UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD
ENGINEERING & THE BUILT ENVIRONMENT

NON-MOTORISED LINKAGES TO PUBLIC TRANSPORT FACILITIES

CASE STUDY: CAPE TOWN RAILWAY STATION

Master's Dissertation (60 Credit)
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ABSTRACT

The focus of the research is to identify which criteria need to be applied to improve the NMT infrastructure design for linkages to Public Transport interchanges, by using the Cape Town Railway Station as a case study. The study used best practice international and South African design guidelines to develop design improvements to three existing NMT linkages. A walkability assessment tool was used to audit the linkages and to assist with the identification of where improvements can be made.

A literature review of the research topic was done to identify the main challenges for NMT design in South African cities. This was followed by researching the NMT policy environment in South Africa, since the policy environment drives the provision of transport infrastructure (Beukes et al., 2017). The literature review included an investigation of the design criteria to apply to improve the infrastructure for walking and cycling linkages. The criteria was used as an informant to select assessment tools that can be used to audit roads to improve walkability. This was followed by researching some audit tools which can assist with an inter-disciplinary audit of sections of the roads under investigation. Best practice design guidelines, as well as the most used South African design guidelines, were part of the literature review.

The research is particularly interested in the NMT linkages to Public Transport facilities. To answer the research questions, a mixed-methods approach containing both qualitative and quantitative data was used. The research aimed to investigate NMT linkages to a Public Transport interchange. The design of the research is based around a single case study, the Cape Town Railway Station, since it is the busiest Public Transport interchange facility in the city in terms of users (CCT, 2022). To test if the Pedestrian First walkability tool (ITDP, 2018) would be sufficient to use, three different NMT routes were identified. The routes include a route which has an existing cycle lane facility, a busy intersection, a NMT route to the Cape Peninsula University of Technology (CPUT), which is an important link to an education facility, and a best practice NMT route to the Cape Town Stadium.

The Pedestrian First, Street-Level Walkability Design Checklist (ITDP, 2018) was used to conduct audits on the selected NMT linkages. This tool does not have criteria for cycling, and three criteria for cycling design were added. Similarly, an addition was made to include nine criteria for security for vulnerable users using the Safetipin app (Safetipin, 2023). This was done to support the challenges experienced by vulnerable users around security.

The scores for each section were calculated to identify the areas which achieved a low score, and these sections were identified as the sections that need to be improved. The sections of the route that were identified to be improved were compared to the latest best practice and South African guidelines to develop design improvements. Three main categories for improvement were identified along the routes, namely multi-modal design solutions, which includes the space allocation for different modes in the cross-section, safety for users, particularly at busy intersections, and operations and maintenance of NMT facilities. The available design guidelines were consulted to establish the main design principles that should be applied to NMT facilities. This was followed by a selection of particular best practice design examples from the guidelines to apply to the sections. These examples are compared to the existing provision for NMT and suggestions for improvements were made.

Upon reflection of the research questions, conclusions were made. The Pedestrian First Street-Level Design Checklist tool, can be used to test the walkability of a street. Street design is a complex process, and requires an inter-disciplinary team with input from the users of the street. Although the NMT policy in South Africa is well developed, the guideline documents, which are an interpretation of policy, need to be improved. The gaps in providing for cyclists need to be addressed to grow cycling volumes. The NMT design guidelines (NDoT, 2015), is a valuable resource to improve NMT infrastructure provision, and the integration of road and NMT guideline documents into one design guideline should be pursued.

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"There are no separate systems. The world is a continuum. Where to draw a boundary around a system depends on the purpose of the discussion"
Meadows, 2008.

1. INTRODUCTION

1.1 Background

Cities are grappling with the challenges of making transportation systems more sustainable. Growing populations make congestion on the roads worse and contribute to carbon emissions. Globally, there is recognition that sustainable transportation systems need to be developed and improved to provide for future travel needs of people. The Sustainable Development Goals that were agreed upon in 2016 have a specific goal for developing sustainable cities. The targets, to achieve these goals, are shown below (UN-Habitat, 2013).

Goal 11: Make cities and human settlements inclusive, safe, resilient, and sustainable.

- By 2030, provide access to safe, affordable, accessible, and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.
- By 2030, enhance inclusive and sustainable urbanisation and capacity for participatory, integrated, and sustainable human settlement planning and management in all countries.
- By 2030, reduce the adverse per capita environmental impact of cities, including paying special attention to air quality and municipal and other waste management.
- By 2030, provide universal access to safe, inclusive, and accessible, green, and public spaces, particularly for women and children, older persons, and persons with disabilities.

There is also a specific target for road safety connected to Goal 3.

Goal 3: Ensure healthy lives and promote well-being for all, at all ages.

- By 2030, halve the number of global deaths and injuries from road traffic accidents.

The targets recognise the importance to improve road safety, especially for people in vulnerable situations. It recognises the need for participatory and integrated planning and management of sustainable human settlements, and reducing the per capita environmental impact of cities, as well as the importance of providing universal access to safe green public spaces. Universal access refers to the provision of infrastructure which makes it accessible for people with different abilities to use. This could include wheelchair users, people with hearing and sight difficulties, as well as amputees.

To support Goal 11, the first-ever United Nations Global Sustainable Transport Conference was held in November 2016. As part of this conference, fifty countries endorsed the "Ashgabat Statement on Commitments and Policy Recommendations". This statement supports the development of cleaner and greener transportation from local transit systems to worldwide multi-modal networks. It is clear from this that Cities are, more than ever, investing and thinking about sustainable transport solutions. The importance of providing walking, biking, and public transport networks in cities are essential to support the sustainable cities' goal.

UN-Habitat recognises the importance of Non-Motorised Transport (NMT) by ordering it as the first chapter in the Planning and Design for Sustainable Urban Mobility report. All modes of transportation that are not propelled by and engine or motor are referred to as Non-Motorised Transport (NMT). This includes using wheelchairs, small-wheeled vehicles like skateboards, push scooters and hand carts, as well as walking and cycling. (UNEP & UN-Habitat, 2022).

The report calls for a paradigm shift in transport policy to focus on accessibility rather than mobility (UN-Habitat, 2013).

"Accessibility is at the core of urban mobility" (UN-Habitat, p2. 2013)

UN-Habitat recognises that accessibility can be enhanced through improved land-use planning by ensuring activities are placed in proximity to users, and that electronic connectivity can also alleviate the need for mobility (UN-Habitat, 2013). With a focus on accessibility, the importance of NMT design, around activities and destinations, has become critical. **Figure 1** illustrates the shift needed from engineers and planners to focus on people. Instead of asking "how many cars can we move down the street?" we should ask "how many people can we move down the street?"

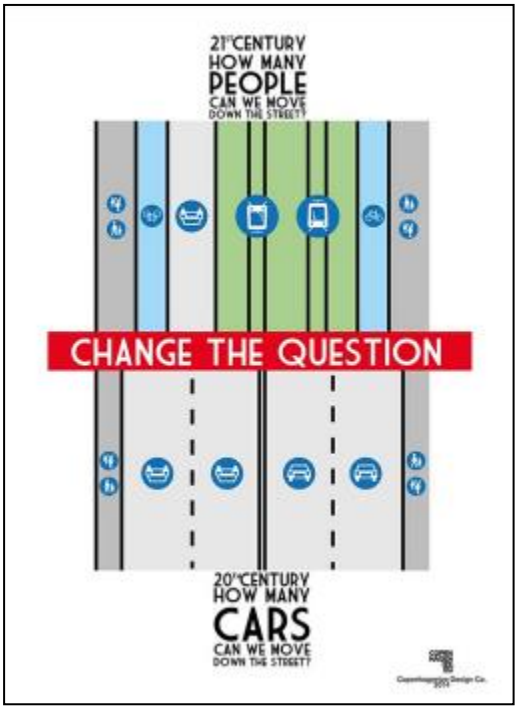


Figure 1: Change the Question.
Source: www.copenhagenize.com

To develop greener and more sustainable transportation systems requires a focus on NMT design. Historically, transportation engineers were taught to design for cars. A shift is needed to focus on designing spaces where people can walk and cycle. With good quality walking and cycling connections as part of the public transport systems, people can improve the way they travel to be more sustainable. This requires a mind shift from users and designers of the systems.

Table 1 summarises the differences between traditional urban transport planning versus sustainable urban mobility planning. The focus of design is moving away from focusing on cars to focusing on people. It supports interdisciplinary design, involving stakeholders with the primary focus on improving accessibility and quality of life. (GIZ, 2014).

This research is focused on NMT design to improve accessibility to existing Public Transportation Systems. It uses Cape Town Railway Station as a case study to identify which criteria to use when designing for NMT users.

Table 1: Traditional Urban Transport Planning vs Sustainable Urban Mobility Planning. Source: ITDP & Rupprecht Consult, 2014, p.3.

Box 2: Traditional urban transport planning vs Sustainable Urban Mobility Planning

While traditional, generalist transport planning approaches focus on the movement of cars by expanding infrastructure, the emphasis should actually be laid on mobility and accessibility for all population groups. The following table compares traditional transport planning with sustainable mobility planning.

Traditional Transport Planning	Sustainable Urban Mobility Planning
Focus on traffic	Focus on people
Primary objectives: Traffic flow capacity and speed	Primary objectives: Accessibility and quality of life, as well as sustainability, economic viability, social equity, health and environmental quality
Modal-focussed (focus on particular transport modes)	Balanced development of all relevant transport modes and shift towards cleaner and more sustainable transport modes
Infrastructure Focus	Integrated set of actions to achieve cost-effective solutions
Sectorial planning document	Sectorial planning document that is consistent and complementary to related policy areas (such as land use and spatial planning; social services; health; enforcement and policing, etc.)
Short- and medium-term delivery plan	Short- and medium-term delivery plan embedded in a long-term vision and strategy
Related to an administrative area	Related to a functioning area based on travel-to-work patterns
Domain of traffic engineers	Interdisciplinary planning teams
Planning by experts	Planning with the involvement of stakeholders using a transparent and participatory approach
Limited impact assessment	Regular monitoring and evaluation of impacts to inform a structured learning and improvement process

1.2 NMT Challenges in South African Cities

1.2.1 Safety

South Africa has the second highest road traffic fatality rate in Africa, at 32 deaths per 100 000 inhabitants, after Nigeria. This figure is even made worse by the fact that less than 2% of all registered vehicles in the world are in Africa, but it accounts for 20% of global traffic deaths. (Kopits and Cropper, 2005).

The main contributors to fatalities in South Africa were 47% jaywalking and 30% speeding, as per the survey done in December 2002 by Jungu-Omara and Vanderschuren (2006). In a case study of Cape Town, Behrens revealed that pedestrians that lived in the city, for two or less years, cross highways significantly more at grade, than using bridges (Behrens, 2010). Research by Sinclair and Zuidgeest (2015) suggests that pedestrians crossing highways in Cape Town appear to choose the lesser of two evils by crossing highways at grade, to avoid violence and aggression, when using foot bridges.

Looking at individual cities, the statistics are even worse, as can be seen in **Figure 2**. The death rate per 100 000 inhabitants in South Africa is above the African average, which is at 24 per 100 000 inhabitants (Vanderschuren and Zuidgeest, 2017).

