RESPONDING TO ROAD SAFETY CHALLENGES: PROPOSED PEDESTRIAN SAFETY MEASURES FOR DURBAN CBD

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ABSTRACT

The cost of road accidents in South Africa was estimated at R162,045 billion or 3,48% of Gross Domestic Product (GDP) for 2017 (RTMC, 2017) with each fatal road traffic crash costing the economy some R5,717,351.00. In the same year, KwaZulu Natal province had 2800 road crash fatalities, which is approximately 20% of South Africa's annual road crash fatalities (RTMC, 2016). The city of eThekwini is not sparred as there has been more than 50 000 road crashes per year, with more than 500 deaths each year since the year 2000 (ETA, 2016). To respond to these challenges, The city of eThekwini has commenced with the project of improving road safety in the central business district (CBD) by implementing some engineering interventions. This is in line with the city's vision of making eThekwini the most liveable city in Africa by 2030 (eThekwini, 2021). These engineering interventions are also aimed at making the CBD safe to all, but more importantly, to pedestrians and other non-motorized transport users. This will be done using traffic calming measures to slow down vehicles and therefore protect pedestrians while crossing or walking in the Durban CBD. The intension is to ensure that speeds within the Durban CBD are regulated such that a vehicle cannot travel more than 40 km/hr.

The following traffic calming measures were proposed and will be implemented:

1. Raised intersections to reduce speeds approaching the intersection area.
2. Raised pedestrian crossings to slow down vehicles and allow safe crossing by pedestrians.
3. Extended kerbs to increase pedestrian refuge space and decrease crossing distance.

With these interventions, the city hopes to be an advocate of the Safe System principles that admit that humans make mistakes, and in design, ensures that (amongst others), the road transport system is forgiving, and that forces in collision do not exceed the limits of human tolerance (Larsson & Tingvall, 2013).

1. INTRODUCTION

Africa has the highest road-related death rate amongst all continents. The rate went up from 26.1 to 26.6 per 100 000 people between 2013 and 2016. The recent economic development leading to an increase in car ownership levels met with slow improvement of road infrastructure and road safety programmes and has seen more roads deaths in recent years. The African continent has 2% of the world's cars but 20% of road deaths, which shows just how important road safety improvement is in the continent as a whole

(World Bank, 2018). Figure 1 compares road fatality rates in different World Heath Organisation regions.

