

ACCEPTANCE OF NON MOTORISED TRANSPORT USERS' SAFETY MEASURES IN BUILT-UP AREAS: A CASE STUDY ON SANRAL ROADS

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ABSTRACT

Several studies were conducted to improve road safety along national roads, but limited work has been done to examine the pedestrian acceptance of road safety interventions under field conditions. Previous work and studies have failed to establish the prevalence of the problem and address this phenomenon. This research is aimed at introducing a new thinking approach into examining and establishing acceptable design limits to ensure road safety for all road users in built-up areas along the National Roads while achieving pedestrian acceptance.

The research was carried out on sections of roads along the national network, this was done on the N1 (Hammanskraal, Gauteng), N12 (Klerksdorp, North West), R510 (Sandfontein, North West) and R567 (Makgofe, Limpopo) and R581 (Mzinti, Mpumalanga). The results of the study revealed the high influence of pedestrian acceptance on the maintenance, use, and non-use of facilities. The study also revealed the high importance of community engagement in improving pedestrian acceptance, social cohesion, and road safety. These results demonstrate that pedestrian acceptance in built-up areas is key in achieving road safety.

1. INTRODUCTION

1.1 Background

According to the World Health Organization (2017), South Africa is ranked 15th among the 47 African countries for traffic deaths and had a 25.1% road traffic mortality rate per 100 000 population. In 2016, the Department of Transport reported 12 702-road traffic fatalities and of these fatalities, pedestrian fatalities involving jay-walking/at-grade crossing accounted for 42.6% of road fatal crashes (DoT, 2017). According to Tingvall & Haworth (1999), human tolerance to mechanical forces is limited and will be exceeded if the vehicle travelling at over 30km/h.

South Africa unlike many developed countries, has a fragmented spatial and transport planning approach which originated the apartheid government. According to Baloyi and Sebola (2012), the apartheid government catalysed racial segregation lead by the Group Areas Act 41 of 1950, which resulted in the creation of dormitory 'jail-like barracks and caused urban sprawl as locations for black communities were placed at the periphery of cities at considerable distances from the city centre. These locations are in peripheral areas and often adjacent to high speed roads resulting in pedestrians sharing road space

with motorised vehicular traffic, as most pedestrian have limited to no alternative available to improve mobility and accessibility to facilities, to meet their various needs.

Due to fragmented spatial planning, build-up areas are adjacent to the South African national road network. Communities in these build-up areas are exposed to motorised traffic travelling at high speeds, often in excess of 80 km/h and 120 km/h and pedestrians exposed to these traveling speeds have almost no chance of surviving the vehicle-pedestrian crash. With greater speed differential there is high occurrences of fatal pedestrian crashes, mostly on arterials and freeways.

As part of the United Nations' Decade of Action to stabilise and reduce the level of road traffic fatalities, the South African National Road Agency Limited (SANRAL) is part of the Safe System approach. The Safe Systems approach to road safety which involves the "provision of safe road infrastructure that reduces the risk of a serious injury or death when a crash occurs, as well as the implementation of road safety educational and awareness programmes that will lead to changed attitudes and behaviour among all road users" (SANRAL Horizon 2030 STRATEGY, 2018).

1.2 Problem statement

SANRAL is responsible for high mobility and strategic roads; as a result, communities adjacent to the national roads have challenges in crossing (access) through these roads. The second challenge is how to find a balance between mobility and accessibility. How can SANRAL effectively provide pedestrian facilities that are acceptable to the communities living adjacent to the national road and that would not impede on mobility?

The lack of proper town planning exacerbated by the allocation of land by tribal authorities, the development of informal settlements, informal trading and historical spatial and transport planning and land-use (social, educational and economic facilities).