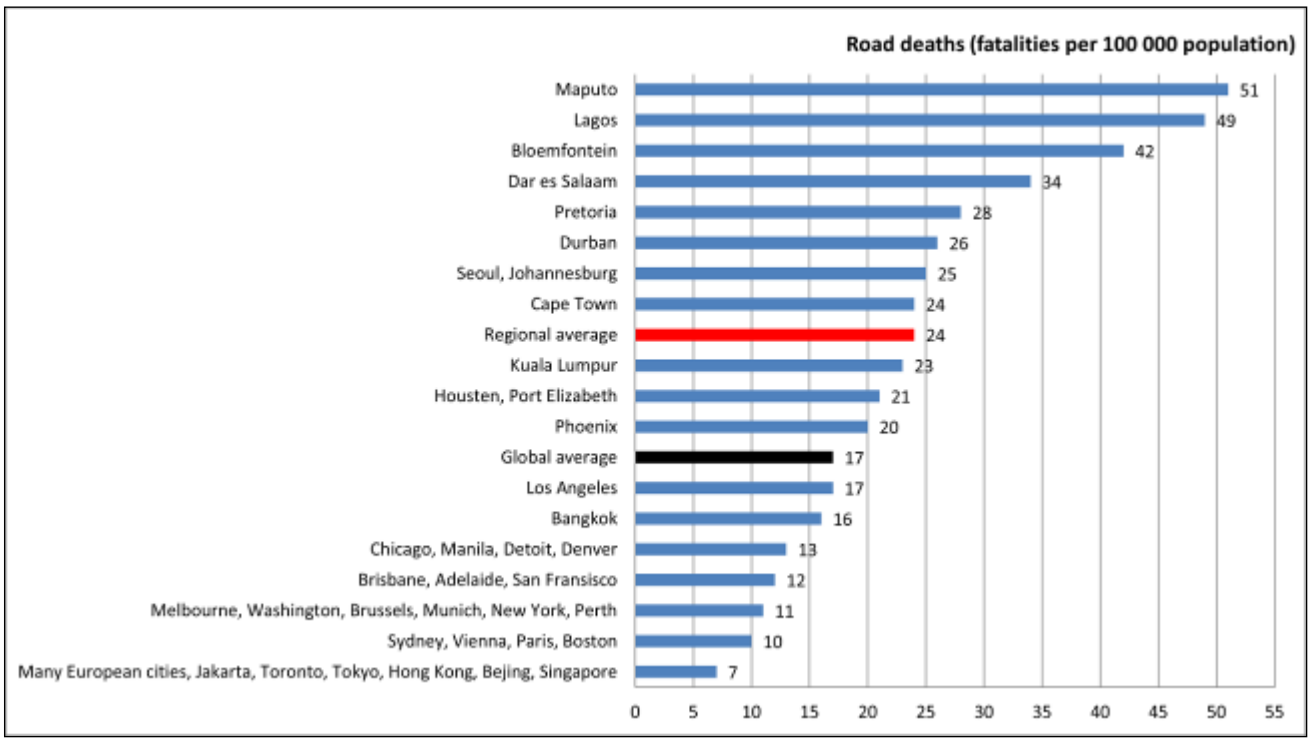


Figure 2: Road Fatality Rates for Continents and Selected Countries (all modes per 100 000 pop., 2010). Source: Vanderschuren and Zuidgeest, 2017, p.58. Adapted from the WHO 2013.

Data from the City of Cape Town Forensic Pathology Laboratory for 2011 indicates that 66% of road fatalities are vulnerable road users (Vanderschuren and Zuidgeest, 2017). Motorcycles account for 6%, cyclists 3% and pedestrians make up 57% of the fatalities number. The percentage of pedestrian fatalities in Cape Town for children and young adults below the age of 29 years is 28% (Vanderschuren and Zuidgeest, 2017). The leading cause of death for children and young adults aged 5-29 years are road traffic injuries (WHO, 2022).

As part of the City of Cape Town's Integrated Transport System, an NMT strategy was developed in 2017. The data from that study confirms that pedestrians make up the highest percentage of the fatalities on the road. It identified that 61% of all road fatalities in Cape Town were pedestrians (City of Cape Town, 2017). The areas with the highest "Equivalent Accident Number" (EAN) were Klipfontein/False Bay, Khayelitsha/Mitchells Plain and the Tygerberg districts. The Blaauwberg district has the lowest EAN number. The strategy also identified the three roads with the highest pedestrian EAN per km as (City of Cape Town, 2017):

- Vanguard Drive (M7), Goodwood
- Lansdowne Road (M9), and
- Strand Street, Cape Town CBD.

The strategy found that cyclists make up 1% of all road fatalities with Tygerberg, and the Southern and Eastern districts having the highest cyclist-EAN.

There is an urgent need to improve the safety on South African roads. Education, improved design, and enforcement are all measures which should be used to increase road safety. A focus on NMT design as part of the movement system is essential to improve the safety of people on the streets.

The seriousness of road safety was confirmed by the World Health Organisation (WHO) when the United Nations General Assembly adopted a resolution in September 2020 to "Improving global road safety". (WHO, 2021). The Decade of Action for road Safety 2021-2023, sets ambitious targets of preventing at

least 50% of road traffic deaths and injuries by 2030. In partnership with UN Road Safety Collaboration, the WHO and UN have developed a Global Plan for the Decade of Action, which was released in October 2021. Elements which need to improve includes:

- Multimodal transport and land-use planning
- Safe road infrastructure
- Safe vehicles
- Safe road use
- Post-crash response

Figure 3 illustrates a powerful message about the speed at which a car travels and the chances of a pedestrian fatality if there is an accident.

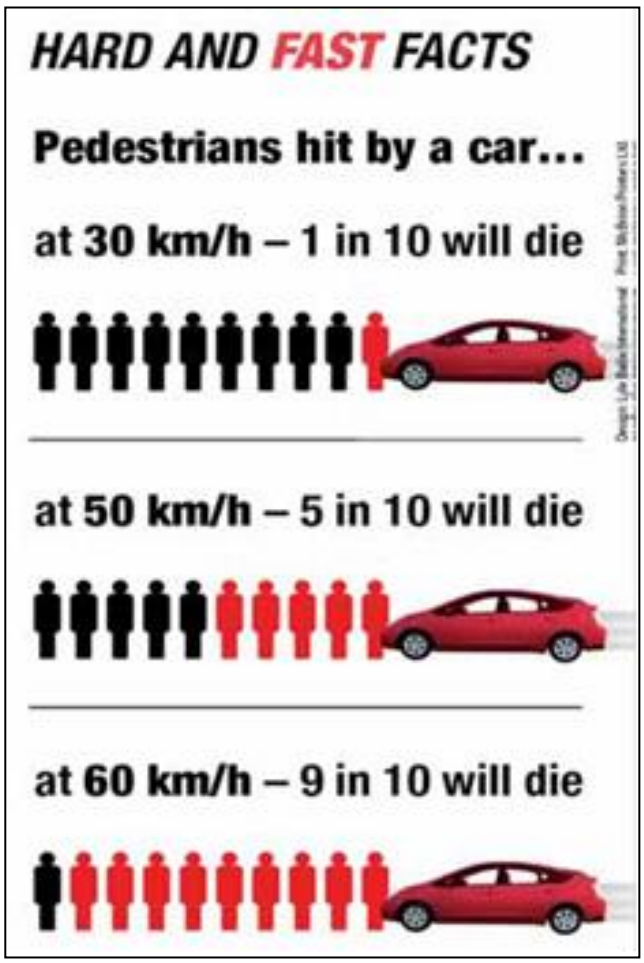


Figure 3: Chances of a Pedestrian Fatality at Different Vehicle Speeds.
Source: Irish Department of Transport, Tourism and Sport, 2013, p.63.

A study by Dumbaugh and Rae (2009) investigated the City of Antonia to establish the relationship between traffic safety and the urban form. The City of Antonia was chosen, because it has a historic city core, streetcar suburbs adjacent to downtown and, also, conventional designed neighbourhoods on the edge of the city (Dumbaugh and Rae, 2009). By using a GIS based database of crash incidence in the city, the location and severity of the crash could be plotted. The following conclusions were derived from the study and recommendations, regarding planning practices, have been made.

- Accidents are related to the speed at which cars travel, as well as the "systematic design error". By designing wider and straighter roads, with the technology of cars being able to travel at very high speeds, chances of accidents are increased (Dumbaugh and Rae, 2009).
- Dumbaugh and Rae (2009) found that the incidence of crashes are higher on urban arterials where the roads are wider and straighter and allows for vehicles to drive faster. They confirm that these conditions are not favourable in urban areas where cyclists and pedestrians also use these streets. These urban arterial type streets should be designed in a more context sensitive way to allow for the different users of the street.
- Retail land use along arterials posed a pedestrian safety issue, which was acknowledged by Perry (cited in Dumbaugh and Rae, 2009). The Europeans provide urban surface streets to reduce vehicle speeds in areas of retail centres (Dumbaugh and Rae, 2009).
- Designing streets at a pedestrian-scale level decreases the incidence of accidents (Dumbaugh and Rae, 2009).
- From this it is essential that speed limits are lowered in areas where there is a high demand for pedestrian and cycling activities. This includes schools, community facilities, health clinics etc.
- For areas which are located next to highways, separated pedestrian, and cycling facilities are needed.

It is clear from the information that more should be done to improve the road safety of pedestrians. Apart from road safety challenges for pedestrians, being secure from crime is another element which influences the walking behaviour of pedestrians in South Africa. The next paragraph discusses how design can assist with making places more secure from a crime perspective.

1.2.2 Security

Apart from the risk of being involved in an accident on the roads, another challenge, facing NMT users in Cape Town, is personal security while using the roads and NMT facilities. Behrens and Makajuma (2017) studied pedestrian crossing behaviour in Cape Town and Nairobi. As part of the study, the authors questioned pedestrians on why they were crossing the freeway at-grade instead of at the foot bridges. The following three reasons were given. The most common response was that people want to take the shortest route (70%) followed by a concern for route distance and crime (17%) and then safety from crime (12%) (Behrens ad Makajuma, 2017). Pedestrians are afraid of criminals waiting for them at the end of a foot bridge, with no way to escape. Another question revealed that 72% of respondents only use a crossing facility when they are travelling with someone. Safety from crime is particularly important amongst women (Behrens ad Makajuma, 2017).

Labuschagne and Ribbens (2014) also identified that "NMT users sense a lack of security in the road environment", mainly due to lack of inadequate street lighting on roads, subways, and footbridges.

In a recent study commissioned by the Volvo Research and Education Foundation (Cooke, et al., 2021), interviews and focus group discussions were conducted in three different African cities, namely Lusaka, Kigali, and Cape Town. The main aim of the study was to understand the needs of vulnerable NMT groups in African cities (Cooke, et al., 2021). The focus groups were conducted with female NMT users older than 18 years, and the main findings from the study were that personal safety while walking or cycling was a shared concern between both male and female respondents across the three cities (Cooke, et al., 2021). In Cape Town in particular, a fear of crime with a threat of sexual assault, especially amongst female NMT users, was prevalent (Cooke, et al., 2021). The fear of crime on routes is a main barrier to access for vulnerable users, and the study proposes that, in African cities, a capabilities approach should be developed to ensure that a just transition for vulnerable NMT users is achieved (Cooke, et al., 2021). This study confirms the importance of providing better NMT facilities for vulnerable users, since security challenges are the main barrier to using NMT modes.

Vanderschuren et al. (2019) reported, in a paper concerned with the perceptions of gender and personal safety, that the most dangerous part of a journey is the walk to / from the railway station, followed by the time spent on the train. The study concludes that there is gender inequity in the South African transport system, especially in the public transport services (Vanderschuren, et al., 2019; FIA, 2016). The study made recommendations to integrate policies that improve personal safety on the public transport system, in particular, public transport and NMT modes masterplans should feature women's need to improve the provision of infrastructure by investing in proper street lighting, secure paved sidewalks and designs that encourage safety and security, especially around rail stations (Vanderschuren et al., 2019).

The City of Cape Town (2017b) recognises safety from crime as a challenge and requires that all projects apply Crime Prevention Through Environmental Design (or "CPTED") principles. These principles include designing facilities which are in environments where there are "eyes on the street". For example, street cafes which provide extra security for pedestrians passing by. It is also about maintaining the vegetation along NMT facilities and providing lighting along routes.

