are discussed to promote the safety of VRUs. These include the strategies, policies, work plans and practices of government departments such as the Department of Transport (DoT) and the Department of Provincial and Local Government (DoPLG). The chapter concludes with the major shortfalls still being experienced in improving the road environment for NMRUs and also lists the areas that need to be researched. The development of proper guidelines for the provision of safe facilities for rural pedestrians and cyclists is one of the major areas that need to be researched.

Key-words: vulnerable road users, pedestrians, road environment

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INTRODUCTION

In South Africa, a significant proportion of the population walk or cycle to their places of work and to other destinations on a daily basis. In 2003, the DoT conducted a National Travel Survey (DoT 2003). This survey showed that 2 259 million or 23.0% of the workforce indicated that they walk to their working place. This figure can be differentiated by area: metropolitan – 8.7%, urban – 24% and rural – 51.8%.

Road accident casualties (fatalities and injuries) among VRUs have always been high and are a matter of grave concern for road authorities. In the early eighties, pedestrians comprised about 48% of all road fatalities, and although the figure has gradually declined over the years, by the year 2004 pedestrians still comprised about 41% of all road fatalities, i.e. 5 309 of the 12 727 road fatalities on South African roads. Table 1 shows statistics by user group fatalities released by the Road Traffic Management Corporation (RTMC 2005).

Table 1. User group fatalities in South Africa: 2003–2004

Year	User group fatalities									
	Driver		Passenger		Pedestrian		Cyclist		Total	
	n	%	n	%	n	%	n	%	n	%
2003	3 349	27,1	3 691	29,9	5 313	43,0	358	2,9	12 354	100
2004	3 351	26,3	4 066	31,9	5 309	41,8	350	2,8	12 727	100

(Source: RTMC, 2005, p.11)

However, the pedestrian statistics in the metropolitan areas are even more cause for concern as shown in Table 2 reflecting data from the eThekweni Transport Authority (2004). Unfortunately cyclist data were not available from this source.

Table 2. User group fatalities in eThekweni: 2003

Year	User group fatalities							
	Driver		Passenger		Pedestrian		Total	
	n	%	n	%	n	%	n	%
2003	134	18.1	157	21.2	451	60.8	742	100

(Source: eThekweni Transport Authority 2004)

Since the mid-nineties, there has also been a growing awareness in South African government circles that the needs of the VRU group, especially the NMRU group, i.e. pedestrians and cyclists, should be catered for. This has started to filter through the policies and strategies initiated by government departments both on the national and provincial levels. Concepts such as "safer pedestrians", *Shova Kalula* ("Ride Easy") and "non-motorised

transport" (NMT) have emerged. This drive implied that the needs of NMRUs would be addressed more holistically. A multitude of interventions evolved from this process, including the increased restriction of vehicle speed and alcohol abuse; the attempted improvement of road user behaviour; and the improvement of the physical environment for NMRUs alongside roads or when crossing roads.

NMRUs comprise a variety of users, ranging from child and adult pedestrians and cyclists; disabled and elderly pedestrians; people pushing wheelbarrows or pulling hand-drawn carts, both in urban and rural areas, to transport sick people or to collect firewood, water, and other commodities such as scrap metal, glass, cardboard, and building material. Animal-drawn vehicles also fall within this category, but are not specifically dealt with in this chapter. The wide spectrum of NMRUs implies that a comprehensive plan needs to be devised and implemented to accommodate each user type.

OBJECTIVE AND RATIONALE

The objective of this chapter is to highlight the research findings and those strategies and guidelines (which have been developed regarding the road environment) that should be addressed in order to improve the challenges that NMRUs have to face on a daily basis. The current shortcomings are discussed, focussing specifically on previously disadvantaged areas and other areas that need urgent attention. Remedial measures that must be implemented to correct these shortcomings are discussed. The data used in this article have been retrieved from empirical research studies conducted by the authors and other researchers in South Africa as well as from a literature review of government policies and strategies. The rationale of this chapter is to draw attention to the major disadvantages that NMT in South Africa still experiences when compared to motorised transport.

THE ROAD ENVIRONMENT CONTEXT

The road environment in South Africa, apart from a few pockets of excellence, generally does not provide a safe environment for VRUs. This is a common problem throughout Africa. In 2000, the Expert Group on Low-Cost Mobility in African Cities (IHE/World Bank 2000) concluded that in general it is impossible to cycle in big cities in Africa without taking a severe accident risk. They recommended that in order to make cycling safe in these cities, firstly, large-scale traffic calming programmes were required, and secondly, there would need to be large-scale improvement of access roads and tracks to meet NMT standards. Although some South African cities would comply with the first requirement, very few would meet the second one.

In South Africa, those townships developed prior to the mid-nineties adjacent to cities and towns, were considered as dormitory areas and in most areas only limited paved road infrastructure was provided. Despite recent upgrading in many municipal areas, many of these townships still lack proper road and pedestrian infrastructure; street lighting is poor; road storm-water drainage systems are lacking or substandard; there are inadequate open spaces, etc. During the rainy season, the poor drainage and lack of paved footways pose major problems to pedestrians. The lack of proper street lighting also presents major road safety and security problems for commuters who leave home early in the morning or arrive home late at night.