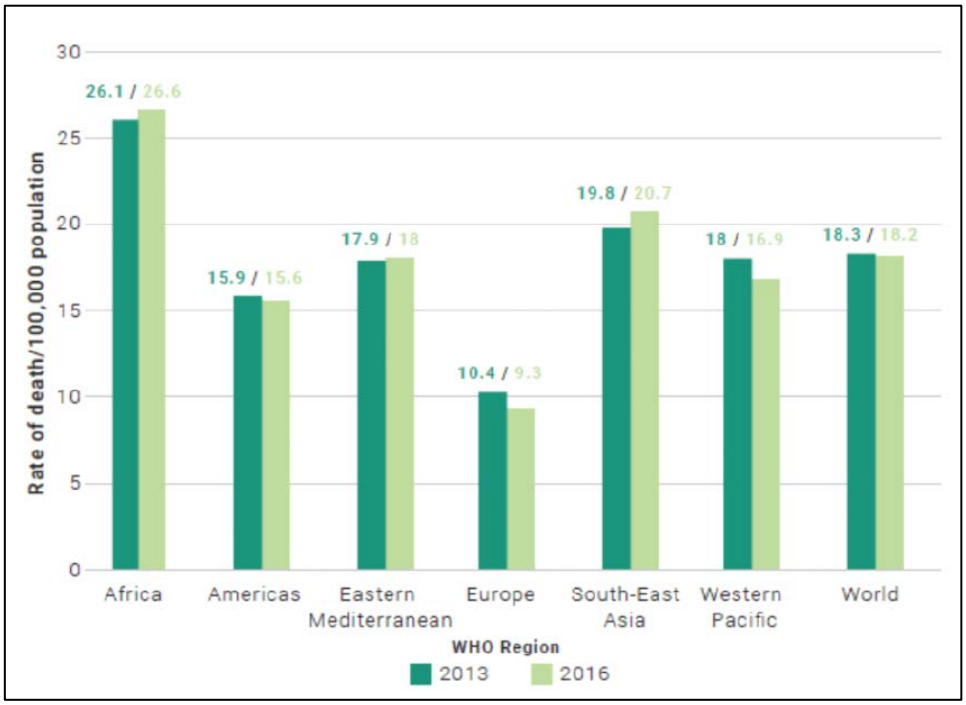

Figure 1: Road fatalities per 100 000 population (WHO, 2015)

In South Africa, the cost of road crashes was estimated at R162,045 billion or 3,48% of Gross Domestic Product (GDP) for 2017 (RTMC, 2017) with each fatal road traffic crash costing the economy some R5,717,351.00. In the same year, KwaZulu-Natal province had 2800 road crash fatalities, which is approximately 20% of South Africa's total annual road crash fatalities (RTMC, 2016).

The city of eThekwini is not spared as there has been more than 50 000 road crashes per year, with more than 500 deaths each year since the year 2000 (ETA, 2016). The Durban CBD has also experienced the wider problem of road crashes and pedestrian fatalities, especially the two streets, Monty Naicker Road and Dr AB Xuma Street outlined in the study area in Figure 2.

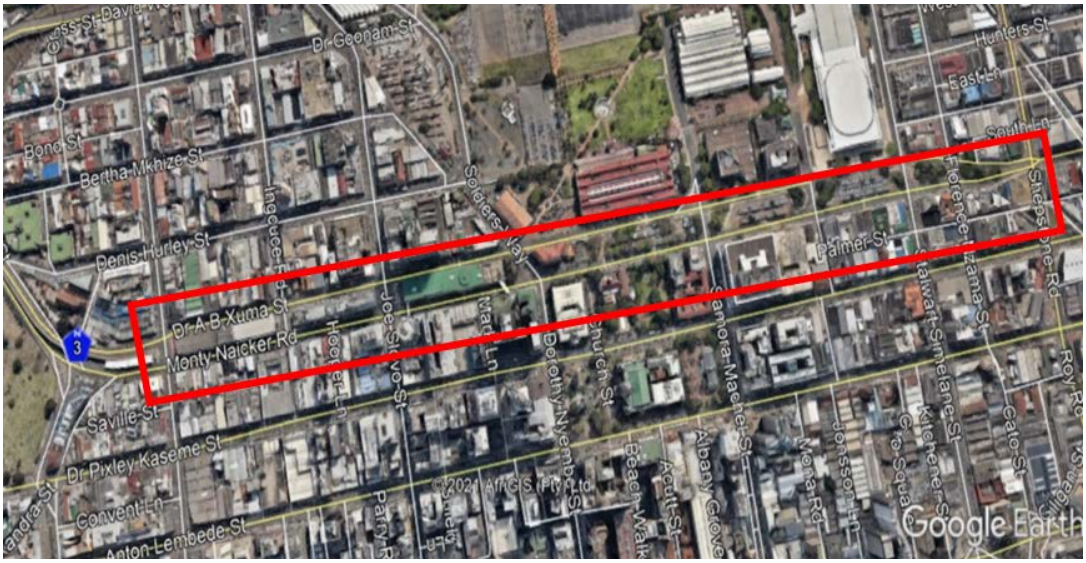

Figure 2: Study area (Google, 2023)

2. PROBLEM STATEMENT

Durban CBD is a vibrant precinct for economic development in the city. This area has a high density of retail, office, restaurant, and shopping land uses which result in high pedestrian activity throughout the day. There are also high volumes of traffic which includes private cars, trucks, and public transport vehicles (i.e., busses and minibus taxis). There are various of public transport stops, allowing passengers to be picked up and dropped off at various points in the CBD. It is also a one-way pair, linking the CBD with the N3 route.