1.2.3 Provision of Infrastructure for NMT

Traditionally, transport engineers in developing countries were trained as "highway" engineers and their focus was on providing road space for vehicles (Mitullah and Opiyo, 2013). This practice has resulted in roads not making provision for NMT users. Examples of this includes slip-lanes at intersections, which provides conflict areas for pedestrians trying to cross that road. Other examples include the provision of large turning radii for kerbs at intersections, which makes it very comfortable for a vehicle to turn at the corner without slowing down, endangering NMT users. The omission of dropped kerbs at intersections and prioritising the green time of traffic signals for vehicles is another example of how design is biased towards vehicles. However, globally, there is a shift towards a more equitable and sustainable transport network in cities. These practices, to improve and retrofit the design of infrastructure to accommodate pedestrians and cyclists, are slowly developing in African cities to improve the design of roads.

Beukes et al., (2013) conducted research on context sensitive design. This method uses the land use, socio-economic and environmental factors to plan roads, which not only provide for private vehicles, but include provision for public transport and NMT users. The research identified that, although the existing road planning guidelines do not preclude innovative design solutions, most planners follow the guidelines, and that road planning and design is largely based on private vehicle volumes and speed.

1.3 Aim of the Research

Non-Motorised Transport forms an integral part of the transport system. As per the various policy and guideline documents, the provision and design of NMT links is critical for a city with a sustainable vision. This research is particularly interested in the catchment area of a Public Transport facility. Each trip made by a person will include at least two NMT links, as shown in **Figure 4,** as adapted from Bhandari, et al., (2014). The ease of access of pedestrian linkages to and from public transport facilities should receive priority, since it influences the modal choice of users (Behrens & Watson, 2009). By using the Cape Town Railway Station as a case study, it can test the NMT connections to the station and propose improvements to the facility.

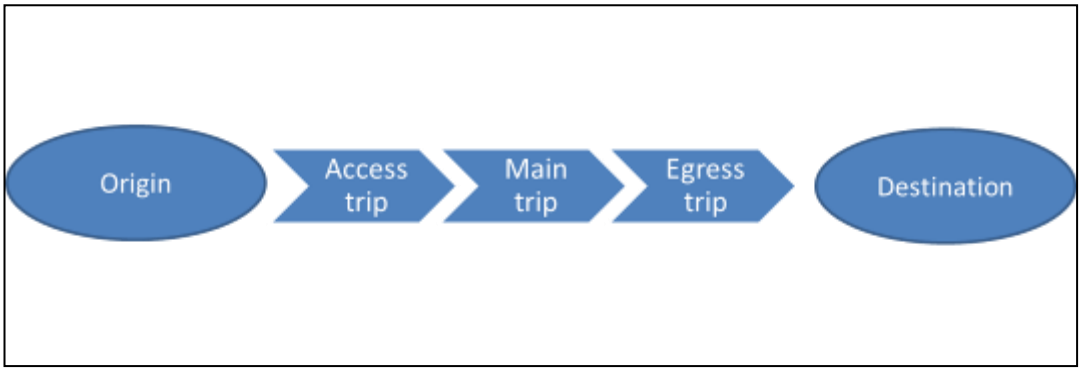


Figure 4: Trip Chain of a Person Using a Transport Mode.
Source: Bhandari, et al., 2014.

"Much of the effort associated with public transport trips is performed to simply reach the system, and the final destination. Access and egress stages (together with wait and transfer times) are the weakest part of a multi-modal Public Transport (PT) chain, and their contribution to the total travel disutility is often substantial" (Bovy and Jansen, 1979).

The focus of this research report is on the NMT linkages to the Cape Town railway station. The access and egress trips are being investigated and proposals are made to improve the linkages to the station. The criteria to be used, when designing NMT linkages to Public Transport facilities, is also identified together with specific design tools to use when designing for NMT users. The paper starts with a general literature review on NMT linkages to Public Transport facilities to identify design criteria. This is followed by identifying design tools to be used, and examples of good and bad designs. This information is then used to develop an improved NMT-link solution for the Cape Town Railway Station.

The questions that will be answered are:

- What are the NMT challenges in South African Cities?
- Who designs our streets?
- What is the policy around NMT in South Africa?
- Which criteria should be used to improve NMT design?
- Which design tools are available for NMT design?
- What are good design examples?
- How to prioritise the decision-making regarding the prioritisation of road users in the cross-section of urban roads?

These questions will be answered by using the Cape Town Railway Station as a case study. The purpose of this research study is to illustrate the importance of NMT linkages as part of the bigger transport system, and to use an inter-disciplinary approach to the design of the NMT linkages to the Cape Town Railway Station.

1.4 Scope and Limitations

The scope of this research is to investigate NMT linkages to Public Transport Facilities. It used the Cape Town Railway Station as a case study to investigate the walkability and cycle-ability of three NMT routes to the station.

Due to resource constraints, not all possible routes to the Cape Town Railway Station could be investigated. The three routes were investigated to ensure that there is a "best practice" route, a route

with cycling infrastructure, and a route that will require a major intersection to be upgraded. This was to ensure that different design elements can be investigated for improvements.

The design process for NMT facilities requires an in-depth process with multiple steps, but the scope of this study extended to making high-level proposals to improve the road sections, by illustrating solutions using Google Earth and the City of Cape Town CityMap viewer. The proposals were developed using the best practice design guidelines, both for international and South African guidelines. During this stage of the process, foreign case examples were also used as informants to develop concept designs. The designs are at the concept design level stage and exclude detail design proposals.

The main limitation of this study is that it did not include user interaction as an input to the designs. This is a crucial step that designers and implementing authorities need to include in their NMT designs, to ensure the user needs are being considered.

The study did not include the cost of providing NMT infrastructure. This could be an area of research to add in the recommendations.

The following section presents a general overview of the contents of this minor dissertation.

1.5 Report Structure

The first chapter introduces the research topic and discusses the NMT challenges experienced in South Africa. The chapter lists the limitations of the study and provides a report structure sections. Chapter 2 provides a background section followed by a literature review on the policy for NMT in South Africa. The chapter identifies criteria to be used to improve street design for NMT users and concludes with available tools to inform the design process.

Chapter 3 explains the research methodology and outlines the process that was followed. Having explored the criteria and some tools, the preferred tool, Pedestrians First (ITDP, 2018), is introduced in Chapter 4. This assessment tool was augmented with three criteria for cycling and nine criteria for security for vulnerable users, using the Safetipin app (Safetipin, 2023). The three different scales of the tool are explained, namely the citywide, neighbourhood and street-level scale. An explanation is given for using the Street-Level Walkability Design Checklist (ITDP, 2018) for this study, followed by an introduction to the case study.

The results of applying the Street-Level Walkability Design Checklist to the three different routes linking to the Cape Town Railway Station are discussed in Chapter 5. Using the walkability assessment results, analysis was done to identify the lowest scoring sections of the routes. These sections were identified for design improvements.

Chapter 6 discusses the three main categories for improvement, namely multi-modal design, accommodation of NMT at intersections, and the importance of a maintenance programme for NMT facilities. The lowest scoring sections were compared to the latest best practice design guideline documents, to develop concept design proposals to improve the walkability and cycle-ability of the routes. Chapter 7 presents the concept design proposals for each of the routes. The final findings and recommendations are presented in Chapter 8 with some recommendations based on the research that was done in Chapter 9.

2. LITERATURE REVIEW

2.1 Setting the Scene

Designing facilities that are people focused and improve the street's function as a place, requires a multi-disciplinary approach. The design should consider the re-balancing of streets to provide for walking and cycling. This way of looking at street design is necessary to address the safety and sustainability issues on South African roads. In South Africa, mode choice is often dictated by income and people within the lower income brackets are, generally, captive to public transport and NMT (NDoT, 2005). By improving the standard of NMT facilities, the majority (up to 72% of people using public transport and NMT to get to work), will have an improved situation (NDoT, 2005).

Figure 5 is taken from a design guideline developed in Ireland in 2013. It shows the different aspects of street design by comparing the conventional street design approach to a more sustainable approach. The main shift is to design for people instead of cars.

Figure 5: The New Way of thinking when Designing Streets.
Source: Irish Department of Transport, Tourism and Sport, 2013, p.3.

Another guideline document which recognises that a different approach is needed is the Manual for Streets (UK Department of Transport, 2007). This document identifies the importance of a multi-disciplinary team to be involved when streets are designed.

There is a need to adapt the approach, in which NMT facilities are designed, as part of the street network. The Manual for Streets (UK Department of Transport, 2007) makes the following comments regarding design:

- Places and streets that have stood the test of time are those ***where traffic and other activities have been integrated successfully,*** and where buildings and spaces, and the needs of people, not just of their vehicles, shape the area.

- In many cases ***shortcomings in street design reflect the rigid application of highway engineering standards in terms of road hierarchies***, junction separation distances, sight lines and turning radii for service vehicles. The result is often a sense of sprawl and formlessness and development which contradicts some of the key principles of urban design.
- ***Imaginative and context-specific design*** that does not rely on conventional standards can achieve high levels of safety.
- ***Each street should be considered as unique*** – understand its location, character, and eccentricities. Relate designs to these local characteristics, not to something built elsewhere.
- The transport user hierarchy should also be applied – ***consider the needs of the most vulnerable users first: pedestrians, then cyclists,*** *then public transport users, specialist vehicles like ambulances and, finally, other motor vehicles.*

2.2 Who Designs Streets

The street design team should include a broad range of professionals to ensure a holistic design approach is implemented (Irish Department of Transport, Tourism and Sport, 2013). **Figure 6** illustrates the different members needed in the design team. It is important to note that the figure excludes the input from the NMT user, which is a crucial input to the development of design proposals.

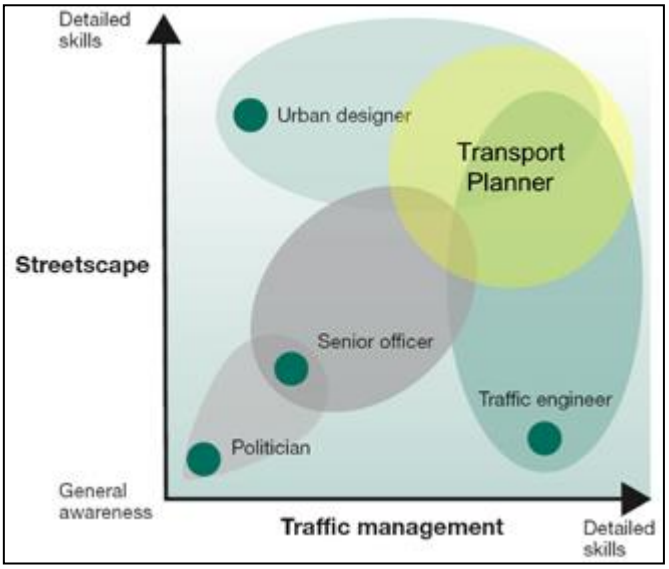


Figure 6: Design Manual for Urban Roads and Streets.
Source: Irish Department of Transport, Tourism and Sport, Ireland. 2013.

In Jones et al. (2007) a comparison is made between the conventional design scope, which urban professionals are responsible for, versus the area of a street plan. The diagram illustrates the overlaps and complexity of street design and the need to be able to work in an inter-disciplinary manner when designing streets (Jones et al., 2007). It clearly shows that the carriageway or roadway is the domain of the transport planner / traffic engineer, and the land use plan is the domain of the urban planners / designers. To have an integrated street design solution the expertise of all these professionals is needed.