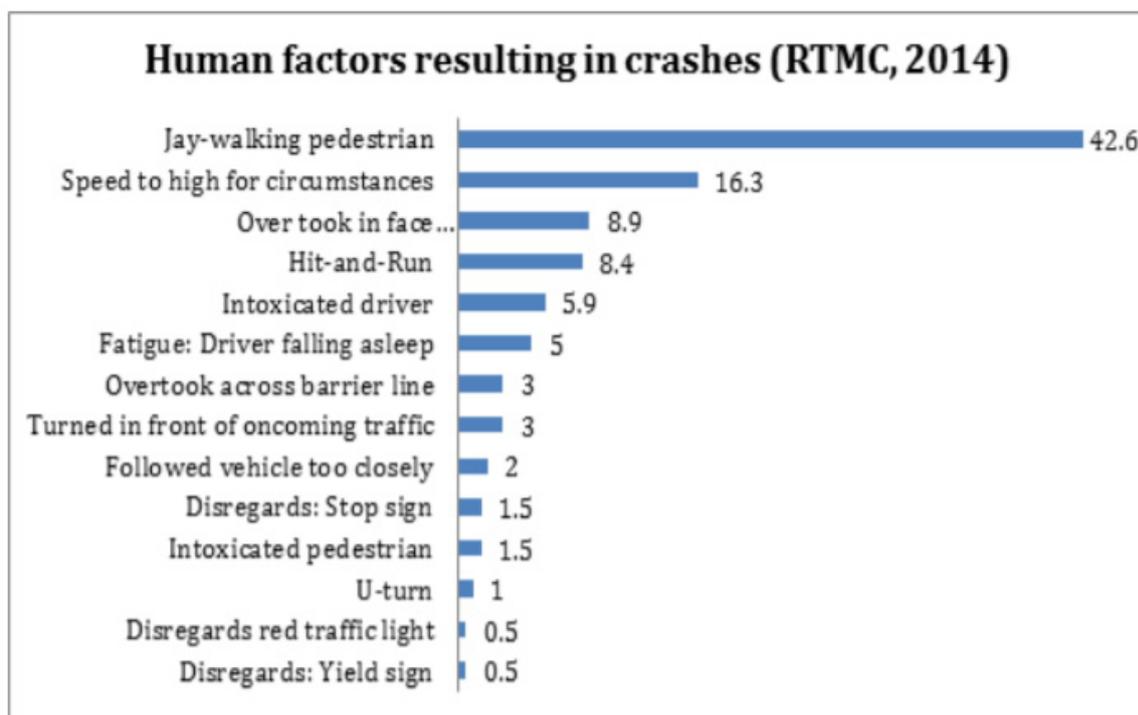


Figure 1: RTMC human factors resulting in crashes

Human factors have a significant impact in road traffic accidents as they influence the road user behaviour. The Road Traffic Management Corporation (RTMC) Annual Report (2014) shows the human factors as they relate to the 2014 fatal crashes as shown in Figure 1 above.

Factors such as speeding and jaywalking are some of the key challenges, as shown in the RTMC human factors resulting in crashes.

2. OBJECTIVE OF STUDY

The objectives of the study are as follows:

- To determine the acceptance of road safety interventions by pedestrians in communities adjacent to national roads.
- To determine how pedestrians, perceive the safety interventions.
- To determine how pedestrians, respond to the interventions.
- To establish the importance of community engagement in achieving pedestrian acceptance and social cohesion.
- To determine acceptable design limits and road safety interventions for national roads along built-up areas.
- Influencing behaviour of road users through provision of road safety interventions that reduce the number of fatal and injury crashes in South Africa is a high-priority among the National Department of Transport and local transportation agencies.

3. METHODOLOGY

3.1 Introduction

A qualitative research method was used, to analyse choices made by pedestrians. The study assumes that the preferences of the pedestrians can be revealed by the habits of using or not using the provided infrastructure.

Historical data was used from projects that were previously investigated and implemented along the national roads in the SANRAL Northern Region. Pedestrian behaviour and reaction towards the provided infrastructure were observed to judge their acceptance of the provided facilities.

3.2 Study area

The following sites are projects that were previously implemented, shown in Table 1 and Figure 2 below. The sites were selected according to the road safety challenges faced because of changes in land use, urban developments and the spatial formation of cities, towns and villages along the national road network that have forced pedestrians to cross or walk along national roads. Moreover, majority of these sites have high volumes of vehicle traffic travelling at high speeds, as such thorough consideration was given to the safety of pedestrians, and a decision was made to enhance the safety of pedestrians around the following sites.