2.1 Human Factors

Although there is road infrastructure, including pedestrian facilities such as sidewalks and pedestrian crossings, the CBD has a high number of road crashes, particularly those involving cars colliding with pedestrians. Figure 3 shows the top 20 areas with the highest percentage of fatal and serious injuries for the period 2015 to 2019. Of all the precincts in Durban, the CBD has the highest proportion of fatal crashes in the city. This is mostly due to human factors, particularly high speeds, as vehicles don't comply to current intervention methods. Pedestrians jaywalking don't have any protection against crashes. Existing pedestrian crossings are also painted and do not deter speeding vehicles from crashing into pedestrians. Although the area has traffic signals to control movement and manage vehicular speeds, vehicles still drive at high speeds. The current at-grade pedestrian crossings are also not respected to by some vehicles, thus posing a safety risk to pedestrians. As a result, the number of accidents, particularly those involving pedestrians, are very high. 3-year crash statistics in the CBD are shown on Table 1.

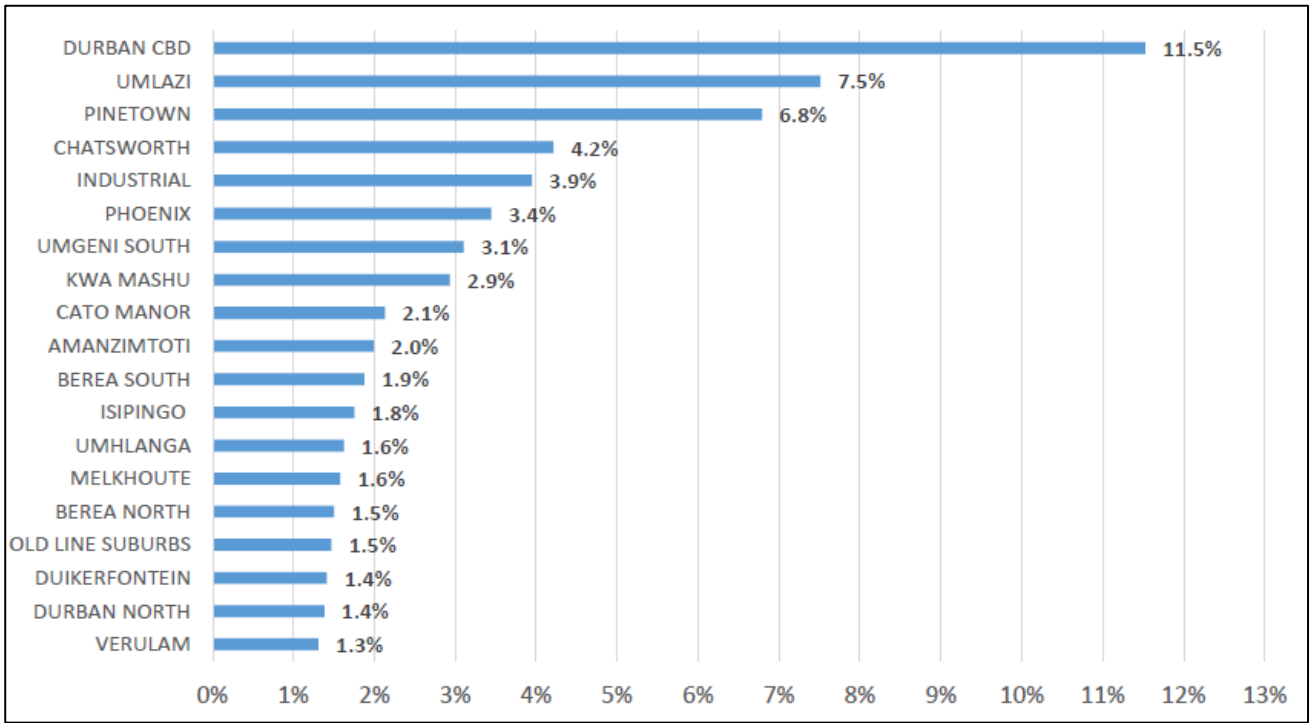

Figure 3: Fatal and serious injuries by area 2015 to 2019 (ETA, 2022)