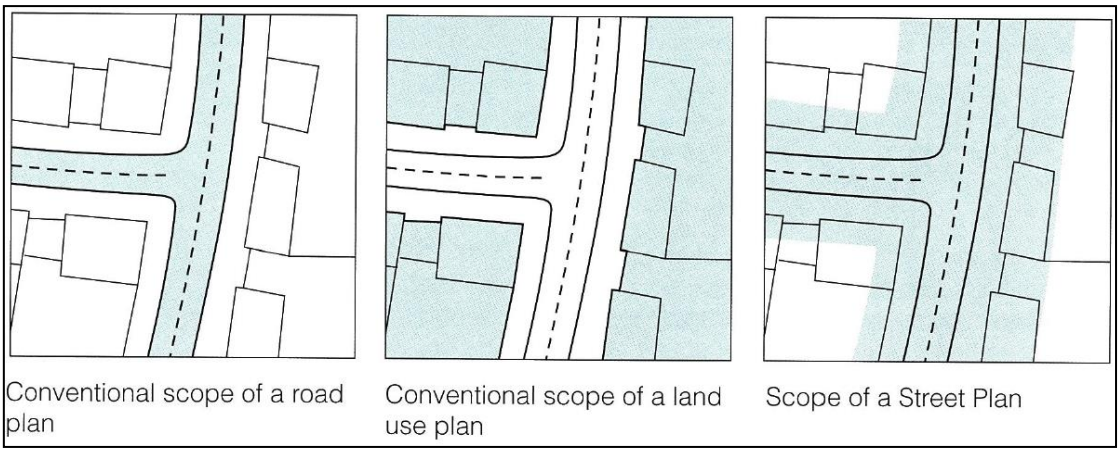


Figure 7: The Coverage of the Link/Place Street Plan in Comparison with Conventional Approaches.
Source: Jones et al., 2007.

The roles of different professionals (**Figure 8**) in the street design process are both an opportunity and deterrent to good street design. In design offices where these professionals can work in an inter-disciplinary manner, the product should be much more integrated and innovative, than in a typical set-up where it is the roads department designing a NMT 'link' with limited input from the urban design department. From a transport / traffic engineer's perspective the focus is on making a transport link as efficient as possible for a person to go from point A to point B. From a place perspective, the urban designers would like to ensure that people want to spend more time in a place (Jones et al., 2007), and herein lies the complexity of designing a good street. There are different goals that need to be achieved for one piece of infrastructure.

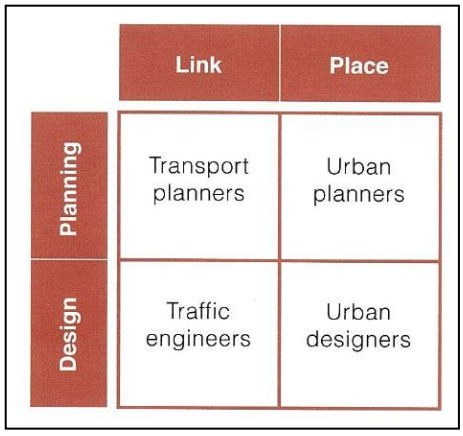


Figure 8: The Roles of Different Professionals in Street Design.
Source: Jones et al., 2007, p.242.

Figure 9 reiterates the importance of having an inter-disciplinary team to integrate and collaborate on the design process of the street. NMT facility design relates, not only to road safety and civil engineering, but also to town planning, urban design, architecture, landscape architecture, and conservation (Behrens et al., 2009).

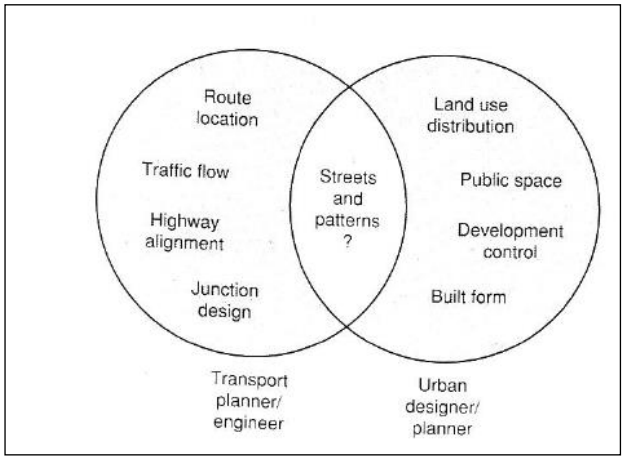


Figure 9: Overlap of Streets in the Design Professions.
Source: Marshall, 2005, p.22.

2.3 South African Policy for NMT Design

The National Department of Transport policy on transport improvement for the country is focused on the provision of improved public transport. The rail system is the backbone of the public transport system and Bus Rapid Transit (BRT) is being rolled-out in the major cities (NDoT, 2007). As part of the public transport journey, a NMT link is always included. This link is seen as the important "first mile" / "last mile" link to access the Public Transport system. As stated by Meadows (2008), there are no separate systems and the NMT link should be part of a seamless public transport system. To improve the experience of the public transport users, there is an urgent need in South Africa to improve the design of NMT facilities.

The following section provides a summary of the main thrusts in NMT policies and strategies in South Africa.

Table 2: NMT Policy Documents.
Source: Various sources.

Policy Document	Main Findings
The White Paper (NDoT, 1996)	• The vision for South African transport is of a system which will: "Provide safe, reliable, effective, efficient and fully integrated transport operations and infrastructure which will best meet the needs of freight and passenger customers at improving levels of service and cost in a fashion which supports government strategies for economic and social development whilst being environmentally and economically sustainable." – p6. • "To improve accessibility and mobility, limiting walking distance to less than about one kilometre in urban areas" – p35. • Accessibility to opportunities (school, work, health care, shops).
Moving South Africa Strategy (NDoT, 1998)	• Lack of affordable basic access (NDoT, 1998). • Walking distance to Public Transport should be less than 15 minutes. • Transport development along corridors.

Policy Document	Main Findings
Public Transport Strategy and Action Plan (NDoT, 2007)	• "Non-motorised transport (NMT), particularly walking and cycling, will serve as an important mode of transport in the Integrated Rapid Public Transport Network." (p.22). • NMT is the key aspect of the "first mile" and "last mile" of a trip.
Draft Non-Motorised Transport Policy for South Africa (NDoT, 2008)	• The document provides policy statements for animal drawn vehicles, cycling, walking and innovative solutions in NMT. It sees NMT as a sustainable and stimulant mode of transport for social and economic development.
Pedestrian and Bicycle Facility Guidelines (NDoT., 2003)	• The manual provides guidelines on the following: (1) Type, location and layout of pedestrian and cycling facilities; (2) Safeguarding of pedestrians at public spaces, termini etc.; (3) Process of planning for pedestrian and cyclists; (4) Accommodation of people with special needs.
NMT Facility Guidelines (NDoT, 2014)	• A revision and update of the 2003 guidelines. It is an easy-to-use guide for practitioners interested in cycling, walking and other NMT uses in urban and rural areas. The guidelines assist to carry out the (1) planning, (2) design and (3) implementation of facilities as well as (4) maintenance programmes for NMT infrastructure.
Western Cape Government Draft Non-Motorised Transport in the Western Cape Strategy (PWCG, 2009)	• The document builds on policies that show the importance of NMT. • The strategy (1) Outline the role of various government agencies; (2) Indicate the commitment of PGWC to improve mobility through NMT; (3) Provide a short-term strategy for rolling out NMT projects; (4) Identify long-term objectives.
100000in10 – Draft Cycling Tourism Framework. (WCG, 2014)	• This strategy wants to achieve an aim of attracting 100 000 international cycling visitors to the Western Cape region over ten years. • The overall objective of this strategy is to increase the growth and jobs within this sector.
City of Cape Town Draft Non-Motorised Transport Strategy (CCT,2017)	• Objective to create a safer and convenient environment for commuters, pedestrians, and cyclists. • Restructure urban public spaces in a way that contributes to creating liveable, and vibrant environments. • NMT plays a critical role within Transport and Urban Development Authority's Integrated Public Transport Network (IPTN). • Some identified problems: poor planning and maintenance, historical bias towards private transport, lack of prioritisation of pedestrians at signalised intersections, inertia in promoting inter-modality between NMT and public transport, low density, and outdated legislation.
City of Cape Town Draft Non-Motorised Transport Plan (CCT, 2017)	• Propose NMT facilities and programs which are integrated with the Integrated Public Transport network (IPTN). • Improve access to public facilities and areas of employment.

Policy Document	Main Findings
	• Develop a new NMT classification system which identifies routes as cycle routes, shared pedestrian-cycle routes, and pedestrian routes. • Routes to eight major public transport interchanges in the City were identified and selected for upgrading. • Desirability of NMT projects decision-making tool which was used to identify and prioritise the NMT projects for the City.
Cycling Strategy for the City of Cape Town (CCT, 2017)	• Vision: Cycling will become recognised and accepted as a safe, viable and attractive means of travel for all and the cycling mode share will increase from 1% to 8% by 2030. • Improve access to bicycles by establishing a low-cost bicycle production plant in Cape Town. • Improve safety and security through communication campaigns and innovative technologies. • Provide and maintain cycling infrastructure by securing funds for the cycling network, creating maintenance Standard Operating Procedures, developing cycling guidelines and initiate a process to review the legislation. • Improve data capturing and monitoring, facilitate stakeholder engagement and improve communication and education. • Strategic cycle routes, bicycle demonstration projects and proposal of cycle highway projects.
Universal Access Policy (CCT, 2014)	• To guide the planning, provision, management, regulation, and enforcement of universal access measures and facilities in the City. • NMT crossing of the transport network. The policy statement is to provide safe crossing facilities for all NMT modes.
City of Cape Town Bicycle Masterplan (CCT, 2011)	• An update of the 2002 plan showing all the existing cycling routes and planned cycling routes for the City of Cape Town.
City of Cape Town Non-Motorised Transport Plan (CCT, 2010)	• This plan provides the pedestrian route planning for the City of Cape Town. It shows the existing pedestrian routes and the planned routes.
Non-Motorised Transport Strategy for City of Cape Town (CCT, 2005)	• The strategy identifies the following need for interventions: (1) access for all, (2) the importance of people and communities, (3) the role of economic and social transformation, (4) environmental sustainability, (5) integration, and (6) awareness. • The strategy provides a framework on how to treat the identified challenges by providing policy statements on all six of the problem areas. • This document also refers to the NMT guidelines by National Department of Transport and shows some examples.

It can be seen from the **Table 2**, that the policy and strategy environment for NMT development is strong at national, provincial, and at the local government level. It is recognised that there is a large captive

market of NMT users in South Africa and, by providing facilities for these users, social upliftment and job creation can be progressed. The policies recognise the importance of access to jobs, education, and recreational activities for users, and emphasises the important role that NMT plays in achieving this goal. NMT is also recognised as a sustainable form of transport which is an important part of the Public Transport system.

2.4 Criteria to use to Improve Street Design

Various studies have been conducted to identify the criteria or design attributes, which makes streets more pedestrian friendly and walkable. The seminal paper by Cervero and Kockelman (1997) identify the 3Ds to provide an attractive pedestrian environment as density, diversity, and design. Further Ds were added to include destination accessibility, distance to transit, and demand management (Ewing & Cervero, 2010).

The Urban Design profession refers to Walkability as the collective term, which describes a street that is pedestrian friendly. According to Burden (1992), walkability is identified as "the extent to which the built environment is friendly to the presence of people walking, living, shopping, visiting, enjoying or spending time in an area". Fitzsimons (2013) researched the term walkability as part of her PhD and explored what the term means in a multi-disciplinary environment. She acknowledged that her understanding of walkability was biased by her academic training as a civil engineer and, through her research, she discovered that what she understood as best practice design was both complemented and contradicted by her training. This emphasises the importance of using a multi-disciplinary team when designing a walkable environment (Fitzsimons, 2013). The research pulled a multi-disciplinary group together to develop walkability criteria. The criteria were organised according to three core themes, namely village, permeability, and streetscape. The criteria are shown in **Table 3** (Fitzsimons, 2013).

Table 3: Walkability Criteria.
Source: Fitzsimons, 2013, p. 188.