The influx of many rural residents to the bigger towns and cities has led to the establishment of various formal and informal settlements, especially next to or close to the road network in order to gain easy access to transport. In many of these areas no amenities exist for NMT. In a study along a 22km stretch of the Golden Highway P73/1, De Beer (2002) found that the densely populated residential areas on either side of the Golden Highway generated large volumes of pedestrians throughout the day, both crossing and walking alongside the road. There were also a lot of pedestrians going to and from the schools located opposite the informal settlements, and also within the formal townships, at certain times of the day.

Pedestrians crossed the Golden Highway along the entire length of the section due to the lack of channelisation. Twenty-seven access roads have been provided over this 22 km section of the Golden Highway and three of these are stop sign controlled intersections. However, no provision has been made for pedestrian facilities at any of these intersections. Furthermore, because no paved sidewalks leading to the taxi bays have been provided, taxis stop anywhere alongside the road. Street lighting was also absent. Recently, the road authorities in Gauteng have embarked upon a community-based project to provide sidewalks along the Golden Highway.

In a similar study of Edendale Road in Msunduzi Metro in KwaZulu-Natal, commissioned by the KwaZulu-Natal Department of Transport, the University of Natal Interdisciplinary Accident Research Centre (UNIARC) found many problems (Riyad & Myeza 2002). In respect of pedestrian safety the following issues were pertinent:

- poor maintenance of the road as characterised by traffic signs, poor visibility and road markings and lack of fencing along Edendale Road to prevent stray animals from wandering on the road, both of which put pedestrians at risk from drivers taking evasive action
- structural problems associated with the Edendale Hospital pedestrian bridge

- lack of pedestrian sidewalks
- lack of visible traffic law enforcement in the area leading to perceived reckless driving, e.g. excessive speeding (especially by taxis), drinking and driving and ignoring traffic lights
- erratic use of pedestrian access ways such as the Edendale Hospital bridge, pedestrian crossings and traffic lights
- need for more road safety campaigns emphasising road-crossing skills for children and adults.

Recent studies conducted by the Council for Scientific and Industrial Research (CSIR) for the Limpopo Department of Roads and Transport (Ribbens & Makhafola 2004), showed that similar road safety problems were experienced in rural areas. This was especially so where major routes run through villages, dividing them into two. People, including school children, have to cross these roads to go to work, shops, schools, recreational facilities and the like. Although speed limits of 60 or 80 km/h are normally introduced, drivers do not adhere to these limits. A typical problem found in many urban areas and rural villages throughout South Africa is that the necessary signage and facilities for NMRUs have either not been provided, or are not properly maintained in accordance with the guidelines contained in the *SA and SADC Road Traffic Sign Manual (RTSM)* (SADC 1997) and the *Pedestrian and Bicycle Facility Guidelines Manual (PBFGM)* (DoT 2003b).

Although this chapter focuses on the deficiencies in the road environment, it would be appropriate to look briefly at road users and their requirements for a safe road environment. Jaywalking, alcohol abuse by drivers and pedestrians, speeding by motorists, not giving way to pedestrians, and lack of visibility are but a few of the human factors contributing to casualties among NMRTUs. These psycho-sociological issues were dealt with in the UNIARC study published in 2004 (Van Schalkwyk & Naidoo 2004). This study concluded that VRUs are unlikely to, (and cannot really be expected to), comply with road safety rules until the road system takes their basic needs for walking or cycling into account. The more important needs of pedestrians and cyclists that are acknowledged in the *PBFGM* (DoT 2003b) are:

- secure facilities free from criminal elements and safety hazards such as slippery surfaces
- protection from traffic, accessibility of facilities to all users
- convenience in the sense of a fast direct route
- comfortable gradients, and an attractive environment.

ENVIRONMENTAL AND ENGINEERING CONTRIBUTORS TO VRU RISK

Many factors within the road environment contribute to increased risk and exposure of NMT. Factors within the planning and design frameworks which contribute to the problem include the lack of a holistic approach to network planning; the inadequate and inconsistent provision of non-motorised infrastructure; poor integration of transportation and land-use planning; and the inadequacy of public transport planning to reduce risk and exposure. These issues are discussed in more detail below.

LACK OF A HOLISTIC APPROACH TO NETWORK PLANNING (AND POOR CONNECTIVITY BETWEEN DESTINATIONS)

The *PBFGM* (DoT 2003b) states that, ideally, a pedestrian and bicycle network should be (re)developed in cities and towns to provide a high level of connectivity between origins and destinations, and to overcome barriers to walking and cycling. The ideal is to provide a complete system of interconnected pedestrian and bicycle ways between all locations in the network visited by pedestrian and cyclists. Furthermore, separating pedestrians, cyclists and traffic can reduce exposure, the ideal being to provide separate pathways for each.