Table 1: Crash statistics on Monty Naicker Road and Dr AB Xuma Street (ETA, 2022)

Year	Monty Naicker Road			Dr AB Xuma Street		
	Crashes	Pedestrians involved	Fatalities	Crashes	Pedestrians involved	Fatalities
2019	390	50	2	256	24	0
2020	236	26	1	165	22	1
2021	276	31	0	167	25	0
Total	**902**	**107**	**3**	**588**	**71**	**1**

2.2 Infrastructure Challenges

2.2.1 Intersection Configuration

The role of traffic lights at intersections in the CBD is to control the movement of vehicles and pedestrians. Intersections and pedestrian crossings are at-grade with the roadway. This is common practice in the CBD. At pedestrian crossings vehicles are expected to give way for pedestrians. The problem in both these cases is cars speeding when approaching intersections, driving through red-traffic lights, or speeding towards pedestrian crossings. For a precinct like the CBD, which is characterised by high pedestrian volumes, this behaviour poses a serious risk of crashes with a high likelihood of fatal crashes as alluded to by Ashton and Mackay (1979) as cited in a report by the Department of Transport (2010).

2.2.2 Turning Radii at Intersections

Existing radii at intersections were designed to appropriate standards for Class 3 roads as per Urban Transport Guidelines (UTG) 1 Manual - Guidelines for the Geometric Design of Urban Arterial Roads (Department of Transport, 1987). This allows vehicles to manoeuvre turns conveniently, at relatively high speed. The challenge, however, is that relatively high speeds are a threat to pedestrians crossing the road at the intersection, especially in the light of the absence of extended kerbs.

3. METHODOLOGY

The city of eThekwini's response to the road safety problem in the CBD, is in line with the Safe System Approach. This approach has at the core of its philosophy, an understanding that road authorities have an ethical and moral responsibility to design and construct roads that are inherently safe. Should humans make mistakes, the system should be capable to absorb these mistakes without detrimental effects to the people involved. Within this paradigm, speed is recognised and prioritised as the fundamental factor in road traffic accident severity (Kumfer, 2019). Further to this, issues such reckless driving, disobeying traffic rules, driving under the influence of alcohol are also major problems in Durban CBD.

The response, as outlined in the Municipality's Action Plan (ETA, 2022) was based on innovative approaches within the established Safe System Framework as shown in Figure 4.

The action plan targets the areas as depicted which are:

- Pedestrian safety.
- Speed management.
- Road safety initiatives on freight routes.
- School road safety.
- Hazardous locations elimination.
- Data collection & research.
- Traffic enforcement.
- Road incident management.
- Road safety initiatives for minibus taxis.
- Road safety initiatives for driving schools.