A Walkable Area	
Core Theme	
Village	1. is built to human scale
	2. is an identifiable place
	3. has accessible facilities in a village centre or frequent nodes
Permeability	4. has a recreational walking facility nearby
	5. has a connected street network within an area with various routes available
	6. is not severed by a large, fast through route
	7. has sufficiently wide, good quality footpaths
	8. has good public transport access
	9. has seamless connections to adjacent areas
Streetscape	10. has no major barriers to access the wider city area
	11. has visual interest along routes
	12. has a pleasant atmosphere contextual to area characteristics
	13. has no visual disorder
	14. has routes overlooked with doors onto the street

Apart from identifying criteria to improve NMT design, Fitzsimons (2013) also recognised that there is a need to develop a definition of walkability, which will be understood across all the disciplines involved in NMT design. She identified, through her work, that the best pedestrian environments were designed by multi-disciplinary teams, which brought their different expertise and experience to the project.

Ewing and Bartholomew (2013) developed a conceptual framework to improve the walkability of an area. The framework recognises three main categories, which can improve the walkability of a street and improve walking behaviour. The three categories are the physical features of a street, for example, the sidewalk width, urban design qualities, and individual reactions of users, which includes a user's sense of safety. The urban design qualities are explained in more detail for clarity. These eight qualities are: Imageability, Enclosure, Transparency, Complexity, Legibility, Human Scale, Linkage and Coherence. **Figure 10** is a conceptual framework developed by Ewing and Handy (2009) which shows the urban design qualities linked to walking behaviour. To better understand the eight qualities, the following paragraphs are described in more detail, describing what is meant by each quality:

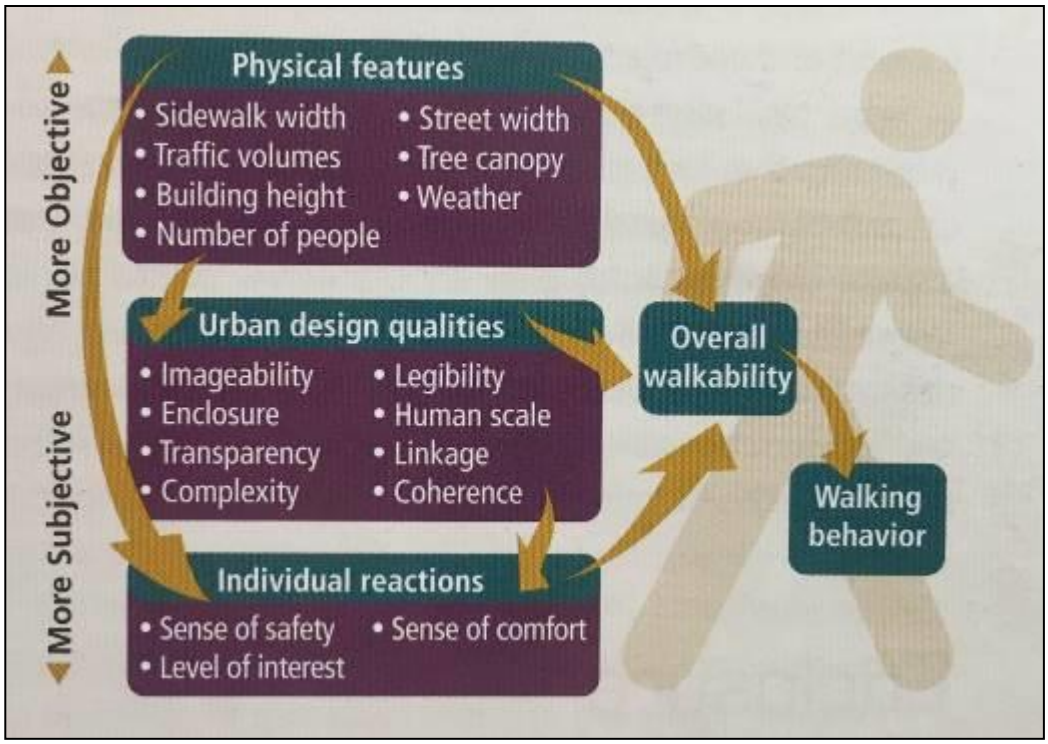


Figure 10: Conceptual Framework for Urban Design Qualities.
Source: Ewing and Handy, 2009.

- Imageability is the quality of the place that makes it distinct (Ewing and Bartholomew, 2013: p.11). Places that rate high in imageability include neighbourhoods of Paris and San Francisco. Places that rate low are strip malls and industrial areas that all look the same. Factors that contribute to the quality of "Imageability" include landmarks, striking views, unusual topography, marquee signage and vernacular architecture.

- Enclosure refers to the way a street is surrounded by elements which allows it to become an outdoor room. This can be done by buildings which are not set too far back from the street, as well as with trees lining the street to create a wall (Ewing and Bartholomew, 2013). The street becomes the floor, buildings the walls, and the sky the ceiling of the outdoor room. Elements, such as on-street parking, planted medians and traffic, all contribute to visual enclosure.

- Human Scale is about designing elements that match the proportions for people. Design elements which contribute to human scale include building details, pavement texture, street trees and street furniture (Ewing and Bartholomew, 2013).

- Transparency is the degree to which people can perceive what is going on beyond the walls of a building. Being able to see the activity beyond the walls. Elements that influence transparency are walls, windows, doors, fencing, landscaping, and openings into midblock spaces (Ewing and Bartholomew, 2013).
- Complexity refers to the visual richness of a place (Ewing and Bartholomew, 2013: p.16). Pedestrians like to look at different activities and interesting buildings along their way. Jan Gehl (1987, p143) notes that an interesting walking network has the "psychological effect of making the walking distance seem shorter." Elements which contribute to complexity are people sitting at tables along the pavement, mixture of old and new building architecture, layering of built elements at the edge of streets, and different social settings along the street (Ewing and Bartholomew, 2013).
- Coherence refers to the order that is visible in the design. The elements that contribute to coherence is the way in which the building, landscaping, street furniture and paving materials are ordered and designed (Ewing and Bartholomew, 2013).
- Legibility refers to a "sense of orientation" for people using the street (Ewing and Bartholomew, 2013: p.18). Elements that assist with the legibility include landmarks that distinguish an area and signage.
- Linkage is the "interconnectedness of different places" (Ewing and Bartholomew, 2013: p.19). Linkage depends on the relationships between paths and nodes to assist with the ease of movement. Better connectivity is often associated with short blocks.

Wolhuter (2015) identifies five criteria believed to provide successful design i.e., providing safety, accessibility, mobility, and convenience while maintaining pleasing aesthetics (De Jager, 2016).

From an engineering perspective the criteria include features to enhance efficiency and safety aspects. This can be seen below (Schoon, 2010):

- Comfort and speed (travel time): the directness of the route and route surface are important design features to ensure a comfortable walking experience. The route should also be easy to maintain.
- Safety: design features which minimise the risk of pedestrians getting injured. This is especially important at crossing facilities and other conflict points along the route.
- Reliability: always provide unhindered access to the destination, and in all weather.
- Security: the route should be free from threats and crime.

Appleyard introduced a new set of built environment components for travel behaviour research which is referred to as the "3 As" of the urban environment (Appleyard, 2016).

- Land-use **activity**: It refers to the activity which is encountered along the route and is mainly based on the existing land use. It can incorporate crime.
- Transport **access**: The functional components of the transportation system (street design, transit services, parking, etc.).
- Urban **aesthetics**: Urban design.

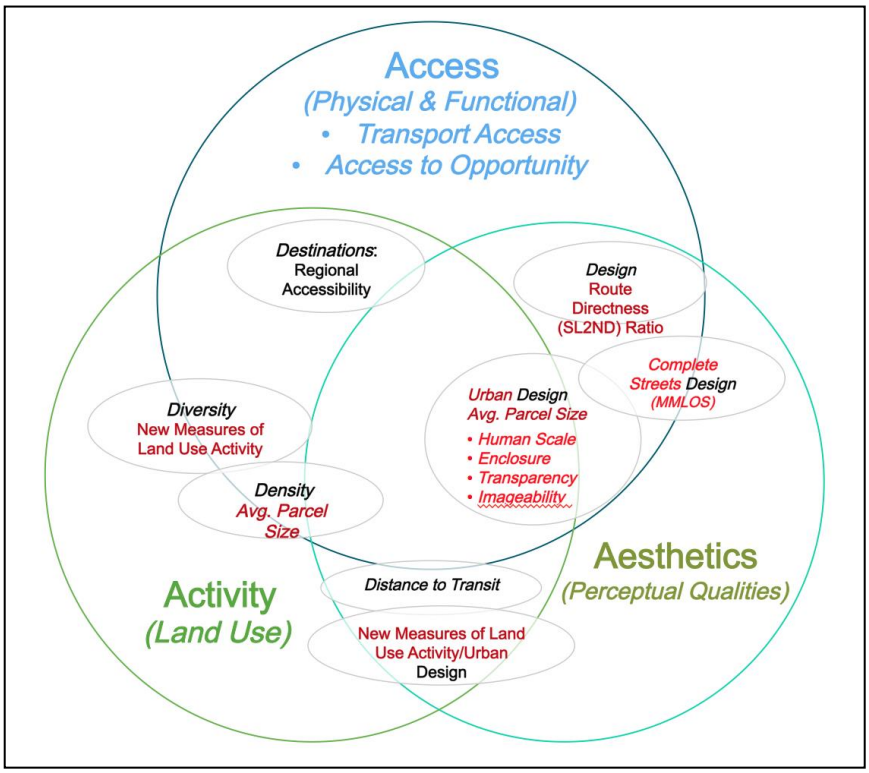


Figure 11: Conceptual Framework for Urban Design Qualities.
Source: Appleyard, 2016.

Using Appleyard's "3 A's" for the urban environment, the different criteria are sorted into one of the three categories. These are Access to transport and opportunities, Activity or Land Use, and Aesthetics or the urban design quality of the street. **Table 4** summarises the criteria which was identified to improve the walkability of a street.

Table 4: Summary of Criteria to use to Improve Walkability of a Street.
Source: Author's own.

3 A's (Appleyard 2016)	Criteria	Author / Reference
Land-use activity:	Density	• Cervero & Kockelman (1997)
	Diversity	• Cervero & Kockelman (1997)
Transport access	Design (2 aspects of design: functional / operational & urban form)	• Cervero & Kockelman (1997) • Appleyard (2016) • Fitzsimons (2013) – wide functioning footpaths; recreational walking facility; connected street network; not severed by fast route • Wolhuter (2015) – safety • Schoon (2010) – easy to maintain
	Destination Accessibility	• Ewing & Cervero (2010) • Fitzsimons (2013) – accessible facilities in village centre; seamless connections to adjacent areas • Wolhuter (2015) – accessibility; convenience • Schoon (2010) directness of route
	Distance to Transit	• Ewing & Cervero (2010) • Fitzsimons (2013) – good PT access • Wolhuter (2015) – mobility
	Demand Management	• Ewing & Cervero (2010)
Urban Aesthetics	Imageability	• Ewing & Bartholomew (2013) • Fitzsimons (2013) – identifiable place • Wolhuter (2015)
	Enclosure	• Ewing & Bartholomew (2013) • Fitzsimons (2013) – routes overlooked with doors onto the street
	Human Scale	• Ewing & Bartholomew (2013) • Fitzsimons (2013)
	Transparency	• Ewing & Bartholomew (2013)
	Complexity	• Ewing & Bartholomew (2013) • Fitzsimons (2013) – visual interest
	Coherence	• Ewing & Bartholomew (2013) • Fitzsimons (2013) – no visual disorder
	Legibility	• Ewing & Bartholomew (213) • Fitzsimons (2013) – pleasant atmosphere contextual to area
	Linkage	• Ewing & Bartholomew (2013) • Fitzsimons (2013) – no barriers

The above walkability criteria will be used as an informant to evaluate which walkability assessment tool will provide the best fit to assess the NMT linkages to the Cape Town Railway Station. A selection of specific design tools that is available, is discussed in Section 2.6. Before the design tools are discussed, the next section summarises the best criteria to use to improve street design for Cyclists.