“Open” and “closed” networks

The process of connectivity can be achieved by applying a number of planning principles of which the concepts of “open” and “closed” networks, horizontal and vertical separation, and the integration of non-motorised and motorised traffic are the most important. Connectivity for pedestrians and cyclists can be achieved when an open network is provided in contrast to the closed network (DoT 2003b). Examples are shown in Figure 1. The main difference between the open and closed networks is that the open network allows traffic movement in as many directions as possible, while such movements are restricted in the closed network. The open network allows traffic to disperse to a number of local streets, in contrast to the closed network which focuses traffic onto a restricted number of high order roads and discourages traffic from using low order streets.

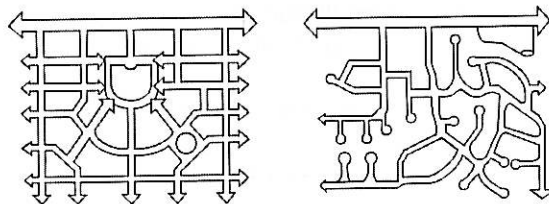


Figure 1. Open and closed networks
(Source: Pedestrian and Bicycle Facility Guidelines Manual 2003)

Both open and closed networks have advantages and disadvantages.

The open network encourages community access and provides greater accessibility for pedestrians and cyclists, while the closed network has the advantage of discouraging extraneous through traffic from using the local street system. This is particularly important in residential areas where it is necessary to preserve the residential quality of the areas, and to protect the safety of residents by reducing conflicts between pedestrians and vehicles. This concept, however, places limitations on the movement patterns of pedestrians and cyclists.

An example of a system which combines the advantages of both the open and closed networks is shown in Figure 2. In this system, linkages are provided for the exclusive use of pedestrians and cyclists. Community access is encouraged, while restricting vehicular access ensures the residential quality of the area.

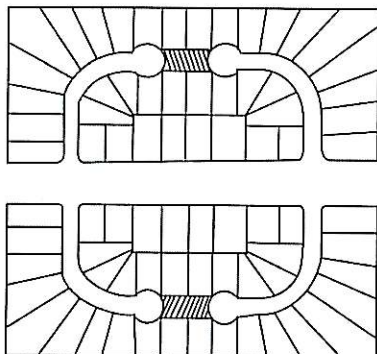


Figure 2. "Compromise" network with pedestrian/bicycle linkages
(Source: Pedestrian and Bicycle Facility Guidelines Manual 2003)

In most cities and towns with the more traditional grid open layouts, there are no proper pedestrian and bicycle networks in existence. Some do have a few network segments, but this seldom provides complete connectivity. Consequently, the pedestrian or cyclist is exposed to traffic in many ways when crossing roads and moving alongside roads.

More recently, the emerging security village phenomenon where public open spaces are closed by means of palisade fencing due to increased criminal activity, has threatened the principle of connectivity. Many of these potential linkages for NMRUs have been closed off by means of fences and security gates. Park strips that normally would have provided short convenient routes

to destinations are no longer available. Pedestrians and cyclists have had to revert to the road network where safe facilities in the form of sidewalks or bicycle ways do not always exist. It should be noted that the general aim of these closures is to reduce the degree of connectivity favouring criminal activity and escape routes. However, the degree of usage is also an important factor here as pedestrians and cyclists are likely to avoid under-utilised facilities and parks for fear of falling victim to criminals. Although the traffic calming measures adopted for Durban's beachfront area some years ago initially severely curtailed connectivity for motorised vehicles, these connections were to a large extent reinstated, to enhance the security of the non-motorised sectors.

"Horizontal" and "vertical" separation

The concept of "horizontal" and "vertical" separation of pedestrians and cyclists from road traffic can be achieved either by separating these modes within the road reserve or by providing walkways and bicycle paths away from the road reserve through open spaces and parks as practised in some Asian countries (Krishna 2002). Figure 3 illustrates the different options that could be applied in South Africa.

Within the road reserve, separate sidewalks for pedestrians should be provided. Class 2 bicycle lanes on the roadway may be provided to separate the cyclists by means of a physical barrier from road traffic, whereas Class 3 bicycle lanes are located on the roadway with no barriers between road traffic and cyclists. Alternatively, a pedestrian walkway or a Class 1 bicycle road could be provided through open spaces or park strips.