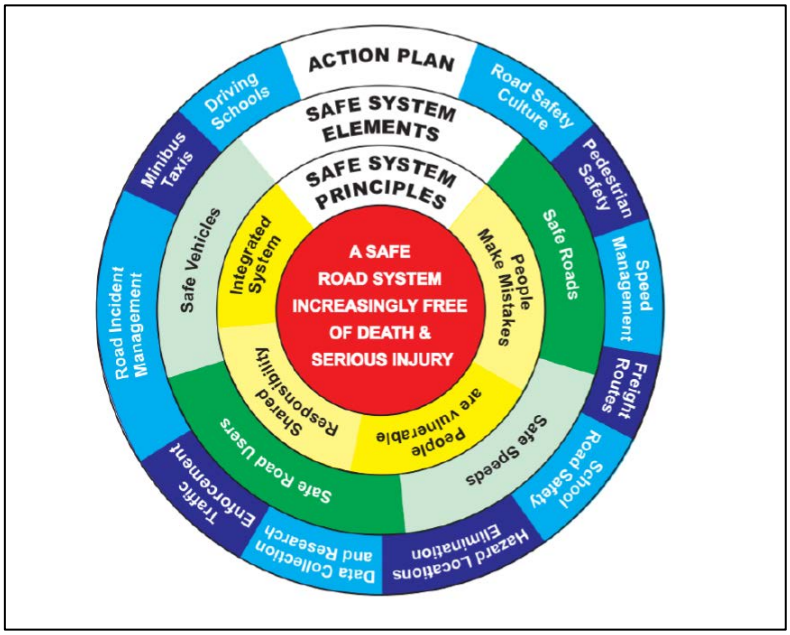

Figure 4: eThekwini's Safe System Approach (ETA, 2022)

About 17,4 million South Africans walked all the way to their destination, therefore many South Africans rely on walking as a means of transport (StatsSA, 2020). The safety of this mode of transport can therefore not be taken lightly and should be considered from the planning stage right through to implementation of pedestrian-friendly infrastructure. Pedestrian fatalities account for about half the number of road-related deaths on South African roads (RTMC, 2016). This is cause of serious concern as eThekwini pedestrians are also not spared, with most crashes involving pedestrians, and with the CBD being a hotspot of such incidents.

In the case of the Durban CBD, speeding was identified as the most prevalent cause contributing to crashes within the CBD. Curbing of speed would therefore be critical in responding to road crashes within this precinct. This is also in line with the findings of literature dealing with the relationship between speed and severity of crashes. A study by Ashton and Mackay, 1976 (cited in Department of Transport, 2010) shows a clear relationship between vehicular speeds and pedestrian casualties as shown on Figure 5. This study and others prove that the higher the speed of a vehicle, the shorter the time available to a driver to stop and avoid a crash. In other words, there is a higher risk of crashing at a higher travel speed. More importantly, the study shows that with a higher speed, the severity of a crash and subsequently the risk of pedestrian death, increases

significantly. The decision to curb speeds was based on this premise. This finding and subsequent response was also in line with studies from abroad. A major study conducted by the Organisation for Economic Co-operation and Development (OECD) and the European Conference of Ministers of Transport (ECMT) in 2006 confirmed that speeding is the number one road safety problem in most countries around the world, and that a reduction in average speed of approximately 5% would yield a reduction in fatalities by as much as 20% (OECD, 2006).

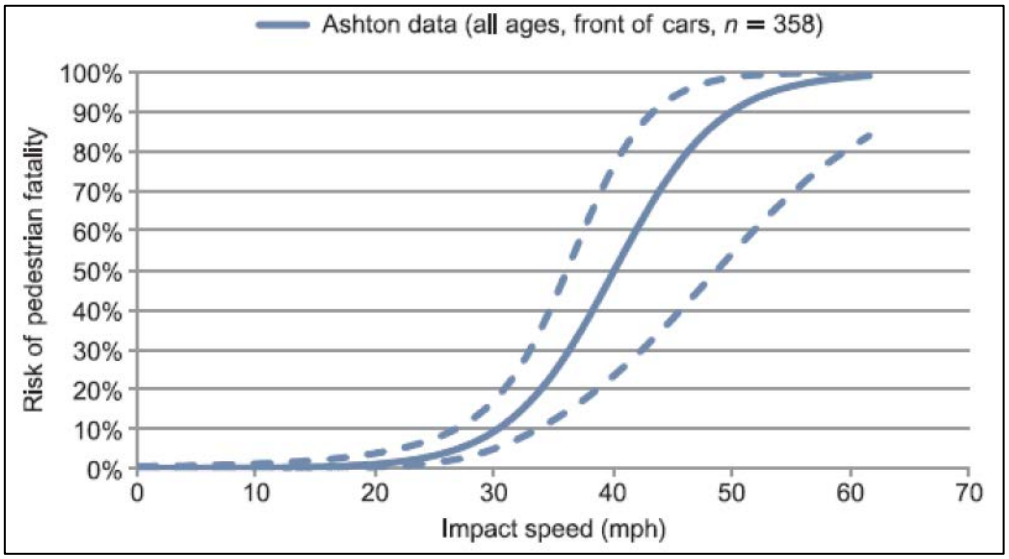

Figure 5: Likelihood of pedestrian fatality, as a function of impact speed (Department of Transport, 2010)