2.5 Criteria to Use to Improve Design for Cyclists

The previous section discussed the criteria to improve street design to improve the walkability of a street. The specific criteria to improve bicycle infrastructure needs to be added to improve the NMT linkages to the Cape Town Railway Station.

Bicycle infrastructure should enable cyclists to make direct, comfortable bicycle journeys in attractive, and safe traffic surroundings (CROW, 2007). Only when these requirements are met, can cycling start to compete with the car.

A study done by Tiwari, et al. (2016) identified criteria in Indian Cities, which would retain the existing high modal share in NMT users, and even increase the share, if safe and convenient NMT facilities are provided. The study tested three scenarios of improvement, namely only improving the NMT infrastructure, only improving the bus infrastructure, and improving both the NMT and public transport infrastructure. It used stated preference surveys and identified the following criteria to improve the modal share for cycling (Tiwari, et al. 2016):

- Provision of bicycle parking at public transport stops increases the catchment area of users on the public transport system.
- A complete network plan for NMT which is well integrated with the existing and proposed public transport system in the City.

Other factors that influence the cyclists' route choice includes:

- Bicycle facility presence and motor vehicle characteristics (Howard and Burns, 2001).
- Parking characteristics (Dixon, 1996).
- Riding surface quality (Harkey et al., 1998).
- Hilliness (Landis et al., 1997).

"Another survey revealed that cyclists may travel up to 20 min or more to switch from an unmarked on-road facility with side parking, to an off-road bicycle trail (Tilahun et al., 2007)."

Cervero (2013) investigates the factors that have contributed to increased bike-and-ride activities for the San Francisco Bay Area Rapid Transit System (BART). To include bicycles as an important access mode to transit, it needs safe, secure, and well-designed bicycle infrastructure. This includes the presence of bike stations, bike racks and electronic locker spaces, as well as protected bike-lane facilities (Cervero, 2013).

Dutch and Danish cities invest significant amounts of budgets into bicycle and pedestrian improvements. Copenhagen shows that reallocating street space to bicycles, and developing a complete network of bicycle paths in the city, improves the congestion and allows transit to have a larger catchment area (Replogle, 2012). During the 1970s Copenhagen abandoned any new built road scheme and rather invested the money in cycling networks. This allowed for a 10% decrease in motor vehicle use in 1980 and 80% increase in using bicycles. The measures used in Copenhagen were to reallocate arterial street space to bicycles and to design and implement a complete network for bicycles to travel. The modal split for Copenhagen is approximately a third for the use of private vehicles, a third use transit, and a third use bicycles.

It is apparent that good street design requires a multitude of elements to be considered to ensure that an enjoyable and functional space is created. Not only does it require sound engineering principles to be followed, but also urban design qualities to enhance the experience. The criteria will be used to assess the street design for NMT linkages to the Cape Town Railway Station.

2.6 Tools to Inform the Design Process

To investigate and analyse people's walking and cycling behaviour, certain tools can be used. The following are some of the investigation tools available: (Gehl & Svarre, 2013).

- Counting: counting is a widely used tool in traffic and transport studies and is useful to provide numbers for before and after studies.
- Plotting: activities, people, places to stay, can be plotted on a plan. This is also called behavioural mapping.
- Tracing: tracing the movement of people between areas.
- Tracking: tracking or shadowing people on a route to gain more insight into where they are going.
- Looking for traces: pedestrian desire lines are often visible on aerial photography maps which provide a good indication of where people in that area want to walk.
- Photographing: documenting where people interact and how the area around them looks.
- Keeping a diary: register details and changes in behaviour from one day to another.
- Test walks: important to be able to observe problems and opportunities along a route.

For the case study, the walkability of the routes was examined. This is to ensure that both traffic engineering principles, as well as urban design principles, are considered when auditing the routes to the Cape Town Railway Station. The walkability assessment tools include aspects that are specifically focused on the user experience, as well. The following tools were investigated, and the Pedestrian First tool was chosen to be applied to this case study.

2.6.1 How to Study Public Life

Gehl & Svarre (2013) developed twelve urban quality criteria to investigate when designing streets for people. The criteria are categorised into three main sections, namely protection, comfort, and enjoyment. By using these criteria, the investigation tools can be used to "score" the area which is being designed. This will assist the designer to develop ideas of how to improve the area. The main criteria used in this tool is shown in **Figure 12**.

Figure 12: How to Study Public Life. An introduction Testing Tools.
Source: Svarre, 2017. Gehl Architects.

2.6.2 Pedestrian Environment Review System

Routes should be monitored and evaluated over the lifespan of the infrastructure to ensure it is fit for purpose. There are several assessment and monitoring audits available, and one of these is the "Pedestrian Environment Review System" (PERS) (CIHT, 2015). This tool is used in the UK as an audit tool to evaluate pedestrian schemes. The methodology was developed by TRL, which is a global centre for innovation in surface transport and mobility. Input was also provided by Transport for London for the second version. This tool assesses the walking environment by using six review frameworks, which apply to specific components of the pedestrian environment. These are: links (footway, subways, and foot bridges), crossings (formal and informal), routes (between key destinations), public transport waiting areas, public spaces (squares and parks) and interchange spaces (spaces between different modes). The elements are scored from -3 to +3, where +3 is the highest score and -3 the lowest score. The audit results are recorded in a software programme which assists with the analysis of the results. The main disadvantage of this tool is that it needs to be purchased.

2.6.3 Walk 21 Foundation: Walkability.App

The Walkability.App is a participatory mapping tool for pedestrians to identify environmental factors that influence the walking experience and share positive and negative aspects of their walking experience (Walk 21 Foundation, 2022). The tool is a mobile phone application that was specifically developed for the Women's perceived walkability at the Luas Tram catchment area in Dublin project (Walk 21 Foundation, 2022).

The app was created as a tool to aid in the study and development of walkability research and policies. It offers insightful information on the positive and negative connections between pedestrian experiences and public areas (Walk 21 Foundation, 2022). **Figure 13** illustrate the main components of the tool.

The two main types of data that participants are gathering while walking are their personal experiences and observations of the surrounding environment. Participants can click on three different coloured icons at the bottom of the screen to rate their experiences. According to a traffic light system, the red symbol denotes a bad walking experience, the amber symbol denotes issues that need to be resolved and the green symbol denotes a positive walking experience (Walk 21 Foundation, 2022). Participants can explain why they feel that way by adding comments. The pre-defined categories are linked according to positive experiences and negative experiences as shown in **Table 5**.

Table 5: Pre-defined Categories linked to experiences in the Walkability.App.
Source: Walk 21 Foundation, 2022.

Pre-defined categories linked to Positive Experiences	**Pre-defined categories linked to concerns of Negative Experiences**
• Appropriate traffic speed • Clean and peaceful • Designed for people • Lighting, seating or ramps • Path quality • Protection from weather • Safe crossing • Secure • Sufficient space • Supported and directed • The path • Trees and visual interest	• Designed for traffic, not people • Dirty, noise or poor air quality • Driver behaviour • Fear of crime • Harassment • Insufficient space or poor path quality • Insufficient trees or visual interest • No lighting, seating or ramps • No path • Poor drainage or protection from weather • Speed of traffic • Unsafe crossing

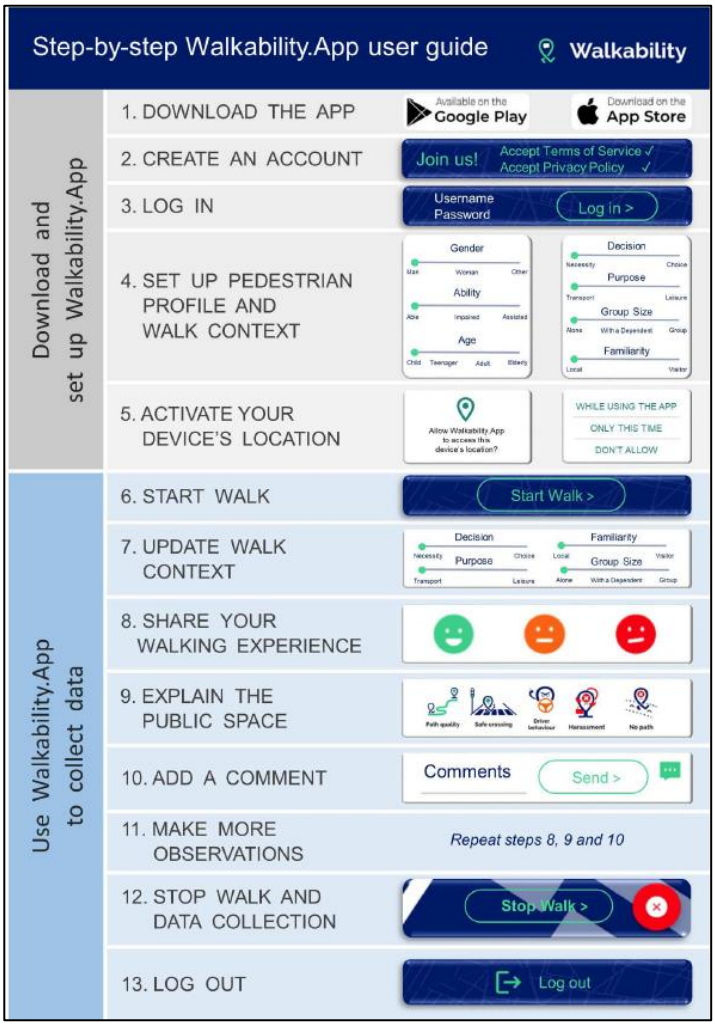


Figure 13: Step by Step Walkability.App user guide.
Source: Walk 21 Foundation, et.al, 2022.

2.6.4 Pedestrian First Walkability Tool

Walkability is a term that is used to understand how well the urban environment is designed to assist with walking trips (ITDP, 2018). Every trip requires a walking trip and focusing on improving this part of the trip chain can enhance the overall public transport trip and improve ridership. The Institute for Transportation and Policy Development (ITDP) developed a walkability tool called Pedestrians First, to assist policy makers, decision makers and designers to improve the walkability of the urban environment (ITDP, 2018). The ITDP wanted to develop a tool that is easily understood and that can be used globally to assist with measures to create more walkable urban areas. Walkability is not a new concept and various tools have been developed in the past but requires intensive data collection to use the tools. The ITDP (2018) developed a tool that can be easily understood, used with easily available data, and can be reproduced. The Pedestrians First tool has metrics that are: clear to understand; avoid biases and create clarity; create clear data collection practices that can be replicated; rely on readily available data and are applicable globally (ITDP, 2018).

The tool's framework is based on the walkability hierarchy of needs pyramid shown in **Figure 14**. This pyramid builds on the most basic needs for walking, for example, having a walkway that is passable to the highest need of a path that is enjoyable.