Table 1: Case Study Areas

National Route	Speed (km/h)	Locations	Province
N1	120	Hammanskraal	Gauteng
N1	120	Mookgophong	Limpopo
N1	60	Botlokwa	Limpopo
N12	80	Klerksdorp	North West
N12	80	Potchefstroom	North West
N17	120	Kwathema	Gauteng
R23	60	Standerton	Mpumalanga
R510	60	Sandfontein	North West
R567	60	Makgofe	Limpopo
R573	80	Moloto	Limpopo & Mpumalanga
R581	60	Mzinti	Mpumalanga

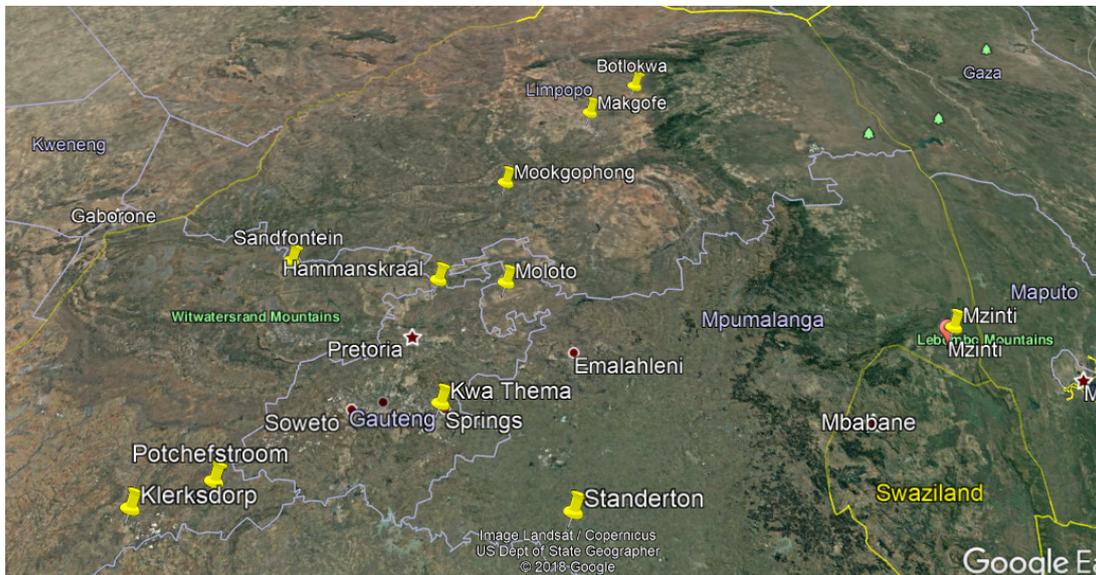


Figure 2: Case Study Areas

3.3 Acceptable design limits

The South African National Road Agency Limited (SANRAL) strives to strike a balance between the safety of pedestrians and the primary use and effectiveness of the national road network. With high death rates due to pedestrians crossing at undesignated crossing areas, the separation of pedestrians and vehicles by providing pedestrian facilities to limit exposure of pedestrians to high-speed vehicles is key.

For instance, in cases where there are schools adjacent to the national road, multiple solutions could be implemented, such as increased signage, reduce speed, speed humps or tables or scholar patrol. The challenge with implementing these solutions is getting approved authorisation according to national approved policies.

For instance, to implement scholar patrol requires approval from the MEC. According to the **National Road Traffic Act 93 OF 1996 Chapter IX - Road Traffic Signs and General Speed Limit No. 57. Authority to display road traffic signs (5)** ... *“In such circumstances and subject to such conditions as the MEC concerned may determine, scholars or students may be organised into patrols (to be known as scholars’ patrols) for the purpose of displaying, in the prescribed manner, an appropriate road traffic sign so as to ensure the safety of scholars or students crossing a public road”*. As such revising of appropriate legislation (policies and regulations) should be considered together with the design guidelines.

According to Technical Recommendations for Highways Geometric Design for Rural Roads (TRH 17) and the Geometric Design Guidelines (GDG), there are no clear guidelines on design elements to use in areas where the following occur:

- Multiple pedestrian at-grade crossing
- Speeding
- Land-use diversity
- High volumes of pedestrians and cyclists
- Schools adjacent to the national road

According to the Safe System Approach, road safety engineering should involve provision of safe road infrastructure that reduces the risks of fatal or serious injuries. For many of the national routes dissecting through build-up areas this would involve implementation of traffic calming measures.