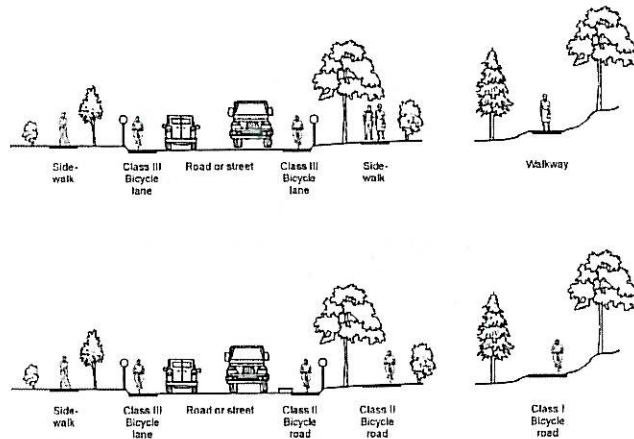


Figure 3. Pedestrian and bicycle ways
(Source: Pedestrian and Bicycle Facility Guidelines Manual 2003)

The idea of the horizontal and vertical separation of non-motorised and motorised traffic has been established through the "new towns" concept developed in the United Kingdom. Ideally, these townships provided a completely separate network of pedestrian and bicycle facilities away from the road network with horizontal separation, e.g. footbridges and subways, where these facilities intersected the road network. Only a few of these holistically planned non-motorised networks exist in South Africa, e.g. Sasolburg, Secunda, Richards Bay, Atlantis, and the initial suburbs of Phoenix north of Durban (the concept was to a large extent abandoned in Phoenix due to security problems as long ago as the 1980s). It appears that adaptations to the principles used internationally are required for local conditions. Other cities and towns, e.g. Cape Town, have developed master plans to cater for the needs of cyclists.

Pedestrian malls are another form of horizontal separation between traffic and pedestrians normally associated with commercial and business centres. There are different types of pedestrian malls, e.g. modified streets, transit malls, interrupted or continuous malls, off-street sidewalk grids, multi-level malls, etc. Many of these have been used successfully in South African cities and towns.

Non-motorised and motorised traffic integration

The concept of integrating non-motorised and motorised traffic was initially developed in The Netherlands through the "woonerf" concept and later "Verkehrsberühigen" in Germany. The idea was to create a residential precinct allowing vehicles to share the road with pedestrians and cyclists under certain conditions. Apart from a general speed limit of 30 km/h, various design measures, generally referred to as traffic calming measures, were introduced to restrict the speed of vehicles in these precincts. The measures include speed humps, raised crosswalks, mini circles, chicanes, chokers and different forms of road closures at intersections (diagonal, partial, one or more legs of the intersection), and mid-block road closures.

In South Africa, as in countries such as Australia, the United States, and Canada, cities have developed more horizontally than in Europe with resultant urban sprawl. Traffic calming has proved to be effective in these countries, but applied in a different context compared to Europe. Traffic calming measures are often aimed at making an area (such as a residential area) safer for pedestrians and cyclists, and particularly for children. However, these measures do not have to be restricted to residential areas only, but can also be applied in any location where there is a high

concentration of pedestrians and cyclists, such as schools, commercial and industrial areas, sports grounds, and public transport terminals. In this respect eThekweni Metro has recently adopted a policy of providing speed humps at all school entrances.

The *PBFGM* (DoT 2003b) indicates that traffic calming is aimed at addressing two specific types of problems experienced on roads and streets, namely traffic intrusion and speeding. The *PBFGM* also recommends different types of treatment to address these problems, and it is important that the problem should be identified correctly before the appropriate treatment is selected. For cost effectiveness and holistic safety very careful planning and consideration of calming measures for each specific individual location is required. "Templates" of a "one size fits all" design should be avoided.

Traffic intrusion is being experienced on many urban streets and roads in ever-increasing volumes due to the growth of urban areas. This problem is often caused by an inadequate major road network that is incapable of handling traffic. The result is that traffic takes "short cuts" through residential areas, resulting in so-called "traffic intrusion". This results in high volumes of traffic on roads and is often associated with a poor quality of life. In a study of the impact of traffic on liveability, Appleyard (1981) found that people living on streets with high volumes of traffic had fewer friends and acquaintances, and a low level of pride, sense of ownership and sense of place. Increased traffic causes people to retreat into buildings and their homes, thus abandoning the public space. This often results in a deteriorating environment in which vandalism and criminal activity increase and people who were neighbours now merely live in adjoining houses and buildings.

Speeding is another problem that is often experienced on residential streets. Many of the older residential areas were designed on a grid pattern, resulting in long straight streets that are an open invitation for drivers to speed. Traffic calming can be very effective in addressing speeding problems, although most measures are only effective at a point along the road or street, and must be repeated to be effective over a long stretch of road. Drivers often become irritated when they perceive that there are an excessive number of calming measures and care is required to ensure that the problem is not exacerbated by drivers detouring to take even less suitable routes.

Lack of pedestrian/bicycle infrastructure and the proper maintenance thereof

Although there has been an improvement in the provision of pedestrian facilities in South Africa over the last few decades, there are still many places where the pedestrian and bicycle infrastructure could be considered as insufficient. This includes the previously disadvantaged areas in urban and rural areas as well as the more recently established formal and informal settlements.

Although road safety problems occur in informal settlements as well as formalised townships, greater safety problems are experienced in informal settlements due to the lack of infrastructure and particularly pedestrian facilities. Such settlements often develop adjacent to major roads in order to gain access to transport, and in some cases, informal housing encroaches onto road reserves.