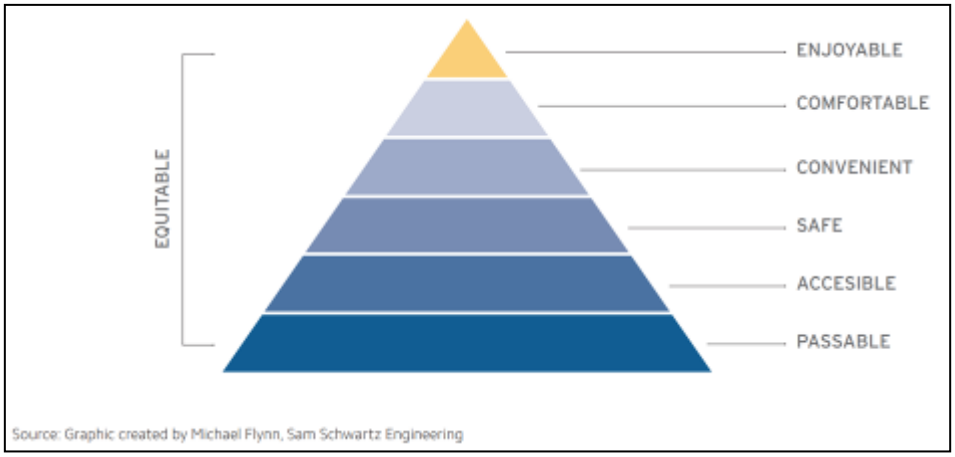


Figure 14: Walkability Hierarchy of Needs Pyramid.
Source: ITDP, 2018.

The walkability hierarchy of needs refer to the following (ITDP, 2018):

- Passable: The urban environment makes it physically possible to walk from one place to another.
- Accessible: This refers to a reasonable walking distance from trip origins to destinations.
- Safe: The route should be safe from crime and traffic, both along and across streets.
- Convenient: The urban environment prioritises walking, particularly in relation to motorised transport.
- Comfortable: This refers to design elements that are incorporated in the walking route that minimises discomfort for the user, such as crowding, fatigue, the weather and darkness.
- Enjoyable: The environment adds to the route by having art, entertainment, or other amenities along the route.

By incorporating the walkability hierarchy of needs into the Pedestrian First tool, the features that promote walkability in cities can be measured. The tool assists with identifying where improvements can be made to make the route more walkable.

According to the Pedestrian First tool (ITDP, 2018), there are three main urban planning factors that influence walkability, namely infrastructure, activity, and priority.

- Infrastructure refers to the elements in the transport system, such as the public realm, sidewalks, crosswalks, traffic signals and the transit services.
- Activity refers to the characteristics of the urban form in the private realm that determines where people and destinations are located.
- Priority refers to the measures that are put in place to give priority to sustainable transport modes over private car use.

2.7 Evaluation of the Design Tools

To decide which walkability tool to use, a comparison is made between the four tools discussed above. The assessment criteria is divided into the Pedestrian First Walkability Tool's categories and the other tools criteria are compared to the nine categories.

Table 6: Comparison of the four walkability tools.

Assessment Criteria	**How to Study Public Life (Gehl & Svarre, 2013)**	**PERS (CIHT, 2015)**	**Walk 21 Walkability.App (Walk 21 Foundatio 2022)**	**Pedestrian First Walkability Tool (ITDP, 2018)**
Walkways	• Protection against unpleasant sensory experiences	• Measure of directness, permeability, legibility etc.	• Designed for people • Path quality	• Walkways are unobstructed and wide enough
Comfortable and Dignified Environment	• Opportunities to walk / cycle (good surfaces)	• Quality of the environment	• Clean air & peaceful • Protection against the weather	• Clean, quiet and covered by shade
Personal Security	• Protection against crime & violence – feeling secure • Opportunities to see	• Personal security	• Secure	• Feel safe and comfortable, well-lit at night
Crossings	• Protection against traffic & accidents – feeling safe (safe crossings)	• Crossing provision • Deviation from desire line	• Safe crossing	• Cars approach crossings slowly, corners are sharp
Road Safety	• Protection against traffic & accidents – feeling safe	• Road safety	• Appropriate traffic speed	• Legal speed limit below 30km/h, kerb bulb-outs
Parking	• No specific indicator to observe parking	• No specific indicator to observe parking	• No specific indicator to observe parkin	• Managed on-street parking and little off-street parking
Walkway Amenities	• Opportunities to stop & stay • Opportunities to sit • Opportunities to talk & listen	• Rest points • Quality of the environment	• Lighting, seating or ramps	• Lighting, seats, public toilets, garbage bins etc.
Transit Access	• No specific indicator to observe the transit access	• Public transport waiting areas review • Interchange space review	• No specific indicator to observe the transit access	• Nearest transit station is less than 500m
Street for babies	• Opportunities for play & exercise • Not specifically for children and babies	• No specific indicator for checking for babies	• No specific indicator for checking for babies	• Play structure, art and well sheltered areas for caregivers

All four tools assess most of the nine categories that forms part of the Pedestrian First Walkability tool. The following exceptions are noted:

- The assessment of the parking category is only done by the Pedestrian First Walkability Tool.

- Transit access is not covered by the "How to Study Public Life" tool or the Walk 21 Walkability. App.
- The street for babies category is not covered by the PERS tool or the Walk 21 Walkability.App.

Since the linkages to public transport facilities are being assessed, a transit access indicator is important for this study. It should also be noted the PERS (CIHT, 2015) tool has to be purchased and is not freely available. The Pedestrian First Walkability Tool (ITDP, 2018) is freely available and is a tool that is easily understood, used with easily available data, and can be reproduced. The case study will use the Pedestrian First tool to assess three different routes to the Cape Town Railway Station. The tool is summarised in **Chapter 4**.

3. RESEARCH METHOD

This chapter describes the research method adopted to answer the questions identified in **Chapter** 1. The focus of the research is to identify which criteria need to be applied to improve the NMT infrastructure design for linkages to Public Transport interchanges, by using the Cape Town Railway Station as a case study. The access and egress trips are being investigated and proposals are made to improve the walking and cycling linkages to the station. The study used international best practice and South African design guidelines to develop design improvements to three existing NMT linkages. A walkability assessment tool was used to audit the linkages and to assist with the identification of where improvements can be made. **Figure 15** illustrates the process followed for the research and is discussed in this chapter.

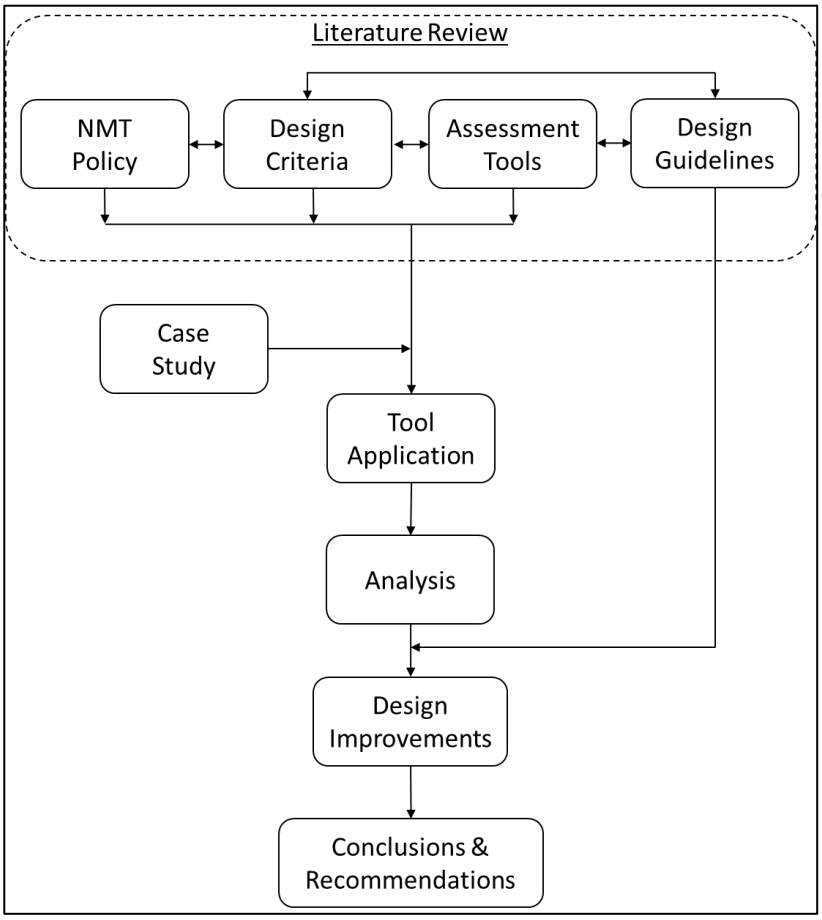


Figure 15: Research Method

3.1 Literature Review

A literature review of the research topic was conducted to identify the main challenges for NMT design in South African cities. This was followed by researching the NMT policy environment in South Africa, since the policy environment drives the provision of transport infrastructure (Beukes et al., 2017). The literature review included an investigation of the design criteria to be applied to improve the infrastructure for walking and cycling linkages. The criteria were used as an informant, to select assessment tools that can be used to audit roads to improve walkability. This was followed by researching some audit tools, which can assist with an inter-disciplinary audit of sections of the roads under investigation. Four available walkability tools were evaluated and the preferred tool was chosen to be applied to this study. Best practice design guidelines, as well as the most used South African design guidelines, were part of

the literature review. These guidelines were explored as part of the literature review, but were only applied when the design improvements were made. The write-up of the specific guideline examples that were used to inform the design improvements is done in **Chapter 7**.

3.2 Case Study Selection

The research is particularly interested in the NMT linkages to Public Transport facilities. To answer the research questions, a mixed-methods approach containing both qualitative and quantitative data, was used. The research aimed to investigate NMT linkages to a Public Transport interchange. To answer the research questions, the case study method is a useful research methodology to use (Yin, 2009). The design of the research is based around a single case study, the Cape Town Railway Station. The Cape Town Railway Station was chosen as the case study, since it is the busiest Public Transport interchange facility in the city in terms of users with 210 000 daily commuters (CCT, 2022). **Figure 16** illustrates the extent of the Cape Town Railway Station Hub and shows the five different public transport modes that are available at the hub namely rail, minibus-taxi (MBT), MyCiTi BRT, Golden Arrow Bus Services (GABS) and metered taxis.

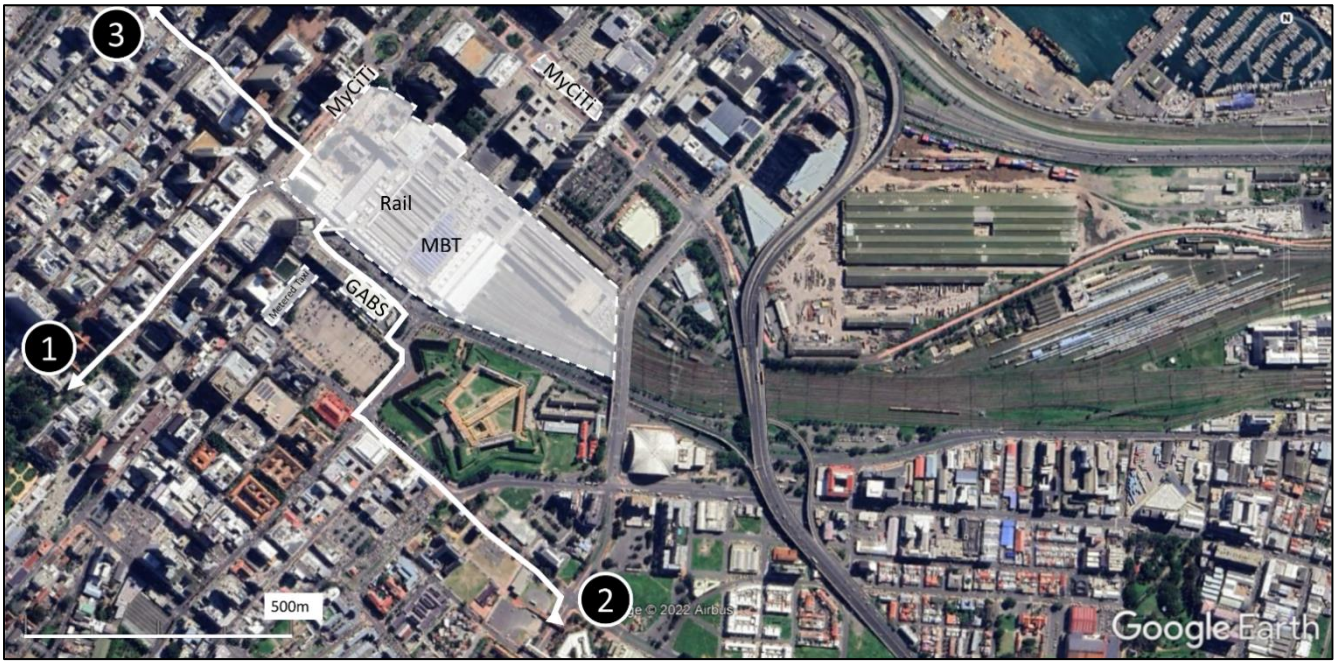


Figure 16: Cape Town Railway Station Hub.
Source: Author's own, Google Earth.