According to the International Traffic Engineering Community (2017), geometric designs for roadways should be *“self-enforcing or self-explaining roadways during the geometric design process. While safety performance associated with these methods is not well-understood yet, an implied outcome of effective speed management is that less severe crashes will result via the application of self-enforcing or self-explaining road design principles”*.

“The objective of self-enforcing roads is to produce speed compliance, typically using geometric elements that would result in driver speed choice that is consistent with the posted speed limit, resulting in actual operating speeds that are appropriate for the intended purpose of the roadway. Ideally, the operating speeds and posted speed limit are also in harmony with the geometric design speed of the roadway”. Whereas, *“self-explaining roadway, encourages drivers to select operating speeds in harmony or consistent with the posted speed limit.”*

4. RESULTS

4.1 Road safety interventions implemented

Table 1 above, shows the locations of the eleven case study areas (also shown in Figure 1), implementation date of the remedial measures, land ownership and the road safety challenges and interventions. Table 2, shows the challenges faced by the communities and the root cause of these challenges. Moreover, Table 2 shows the remedial measures implemented as well as the acceptance of the measures by the pedestrians.

The observed challenges for the identified sites were:

- Access to educational, health care, social (pension pay points) facilities and water and economic zones.
- Access to public transport.
- Lack of proper or safe pedestrian crossing facilities and traffic calming measures.
- Access management, illegal direct accesses to national roads and land use.
- High traffic volumes and speeding.
- Conflict between mobility and accessibility.

The above challenges were confirmed by the various stakeholders and affected communities, through engagements and information sessions held prior to the finalisation of the possible remedial measures for the different study areas.

The initial community consultations are carried out at municipal level with the affected local community, ward councillor, local business and municipal representatives. Once a project is identified and registered the project liaison committee (PLC) is established to create a platform for project liaison with the local community, this allows for better management of expectations of local business and communities through communication. The PLC offers a critical platform to obtain support of the local community on proposed road safety measures, prior to implementation. Also, the PLC offers a platform to communicate the work execution, sub-contracting opportunities and employment facilitation for the local community.

Of the observed challenges the following remedial measures were proposed and implemented:

- Pedestrian footbridge and underpasses to provide safe crossing
- Fencing and boundary walls to channel pedestrians
- Pedestrian speed tables
- Side-walks for pedestrians and cyclist (universal access)
- Traffic calming measures (roundabouts, rumble strips and control of speed by illusion (COSBI))
- Lighting of the road reserve to increase visibility at night
- Additional road signage and markings to provide guidance to motorised traffic.
- Intersection improvements (grade separation)
- Road safety education and awareness
- Scholar patrol to assist school children in crossing national roads

The proposed remedial measures were discussed and workshopped with affected communities and stakeholders to get buy-in, acceptance and for the community to take ownership. Community acceptance is key in achieving road safety, this is often achieved by involving local community and creating a working relationship with well-defined objectives.