The improvement of the built environment was also identified as a key measure to ensure road safety as shown by Yannis et al., 2018. This can be done by implementing traffic calming measures to slow down vehicles and therefore protect pedestrians while walking or crossing a street in the Durban CBD. The intention is to ensure that speeds within the Durban CBD are regulated such that a vehicle cannot travel at more than 40 km/hr.

The following traffic calming measures were proposed and will be implemented:

a) Raised intersections to reduce the speed of vehicles approaching the intersection area (Figure 6).
b) Raised pedestrian crossings to slow down vehicles and promote the safe crossing by pedestrians (Figure 7).
c) Extended kerbs to reduce the speed of vehicles turning, increase pedestrian refuge and decrease crossing distance (Figure 8).

Raising intersections introduces vertical deflection which in turn, forces drivers approaching the intersection to slow down. This also allows pedestrians crossing at the intersection, to do so with increased safety. The municipality will consider using different materials (e.g., coloured block paving etc) with regards to improve the visibility to road users. With this mitigating measure, even in the case of a crash, operating speeds are lower and therefore a crash will less likely result in serious injuries or death. This principle is in line with the Safe System approach. A concrete channel starting from minimum 0.3m-wide will be designed to accommodate stormwater to continue to flow along the kerbs. Existing pedestrian crossings and all relevant traffic signs will be maintained. Existing pedestrian crossings are currently signalised and may require timings to be

optimised to allow for more green time for pedestrians where necessary. All crossing facilities will be designed to be in accordance with the non-motorised transport (NMT) and universal access (UA) guidelines.

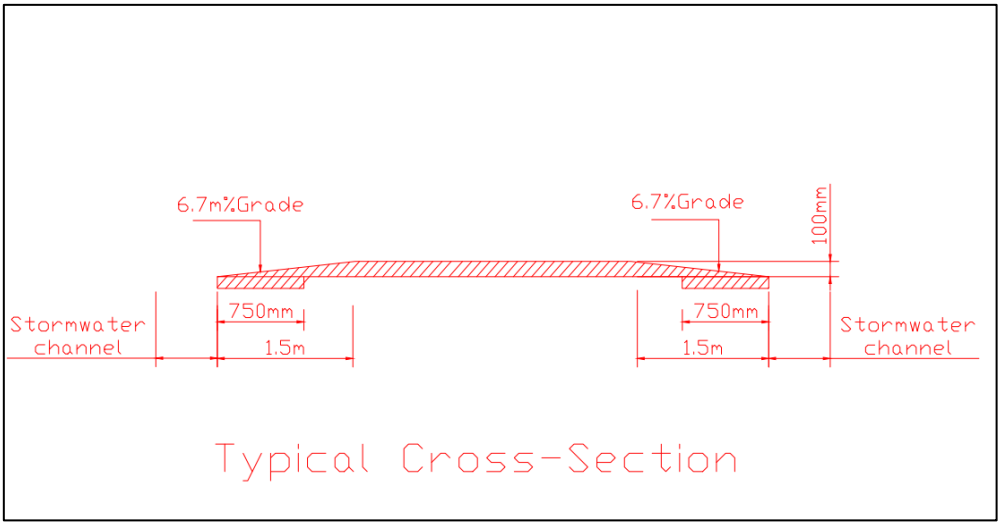

Figure 6: Typical raised intersection (ETA, 2022)