Although transportation facilities have been provided in some townships, many of these facilities have not been properly maintained or have been neglected due to limited budgets. This applies especially to pedestrian facilities such as sidewalks and pedestrian crossings. In many townships pedestrian facilities are completely lacking. In a study of Maunde Street, one of the main arterials in Atteridgeville, commissioned by the City of Tshwane to improve pedestrian safety along this route, De Beer (2000) reported that a number of pedestrian facilities were required, including:

- additional raised pedestrian crossings
- pedestrian walkways
- improved road markings and street lighting
- vertical kerbs at intersections to prevent minibus taxis from cutting corners
- paving for pedestrians at intersections
- taxi bays as well as additional taxi bays where required.

Similarly, a study of Edendale Road in Msunduzi Metro (Riyad & Myeza 2002) recommended that:

- vehicle speeds be reduced by introducing calming measures at schools and busy intersections
- law enforcement be improved with increased visibility of enforcement during peak hours
- road safety campaigns be targeted to provide a co-ordinated multi-disciplinary approach to road safety
- vegetation be maintained and cleared, especially on sidewalks
- a longer barrier be erected to prevent pedestrians crossing at grade

instead of over the bridge provided

- signage be improved and updated
- research be conducted into changing the behaviour of VRUs such as pedestrians.

Various common problems, which have a negative impact on road safety, are experienced in informal settlements and townships (DoT 2003b), including:

- hawkers in the road reserves which block pedestrian sidewalks
- small businesses which operate on the sidewalk such as car maintenance, telephone booths, etc.
- shacks/houses built up to the edge of the road
- minibus taxis which use the sidewalk as stops, ranking areas and even repair and washing bays
- boulders placed on the walkway to protect properties against traffic
- lack of drainage, or poorly maintained drainage systems, force pedestrians onto the roadway during the rainy season. Regular maintenance of such drainage systems would improve the plight of pedestrians walking alongside roads especially during inclement weather conditions
- non-existent or poorly maintained street lighting, which is a very important amenity for pedestrians who often leave early in the mornings or arrive home late in the evenings. A major proportion of pedestrian casualties in South Africa are recorded during the hours of darkness.

The forthcoming 2010 FIFA World Cup will provide an important incentive for NMT infrastructure in the cities and towns where qualifying matches will be played (DoT 2005). The Towards a 2010 Transport Action Agenda (DoT 2005) lists the non-motorised project opportunities for cities and towns that will assist in the acceleration of implementation and delivery, e.g. Johannesburg, City of Cape Town, eThekweni, Nelson Mandela Metro, Mangaung, Rustenburg, Polokwane, Kimberley/Sol Plaatjies Municipality, Tshwane Metro, Mbombela/Nelspruit and Orkney/Klerksdorp.

Inadequate integration of land-use and transport planning with regard to NMT

In South African cities, examples illustrating the inadequate integration of land-use and transport planning abound. This deficiency is reflected in permitting housing areas for the poor, or squatters, to be established next to freeways and other high volume roads, and positioning pedestrian generators (shops, schools, industrial areas, sport stadiums, etc.) next to major roads. Inevitably these developments lead to people crossing those roads at grade to access transport, and to go to work, school or the shops.

In a study conducted in 2000, Johnson, Davidson & De Beer (2000) identified 19 sites on national and provincial sites in Gauteng that could be considered as hazardous pedestrian locations. The study showed that some of the major issues related to these problem sites being located next to major roads were: schools (26%), high activity zones such as commercial areas (21%), squatter and low income areas (42%), and industrial areas (16%). Therefore, safe crossing facilities, such as footbridges with proper barriers to channel people to them, must be provided initially and not only after many people have been killed crossing high speed roads.

Such footbridges, unless properly designed, may actually prove disadvantageous to the 30% of the population that includes the sick, pregnant women, physically disabled, and aged and even those with a fear of heights. Thus, they must have appropriate ramps, smooth ground level access and hand railings. Mohan (2005) has argued that: "We will never eliminate carelessness, absentmindedness and even neglect in day-to-day activities, but by designing products and environment to be more tolerant of these normal variations in human performance, we can minimise the number of resulting crashes and injuries" (p. 35). It is only when society learns to put people before technology, that they will have learnt compassion and only through compassion that we can heal our prejudices (Noah 2004).

There are a number of good practice examples where the South African Roads Agency Limited (SANRAL) and other road authorities have provided footbridges and barrier walls to prevent pedestrians from adjacent settlements from crossing freeways at grade, e.g. the R300 and N2 freeways in Western Cape, the N1 freeway at Hammanskraal in Gauteng, the N4 freeway in and near Witbank in Mpumalanga, and Edwin Swales VC Drive and South Coast Road in KwaZulu-Natal.