Table 2: Road Safety Locations and Interventions

National Route	Speed (km/h)	Locations	Province	Implementation Date	Land Ownership	Road Safety			Remedial Measures
						Before Interventions	Road Challenges	After Interventions	
N1	120	Hammanskraal	Gauteng	Jan-03	Tribal land	Multiple pedestrian crossing At-grade.	Access to water (Kekana Gardens Village were fetching water at Marokolong Village using wheelbarrows across the N1) - Town Planning	After the barricading of the road reserve and other remedial measures we implemented, no fatalities or crashes involving pedestrian were recorded in this area.	Pedestrian bridge, Fencing off the road reserve (boundary walls), upgrading of underpass (culvert) for pedestrians
N1	120	Mookgophong	Limpopo	Jun-12	Municipal	Multiple pedestrian crossing At-grade	Access to Educational Facilities, Health Care, Pension Pay points and graveyards placed on either one of townships - Town Planning	Although the remedial measures implemented did not completely eliminate pedestrians crossing (especially the youth), a significant reduction of incidents involving pedestrians was observed for a while. The number of weekend incidents reduced significantly.	Pedestrian bridge, Fencing off the road reserve (boundary walls)
N1	60	Botlokwa	Limpopo		Tribal land	Speeding, At-grade crossing, Land-use,	Public Transport, Shopping Complex, Pension paypoint, Major Hospital, Educational Facilities, Live stock crossing the N1. Lack of pedestrian crossing facilities - Town Planning and Engineering	The locals have confirmed the changes the remedial measures has done in terms of incidents involving pedestrians in this village. The grade separation and the 2 pedestrian bridges improved the situation tremendously although there are few locals who still access the highway for hiking purposes.	2 x Pedestrian bridges, Grade separation (construction of interchange), Fencing off some sections of the road, Road Safety Education
N12	80	Klerksdorp	North West	Jun-16	Municipal	High volumes of pedestrian crossing At-grade	Access to shopping complex, educational facilities, live stock, public transport, lack of visibility	After the construction activities , new signage and markings were completed, local traffic officials reported a reduction in the severity of crashes due to the traffic calming effect produced by the newly constructed roundabout.	Pedestrian bridges, Intersections improvement and traffic calming (construction of a roundabout and signalled intersections), rumble strips, additional signage, Fencing off some sections of the road
N12	80	Potchefstroom	North West	Sep-13	Municipal	Speeding, High volume of pedestrians and cyclists travelling on the N12 travelling to Town from Ikageng (Township - 6km)	Access to economic zones, employment and access management	Access management improvement to channel traffic (NMT, PT and MT). Although there are few locals who insist of riding the bicycles along the N12, majority are using the provided facilities.	Pedestrian and NMT facilities (sidewalks), Intersections improvement, additional signage, Fencing off some sections of the road reserve (boundary walls), closing of unsafe and illegal direct accesses to the National Road. Road Safety Education.
N17	120	Kwathema and Wemmerpan	Gauteng		Municipal	High volumes of pedestrians crossing	Access to Economic Zones (Industrial area) and social facilities. Land use and lack of safe crossing facilities.	The community has embraced the infrastructure constructed and are using it on daily basis. No report of incidents involving pedestrians in and around the vicinity of the project.	3 x Pedestrian bridges, Fencing off some sections of the road
R23	60	Standerton	Mpumalanga	May-14	Municipal	Speeding and high volumes of pedestrians travelling on the R23 travelling to Town from Extension 7 & 6 (Township - 3km)	Access management (multiple direct accesses to the National road). Access to employment, educational facilities and health care. Public transport and NMT	Although there have been some vandalism of the palisade fencing provided by some elements within the community, a reported reduction in crashes was reported by the locals and also observed by the RRM site personnel. The provided sidewalk is also being used by the majority of locals on daily basis as they walk to and from town.	Pedestrian and NMT facilities (sidewalks), additional signage, Fencing off of the road reserve (palisade fencing), closing of unsafe and illegal direct accesses to the National Road. Road Safety Education.
R510	60	Sandfontein	North West	Mar-18	Tribal land	Speeding, Multiple At-grade crossings	Lack of proper crossing facility and traffic calming measures. Access management. Lack of visibility. Law enforcement visibility. Tavern.	Two schools on both side, Primary School and High School on either sides, crossing assistance required Filling Station Access not according to standards Insufficient signage	Improve signage, raised crosswalks/ speed table and filling station access, Community development project - Sidewalks, access management, lighting access management and fencing off of the road reserve.
R567	60	Makgofe	Limpopo		Tribal land	Speeding and School kids crossing at-grade	Lack of proper crossing and NMT facilities	Schoolar Patrol	Schoolar Patrol Infrastructure
R573		Moloto	Mpumalanga	Jan-17	Tribal land	Speeding and high volumes of pedestrians travelling on the R573	Land use, high traffic volumes, alternative to the N1,	First phase completed in December 2018. Community members confirmed that for the first time in years there were no reports of serious crashes in the section completed.	Intersection Improvements (3 Roundabouts for traffic calming and a butterfly intersection), Public Transport Facilities, Pedestrian and NMT facilities (sidewalks), additional signage.
R581	60	Mzinti	Mpumalanga		Tribal land	Speeding and lack of crossing facilities	Lack of proper crossing facility and traffic calming measures. Access management. Lack of visibility. Lack of proper crossing and NMT facilities	Awaiting response from MEC on Schoolar Patrol Implementation according to the National Traffic Act	Signage Schoolar Patrol Infrastructure