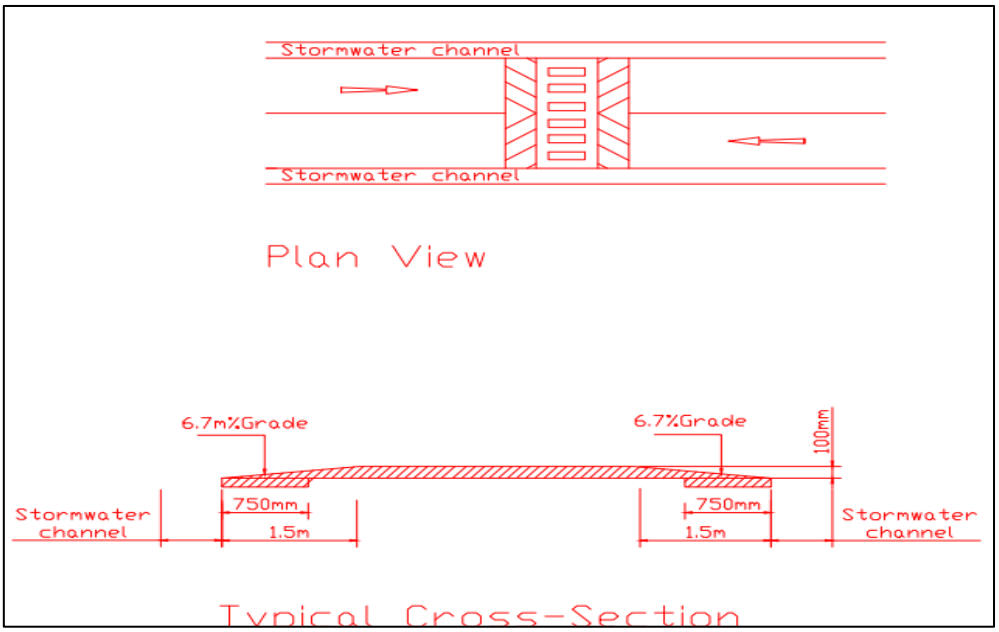

Figure 7: Typical raised pedestrian crossing (ETA, 2022)

Existing midblock pedestrian crossings will also be raised as a way of introducing vertical deflection, a type of traffic calming. Like in the case of raised intersections, raised pedestrian crossings will work as a way of complementing traffic signals at midblock crossings. This measure ensures that vehicles approaching pedestrian crossings are forces to slow down and allow pedestrians to cross safely. Note: a concrete channel starting from minimum 0.3m wide will be designed to accommodate stormwater to continue to flow along the kerbs. The existing pedestrian crossings and all relevant traffic signs will be maintained. All existing pedestrian crossings are signals. All crossing facilities will be designed to be in accordance with the non-motorised transport (NMT) and universal access (UA) guidelines.

Extended kerbs at intersections will be introduced to enlarge the pedestrian refuge area and decrease crossing distance (see Figure 8). This way, pedestrians will have more refuge area and less distance to walk at intersections. Vehicles that are turning will also be forced to slow down as there will be less area to manoeuvre (NACTO, 2022).