Currently, the Integrated Development Planning (IDP) plans of most of the municipalities have yet to cover road safety issues and therefore the needs of VRUs have not been addressed. Hopefully, more emphasis will be placed on the integration of land-use and transport planning through the IDP process (in terms of the Municipal Structures Act, Act No. 23 of 2001) and the Integrated Transport Planning (ITP) process (in terms of the National Land Transport Transition Act, Act No. 22 of 2000).

The national and provincial departments of education can also play a significant role in this process as many schools have yet to be provided in the previously disadvantaged areas through the new schools provision programme.

When planning the location of school sites, due consideration should be given to the fact that these sites should preferably be located away from major roads. Liaison with responsible authorities should also take place on adjacent road design in order to ensure the provision of safe taxi and bus bays off the main route.

Inadequate public transport planning for unnecessary exposure and risk to VRUs

A number of problems have been identified at public transport facilities that contribute to the unnecessary exposure and risk of pedestrians. The *PBFGM* (DoT 2003b) highlights some of these issues. Typical problems include the offloading of passengers on major routes and the inadequate planning of facilities at public transport termini, bus and taxi stops, etc.

In many cases public transport is not routed into informal settlements and townships, thus creating the problem of passengers being loaded and off-loaded along major roads and freeways. In a study conducted on the R59 freeway, De Beer and Davison (2002) found that motor vehicle access to the service roads parallel to the freeway had been gained by removing sections of the fence. Vehicles thus stopped under freeway bridges to offload passengers, who then crossed the freeway or made their way up the embankments of interchanges. Footpaths were often seen leading from the bridge parapets down to the road shoulder under the bridges. In many other areas taxi drivers loaded or off-loaded passengers at the entrances to the main roads and returned for another load of passengers during peak hours, e.g. the R550 at Oliivenhoutbosch. A good example of integrated planning is to be found at the Nseleni Interchange near Richards Bay where a major road crosses the N2 and commuters are involved in changing taxis. In an innovative design for SANRAL, four taxi bays on route MR 231 and two on the N2 are linked by surfaced walkways and stairs.

Very high concentrations of pedestrians are often found in public transport facilities such as railway stations, bus termini and mini-bus ranks. Such concentrations typically occur in the early morning and late afternoon peak periods. Accidents tend to occur at these locations due to factors such as pedestrians running across the road to catch a bus or train. The *PBFGM* (DoT 2003b) recommends that at public transport termini and stations, sufficient and proper pedestrian facilities be provided. Due to the large volumes of pedestrians using these facilities, it is not sufficient to provide minimum designs. Wider than minimum sidewalks are typically required, while pedestrian crossings must be provided where needed. Particular attention should also be given to the provision of pedestrian refuge islands

and traffic calming measures. The *PBFGM* (2003b) also recommends that in the planning of pedestrian facilities at public transport termini and stations, it is imperative that pedestrian desire lines need to be studied in order to determine the needs of commuters. Such desire lines can be established by means of pedestrian counts or by aerial photographs.

Pedestrian crossing facilities are also often required near or adjacent to bus and mini-bus stops. The *SA and SADC RTSM* (SADC 1997) prescribes the road signs and markings required to accommodate such facilities. Pedestrian accidents at bus stops often occur because of pedestrians stepping out from behind or in front of the bus and moving directly into the path of an oncoming vehicle. This problem can be addressed by providing space for the bus to move well clear of the travelled way by painting or constructing an island between the bus lay-by and the roadway.

SECTORAL RESPONSES TO PROMOTE THE SAFETY OF VRUS

The improvement of the road environment for NMRUs depends on the co-operation of all key stakeholders. The major governmental role-players would be the DoT (and its agencies), the DoPLG, provincial and municipal road authorities. All these and the private sector should work together to refine injury prevention practices to promote safe usage of the road by VRUs especially NMRUs. The role that each of these governmental stakeholders play or should be playing will be briefly highlighted.

THE DEPARTMENT OF TRANSPORT, ITS AGENCIES AND COMMUNITIES

The DoT has taken the lead in initiating a programme for the improvement of pedestrian safety through its *Road to Safety Strategy, 2001-2005* (DoT 2001a). One of the four pillars of this programme is focussing on "safer pedestrians". Two specific actions are contained in the Strategy to achieve this outcome, i.e. the *Arrive Alive* campaign and the *National Pedestrian Action Plan*. Both these actions are aimed at identifying hazardous pedestrian locations and improving the road environment. The *Arrive Alive* campaigns are intended to improve the 10 worst hazardous pedestrian locations in each province.

The *National Pedestrian Action Plan* (DoT 2002a) identified 356 hazardous pedestrian locations countrywide. The main conclusion of this analysis was that an amount of R520m – phased over a five-year period – would be required for the implementation of countermeasures at the 356 hazardous pedestrian locations identified in this business plan. The major engineering shortcomings were: lack of crossing facilities (at 164 sites); lack of roadside

facilities (at 118 sites); lack of street lighting (at 118 sites); and poor geometric design (at 77 sites). Other main findings were that more than half (53%) of the hazardous pedestrian locations were situated in metropolitan/ local areas on arterial and collector roads. Another one third (35%) were located on provincial roads, especially arterials, many of which traversed formal and informal settlements. Altogether 43 sites were identified on national roads of which 25 were on freeways (dual carriageway roads). Almost half (48%) of all the hazardous pedestrian locations were situated on arterial roads.