4.2 After interventions/ remedial measures

Based on the observations, testimonies, and engagements with various stakeholders, where the measures were implemented, the following were noted:

- After the fencing/ barricading of the road reserve the amount of crashes involving pedestrian reduced for the Hammanskraal, Mookgophong, Botlokwa, Potchefstroom and Standerton study areas. Although this remedial measure did not completely eliminate pedestrian crossings especially among the youth in places like Botlokwa. Furthermore, in Hammanskraal there are instance where some sections of the wall were vandalised during service delivery strikes, the community thereafter made a request for SANRAL to reinstate the wall.
- The grade separation (interchange) on National Road N1 in Botlokwa has resulted in less conflict between locals (non-motorised transport) as well as motorists and it was confirmed by community leaders that accidents involving pedestrians and motorist have declined, although there are locals that still access the national road for hitch-hiking purposes.
- Pedestrian bridges constructed along the national road in Hammanskraal, Mookgophong, Botlokwa and Kwa Thema, have allowed safe crossing for pedestrians and this have eliminated the number of fatalities involving pedestrians. Due to linear expansion of the villages and townships along the national roads, a need for additional pedestrian bridges has been identified to allow for convenience, safe and easy access. This is the case in Mookgophong and Hammanskraal.
- The existing four-legged intersections were converted into a roundabout in Klerksdorp on National Road N12 and Moloto on National Road R573. Positive feedback was received from the local traffic officials and other stakeholders about the impact of the interventions implemented. The number of accidents and call outs for emergency personnel in the area reduced drastically. Pedestrian infrastructure provided is being utilised. Initially local drivers and heavy vehicle drivers did not accept the choice of a roundabout as a preferred type of intersection instead of the old four-legged intersection that was under capacity and not safe or user friendly for both the pedestrians and motorists. However, with time the locals and heavy vehicle drivers accepted the intervention once they saw the impact it had in traffic collisions as this also allowed for safe crossing of pedestrians and life stock.
- Communities have embraced sidewalks implemented in places such as Standerton, Potchefstroom and along the national roads as this offer refuge for Non-Motorised Transport (NMT) users. This has reduced the number of jay-walking and incidents involving Non-Motorised and Motorised Transport users.
- In Botlokwa visibility improved with implementation of lights along the national road. According to Damsere-Derry et al (2010) crashes involving pedestrian predominantly occur at night time in predominantly unlit settlements. The study shows the role lighting plays in making pedestrians more visible to motorised traffic at night.
- Speeding is one of the biggest challenges and the possible factor for crashes in rural areas. To mitigate these challenges speed tables where implemented in Sandfontein and Moloto this required paradigm shift from the norm especially from SANRAL, as these two routes are seen as high mobility roads however dissect through build-up areas.
- Scholar patrol - there have been several requests and areas where this is already in operation, places such as Mzinti and Makgofe.

5. CONCLUSIONS

Based on the case studies discussed in paragraph 4.2 it can be concluded that not all NMT users will use the allocated infrastructure, however there needs to be continuous engagement with local stakeholders through road safety education and awareness campaigns to promote the usage of NMT facilities along the national roads.

The existing legislation and policy may have to be modified, or new legislation or policy be developed to govern design elements that could affect the implementation of traffic calming measures in more build up areas. For example, SANRAL has developed **“GUIDELINES FOR PEDESTRIAN AND PUBLIC TRANSPORT FACILITIES ON NATIONAL ROADS”** this shows a paradigm shift by SANRAL in accepting that there is a need to have a balance between mobility and accessibility is required.

According to Sinclair (2017), there is “insufficient attention to integration of road function with decisions about speed limits, road layout, and design”. Detail discussions should be done to focus on revising design elements that influence road safety.

It is evident that SANRAL as the road authority for national roads should provide for NMT infrastructure on all national roads traversing through villages and townships. As also confirmed by Macozoma & Ribbens (2004) provision of NMT transport facilities should be pro-active, and the provision of these facilities should adequately meet the most vulnerable road users’ needs and safety.

Based on the case studies discussed above, it is evident that communities and road users in general residing in villages and townships adjacent to our national roads are accepting the NMT infrastructure and interventions provided. Community involvement is key in achieving implementation of NMT infrastructure interventions and acceptance thereof.

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