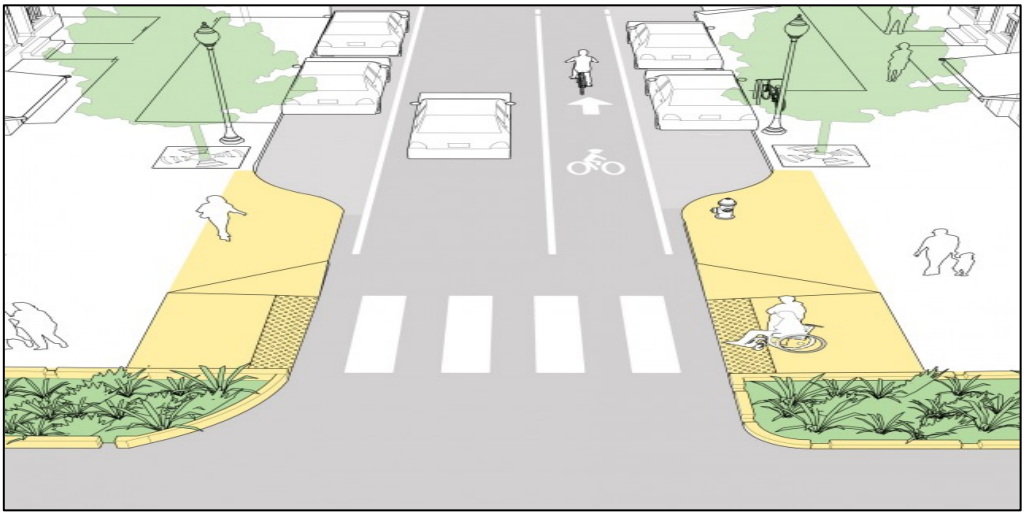

Figure 8: Extended kerbs at intersection (NACTO, 2022)

3.1 Technical Details of the Design

The geometric parameters used in the abovementioned solutions are in line with the Guidelines for the Geometric Design of Urban Arterial Roads (Department of Transport, 1987). As the focus is on the introduction of raised pedestrian crossings and intersections, the horizontal and vertical alignment of the road was kept the same. Drainage design adheres to the requirements of the eThekwini Drainage Manual for Urban Areas (eThekwini, 2008). A -2% cross fall across the road was assumed and a 300mm channel was assumed on either side of the road.

There was a reduction of turning radii on intersections along Dr AB Xuma Street (Class 3 road) & Monty Naicker Road (Class 3 road) to allow for tracking of heavy vehicles in the CBD. The design also added extended kerbs on intersections to allow safe crossing and refuge for pedestrians. This was undertaken using the following geometrics standards as outlined in Table 2.

Table 2: Geometric design criteria - horizontal alignment

Horizontal Alignment				
Design Speed (km/h)	**Design Vehicle**	**Min Turning Radius (m)**	**SSD (Stopping Sight distance)**	**Active Taper rate**
40	WB50	12,8	45	1:20
Passive Taper Rate	**Min Radius For Horizontal Curves (at +0.06 superelevation) (m)**	**Lane Width (m)**	**Sidewalk (m)**	**Median**
1:5	90	3.5m Standard and 3m turning	3m-6m	5m turning and refuge and 1.5m for separation of traffic

Source: Department of Transport, 1986

4. CONCLUSION

The city of eThekwini has a long-term strategic vision of being “Africa’s most caring and liveable city by 2030” (COGTA, 2020). This long-term strategy is implemented through various plans. In the context of road infrastructure, it is implemented through the municipality’s five-year working document, which is the Integrated Development Plan (IDP). It is then budgeted for and included in the Integrated Transport Plan (ITP). The safety of road users is central to this vision. The need for road users in general, and particularly pedestrians, to feel safe in the CBD is important because it influences the current and future attractiveness of the area to road users. It also affects potential investment because business is drawn into an area that attracts people in and around it. If the CBD remains unsafe, potential investment is deterred.

The city of eThekwini strives to be an example of a paradigm shift that designs residential and business precincts with Non-Motorised Transport (NMT) users in mind. The re-demarcation of road space in South Africa to benefit all, and not just vehicle drivers, justifies continuous debate. This project is part of the paradigm shift that is alluded to in the green Transport Strategy for South Africa: 2018-2050 which aims at “Promotion of non-motorised transport infrastructure to promote sustainable, carbon neutral modes of transport (e.g. cycling, walking) amongst others (Department of Transport, 2018).

It is therefore important to promote road safety by prioritising pedestrians and other vulnerable road users by ensuring their safety. The widening of sidewalks to a minimum of 3m to 6m will ensure that the high pedestrian demand is met, and pedestrians will get off the roadway and use sidewalks. The reduced turning radii will ensure that turning vehicles do so with lower speeds and therefore reduce severe injuries from crashes. The raised pedestrian crossings and intersections will also help reduce speeding by vehicles and that if pedestrians do get involved in crashes, it is at lower speeds which prevent serious injuries and fatalities as outlined by the Safe System Approach. This project aims to be a model for other CBDs to be pedestrian and NMT-user friendly.

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