Various manuals published by or with the DoT including the *PBFGM*, the *South African Road Safety Manual (SARSM)* (DoT 1999) and the *SA and SADC RTSM* (SADC 1997) contain standards and guidelines for improving the road environment for pedestrians and cyclists. Since the more general application of these manuals would significantly improve the situation, their role will be briefly highlighted. The *PBFGM* (DoT 2003b) covers a wide spectrum of engineering guidelines that could be employed to improve the road environment. The *SARSM* (DoT 1999) consists of seven volumes, which provide road authorities with tools to evaluate traffic operations and assess the road safety aspects of their road network, including the needs of VRUs. The *SA and SADC RTSM* (SADC 1997) covers all the road signage and markings required to provide safe road infrastructure, including those for pedestrians and cyclists.

The *Shova Kalula* Bicycle Programme (DoT 2001b) is part of the process to improve rural mobility. It is aimed at two target groups: first, the young – particularly the estimated 350 000 secondary school students and 445 000 primary school students who currently walk more than 3 km to school; and second, the estimated 573 000 urban workers and 472 000 rural workers who currently walk for more than 20 minutes daily to get to work.

A study by UNIARC (Mpanza 2002) aimed at developing a coherent strategy for the *Shova Kalula* Bicycle Programme covered three rural villages in KwaZulu-Natal. The study revealed that the programme was well received although possible cultural inhibitions relating to women and girls riding bicycles were indicated. Of the cyclists surveyed 89% used bicycles for commuting to school, 14% to work and 5% for recreation. One of the main issues relating to the infrastructure and safety of cyclists was the need for targeted road safety education. This is vital for the correct use of available infrastructure as internationally, Mohan (2005) has found that two thirds of cyclists killed and injured in accidents involving cars have violated a law or safety rule. Furthermore, the percentage of crashes is greatest in

the 12 and under age group. It would seem that topography played a part in that although the flat terrain around Mbazwane is ideal for cycling, it is also problematic in that heavy vehicles maintain high speeds and the high and low pressures they create endanger cyclists. The major issues relating to infrastructure in areas of gravel roads relate to: potholes which cause vehicles and cyclists to deviate from the left-hand side of the road; dust which reduces visibility and obscures cyclists; and the presence of the gravel "windrow" at the edge of the carriageway which makes riding hazardous.

Thus, one of the major problems that has yet to be resolved regarding the *Shova Kalula* Bicycle Programme is where the children who are the main supporters of the programme must ride when they go to school. Currently, there are only limited planning guidelines in South Africa to address this problem on rural roads and further research is required. In addition, in many of the areas (Izinqoleni, Bakenberg, Witpoort, etc.) theft of cycles is a problem, hence secure "parking facilities" must be considered in design. The schools must obviously be the focal point of any cycle infrastructural planning especially in rural areas.

The *Rural Transport Strategy* (DoT 2002b) is directed at the delivery of rural transport infrastructure and services. The strategy states clearly that "*Rural transport infrastructure*" does not cover access roads only, but also district roads, public transport interchanges, tracks and other NMT infrastructure – provided mainly by the provincial and local spheres of government, the National Department of Public Works (NDoPW) and SANRAL – all of which are directly or indirectly involved in communities and create local construction-related jobs.

Besides the National Land Transport Strategic Framework (NLTSF), which is a legal requirement in terms of Clause 21 of the National Land Transport Transition Act, Act No. 22 of 2000, the rural transport strategy is aligned to: the Integrated and Sustainable Rural Development Programme (ISRDP); the requirements for Integrated Development Planning (IDP) as set out in the Municipal Structures Act, Act No. 117 of 1998; and the government's main social and economic development programmes, such as the Poverty Alleviation Programme, the Community Based Public Works Programme (CBPWP), the Local Economic Development (LED) Programme, the White Paper on National Transport Policy (1996), the Road Infrastructure Strategic Framework, and the Provincial Land Transport Frameworks (PLTFs) that have been developed in all of the provinces.

THE DEPARTMENT OF PROVINCIAL AND LOCAL GOVERNMENT

The DoPLG has initiated a number of national imperatives to improve conditions in the previously disadvantaged areas of the country. These include the introduction of IDP, the Urban Renewal Programme (URP), the Integrated Sustainable Rural Development Strategy (ISRDS), the Municipal Infrastructure Grant (MIG), and others. The role that some of these strategies could play in improving the huge backlog of infrastructure, including NMT infrastructure, in townships and rural areas (especially the urban and rural residential nodes) will be highlighted.

Most IDPs and Integrated Transport Plans (ITPs) do not cover the issue of road safety infrastructure provision. The enabling transport legislation (the National Land Transport Transition Act, Act No. 22 of 2000), which through its National Land Transport Strategic Framework (DoT 2006) covers the field of road safety and Provincial Land Transport Frameworks, should thus be extended to cover this aspect as well. The role of NMT and its infrastructure requirements should also be catered for.

MIG is a conditional grant which supports municipal capital budgets to fund municipal infrastructure and to upgrade existing infrastructure, primarily benefiting poor households. The provision of infrastructure for NMRUS, e.g. sidewalks and footbridges, falls within the ambit of this funding, seeing that the major shortfall of these types of infrastructure lies in the areas occupied by the poor households.

CONCLUSION

The following shortcomings still exist in engineering practice and government policies as well as strategies:

First, there is no comprehensive national NMT policy in South Africa. The planning, design and provision of facilities for these VRUs are therefore not properly co-ordinated and considered. The DoT should take the lead in collaborating with the provincial and municipal road authorities and the DoPLG to develop such a policy.

Second, road authorities should consider developing pedestrian and bicycle master plans for formerly disadvantaged suburbs as part of an ITP in conjunction with the IDP process, the URP and the ISRDS. Such master plans should be based on pedestrian desire lines and major land uses that generate pedestrian traffic in the community.

Finally, the lack of pedestrian facilities in informal settlements and in many formerly disadvantaged suburbs is often a cause for many road safety problems. A summary of the most important facilities required in such areas includes:

- An internal network of pedestrian sidewalks and walkways should be provided based on pedestrian desire lines and major land uses generating pedestrian traffic in the area such as schools, sports fields, commercial centres, etc.
- Pedestrian crossings should be provided at locations where the internal network of pedestrian walkways crosses major roads.
- Land uses such as schools and other pedestrian generators should be located away from major roads, or situated in such a way that major roads do not need to be crossed. If this is not possible, provision should be made for grade separation and the channelisation of pedestrians to these crossing points. In designing these products and environment cognisance should be taken of the normal variations in human performance in order to minimise the number of resulting crashes and injuries.
- Roads should be designed in such a way to limit speeds. Where this is not possible, traffic calming measures should be included in the upgrading of settlements to safeguard VRUs.

RECOMMENDATIONS

The *PBFGM* (DoT 2003b) provides information and guidelines on a variety of aspects related to pedestrian and bicycle facilities. During subsequent development of the manual, however, a number of issues have been identified which require further study and research. These issues could not be adequately addressed in the current edition of the manual and most of the recommendations are based on studies undertaken in other, more developed countries.

Some of the more important areas identified that need further research are:

- The causes and types of accidents involving pedestrians and cyclists in South Africa.
- The maximum walking and cycling distances acceptable to the local population: Limited local interviews conducted by UNIARC (Van Schalkwyk & Naidoo 2004) found that children in Umlazi walked 15 km to school every day. It is likely that at least 1 to 2 hours (1.5 to 3 km) are common, although not necessarily acceptable, amongst poorer communities in South Africa.
- According to the National Road Traffic Regulations, pedestrian crossings are implicitly defined at all road junctions, i.e. they do not have to be marked. Pedestrians therefore have right of way at junctions, irrespective of whether an approach to a junction is controlled or not.

In practice, most drivers do not seem to be aware that this requirement also applies to uncontrolled approaches to junctions.

- A simple system, which does not rely on the collection or availability of traffic and accident data, has been proposed for prioritising pedestrian sidewalks. However, the system should be extended to include other types of pedestrian (and cyclist) facilities.
- The provision of a separate bicycle road parallel to a street or road within the reserve boundaries in urban areas poses a serious problem when there are driveways along the road. Drivers exiting from driveways generally do not pay attention to cyclists, which increases the danger of accidents. Such bicycle roads on streets and roads with driveways will only be successful if they are provided directly adjacent to the street and road itself (similar to a bicycle lane), and if it is clear to drivers that they must yield to cyclists.
- More cost effective barricades and fences for use along roads to prevent pedestrians and cyclists entering the road reserve: The most effective form of barricade appears to be a concrete or brick wall, but the cost of such barricades is very high. Consideration of vegetated barriers may be an option.
- Traffic calming is particularly important for pedestrians and cyclists. The current national guidelines are outdated and urgently need to be updated. Local experience especially with regard to security must be incorporated.
- Current guidelines for the planning, design and provision of facilities for rural pedestrians and cyclists are very limited and should be expanded into a set of useful tools.
- When promoting cycling, especially in informal townships, designers should consider adopting the designs used by developing countries in the east where NMT predominates rather than those advocated by the more developed western societies.
- Lower order urban streets and rural roads must be viewed and designed as transport infrastructure for the entire range of transport modes, i.e. vehicles, motor cycles, cycles, animal drawn and pedestrian. No one mode should have exclusive use and priorities (if any) should be allocated according to the prevailing circumstances. NMT must be viewed as part of the solution rather than the problem of road transport.

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