Cape Town Railway Station has high volumes of pedestrians exiting and entering the facility at different times of the day, which makes it great to test whether the provision of NMT facilities around the station could be improved. To appropriately test if the Pedestrian First walkability tool (ITDP, 2018) would be sufficient to use, three different NMT routes were identified. As a first step, a 1 km radius circle was drawn around the centre of the Cape Town Railway Station, to identify which routes fall within this area. The 1000 m radius was used in support of research that was done by Hitge and Vanderschuren (2015), which concluded that the average distance that pedestrians walk to Public Transport facilities in Cape Town, is 1.3 km. This distance is longer for rail (Hitge and Vanderschuren, 2015), at around 2 kms, but the Cape Town Railway Station facility accommodates different Public Transport modes in the interchange. Therefore, the average of 1.3 km is a good indication of walking distance. Instead of using the 1.3 km radius, a 1 km radius was used for this study to account for the rich urban infrastructure that is available in the CBD area and to illustrate the use of the Walkability Design Checklist tool (ITDP,

2018). This 1 km radius is still larger than the internationally applied walking distance of 800 m. Deciding which routes to include in the investigation was based on selecting routes, which have different design elements present, to test the audit tool for different examples. The routes include a section which has an existing cycle lane facility, a busy intersection, a NMT route to the Cape Peninsula University of Technology (CPUT), which is an important link to an education facility, and a best practice NMT route to the Cape Town Stadium.

The routes that were chosen are shown in **Figure 16** and discussed below:

- No.1: Adderley Street route from the Cape Town Railway Station to the Company Gardens. This 1 km route incorporates walking and cycling elements, as well as MyCiTi stops and MBT services along the route. There is also an underground facility, which links the Cape Town Railway Station to Adderley Street through a tunnel.
- No.2: The 1.5 km walking route to Cape Peninsula University of Technology (CPUT) incorporates walking elements and public transport stops along the route to reach the CPUT facility.
- No.3: The Fan Walk is an NMT route which was designed as part of the preparation for the 2010 FIFA World Cup. This route is seen as a best practice design route. It is approximately 2.5 kms from the Cape Town Railway Station to the Cape Town Stadium and incorporates walking and cycling elements along the route.

A limitation of the case study method is that results from the case study cannot be directly applied to other cases. However, the case can add to the knowledge, particularly in the field, which can be transferred to other contexts (Flyvberg, 2011).

3.3 Applying the Pedestrian First Tool

The Pedestrian First, Street-Level Walkability Design Checklist (ITDP, 2018) was used to conduct audits on the selected NMT linkages. The ITDP's Pedestrian First tool is a mechanism to track, measure and understand features that track walkability in cities (IDTP, 2018). The tool has indicators at three different levels namely the metropolitan urban area, neighbourhood and block or street-level. To test the walkability of the three routes to the Cape Town Railway Station, the street-level tool was used. This tool comprise of a walkability design checklist.

The Design Checklist tool has 41 checkbox items, which are divided into nine categories. . The nine categories are walkways, comfortable and dignified environment, personal security, crossings, road safety, parking, walkway amenities, transit access and streets for babies (ITDP, 2018). The tool is an online tool with an option to download results in pdf or excel format. The tool was selected, because it includes multi-disciplinary elements, which corresponds to the criteria that were identified to improve walkability of routes. The tool is also easy to use, both by technical professionals and users of the routes. The tool is not data intensive and can be used globally. Furthermore, the tool includes references to the latest best practice design guidelines.

Site surveys were conducted on Monday 12 December 2022 from 11 am until 1 pm for the Fan Walk route (No.3). The decision to start with the Fan Walk was for the author to use the tool on a best practice example first, before attempting the audits on the two other routes. The CPUT route (No.2) was surveyed on the same day from 5 pm until 7 pm which allowed for observations during the peak period when users walked to the Railway Station to access the different modes of transport to go home. Since the tool observes physical features of the routes, the audits can be done at any time of the day. The last route along Adderley Street (No. 1) was audited on Thursday 15 December 2022 from 9:30 am until 11 am. An evening survey, between the hours of 7:30 pm until 9 pm, was included in the site surveys to establish how well lit the areas are during this time. The evening survey was also used to get a feel for the security challenges at this time of the day. The site surveys during the day were all done by the author. For the evening survey, an extra person was organised to assist with security during the survey.

To prepare the audit checklist for the site surveys, the excel sheet for the Design Checklist was downloaded and a physical form was created. The form was completed while walking along the routes and observing the elements on the Design Checklist. This tool does not have criteria particularly for cycling, and three criteria for cycling design were, therefore, added to ensure that cycling observations are included in the audit. The three criteria that were added to the form were presence of bicycle parking, bicycle lane facility features and road markings for cycling. The three elements were added to the end of the form and denoted by B. Similarly, an addition was made to include nine criteria for security for vulnerable users informed by the Safetipin app (Safetipin, 2023). This was done to support the challenges experienced by various vulnerable users around personal security. The elements in the form denoted by S, included the Safetipin elements. The elements that were added were lighting, walk path condition, openness, visibility, availability of public transport, presence of security, number of people on the street, gender usage and feeling safe (Safetipin, 2023).

The checklist was applied to check the different elements along the route. Each route was divided into two to three main sections, to be able to capture more detail for each section. Photographs were taken to assist the designer during the analysis of the data. An example of the Design Checklist that was used during the site surveys can be seen in **Appendix A**.

3.4 Analysis

For each of the routes, the Street-Level Walkability Design Checklist (ITDP, 2018) was used to calculate a score. The checklist requires the field agent to score each checkbox item by answering ‘yes’ or ‘no’ to the statement in the checklist. If the answer is ‘yes’, it means that the particular criteria has been met, and a positive score is given. If the criteria has not been achieved, a zero score is given. So, achieving a high score would indicate a street section which has good walkability characteristics. The scores for each section were calculated to identify the areas, which achieved a low score.

The results for the routes were based exclusively on the Street-Level Walkability Design Checklist. The items that were added for cycling and the Safetipin items were used to enhance the understanding of the design environment. The elements were not included in the overall scores as indicated in **Chapter 5**, but the observations from the cycling and Safetipin elements were used in the SWOT analysis to identify the shortcomings regarding the provision of cycling elements and personal security challenges for vulnerable users.

To assist with the scoring of the routes, the routes were divided into two to three sections according to similar features along the route. For example, if the cross-section stayed similar along the route, this would form a section. A large intersection with various conflicting movements would form another section of the route. The sections for the three routes are explained as follows.

- For the Adderley Street (No.1) route, the first section is from the Railway Station to the Strand Street / Adderley Street intersection. This section included observations at-grade as well as the underground facility. Section two is from Strand Street / Adderley Street intersection to the entrance of the Company Gardens. The cross section along this part of the route was similar.
- For the CPUT (No.2) route, the route was divided into two sections. The first section was from the Railway Station to the Grand Parade and the second section from the Grand Parade along Darling Street to Sir Lowry Street.
- For the Fanwalk (No.3) route, the first section stretched from the Railway Station to the St. George’s Mall and includes the crossing of Adderley Street. The next section were the route along the Fan Walk from St. George’s Mall to Buitengracht Street. This section of the route along Waterkant Street, were mainly pedestrianised with vehicular access for deliveries. The last section was the section from Buitengracht Street to Chiappini Street. This section included the Prestwich Memorial Garden Park.

The photographs that were taken during the site audits were useful to check items which were not adequately described and captured during the site audits. The photographs were a valuable resource of information to consult during the analysis phase. Once the sheets were summed, the areas with the lowest scores, typically 50% and below, were identified as the sections of the route that need to be improved.

The quantitative data and case study infrastructure assessments were combined to present a comprehensive understanding of the sections. The findings from the analysis were summarised in a SWOT analysis. This is presented, along with photographs and discussions, to summarise the main areas where improvements to the sections could be made.

3.5 Design Improvements

ITDP and UN-Habitat (2018) summarise the design process in three steps and confirms the importance of public participation. Participation in the design should include local residents, businesses and other stakeholders in the planning and design of streets (ITDP, 2018). This can help to improve a community's active use and sense of ownership of the street as well as improving transparency between the local government and the users of the street (ITDP, 2018). To assist with a participatory approach, tactical urbanism can be used to encourage participation and test ideas. Tactical urbanism allows for temporary installations, like for example using plant boxes to demarcate the street improvements, to test new street designs before it is fully implemented (ITDP, 2018). Due to the limitations of this study, it did not include public participation, but the author recognises that this step is crucial.

The process followed for the design improvements and the overall design process is shown below.

- Step 1: Investigate the three routes to the Cape Town Railway station by using the Pedestrians First Walkability tool. During the site visits, photographs were taken and observations were recorded on the audit sheet.
- Step 2: Apply the Pedestrian First Walkability tool to the different sections of the routes. Once the scores are finalised, the areas which need improvement are clearly identified. These were generally sections that scored 50% or less.
- Step 3: After analysing the results of the Pedestrian First Walkability tool, the different cases for improvement were identified. The summary of the results were presented in a SWOT analysis table. The cycling and Safetipin observations that were added to the audit sheet were used to enhance the understanding of the scores from the Street-level Walkability Design Checklist.
- Step 4: The available right-of-way was identified using the CCT City Map viewer which shows the building lines for each section of the routes. Next, the available guideline documents were consulted to assist with the development of design improvement. Three main categories for improvement were identified along the routes, namely multi-modal design solutions, which include the space allocation for different modes in the cross-section, safety for users, particularly at busy intersections, and operations and maintenance of NMT facilities. Quantitative traffic count data was available for the intersection design and was considered as an informant to the design process. The available design guidelines were consulted to establish the main design principles that should be applied to NMT facilities. This was followed by a selection of the best practice design examples from the guidelines to apply to the sections. These examples are compared to the existing provision for NMT, and suggestions for improvements were made. The design improvements ended with a before and after sketch to indicate the outcome of the design proposals.

  Once a design option is chosen, the space required for footpaths, cycle tracks and public transport is demarcated along the carriageway. Care was taken to ensure that the space provision for the walkways and cycle lanes did not fall below the minimum requirements. The final cross section was designed to fit the required elements in the available cross section width.

- Step 5: Once the centreline and overall kerb alignment are fixed, the positions of elements such as parking bays, trees and turning lanes can be determined.
- Step 6: The completion of the detail design phase which includes the placement of street furniture and utility boxes. This step did not form part of this study.

3.6 Reflection: Conclusions and Recommendations

A reflection of the research questions is presented in this section, followed by the main conclusions. A set of recommendations for improvement to South African guideline documents and policy is made. Recommendations regarding further research work are offered.

4. WALKABILITY TOOL

4.1 ITDP Pedestrians First Walkability Tool

The ITDP Pedestrians First tool has indicators for three different levels (ITDP, 2018). The levels are Metropolitan Urban Area (Citywide); Neighbourhood and Block (street-level). The three levels of the tool can be used in combination or separately to assess walkability in a city. Each level has a different core function, target audience, purpose, and type of intervention. A summary of the functionality of Pedestrian First is shown in **Table 7**.

Table 7: A Summary of the Functionality of Pedestrian First.
Source: ITDP, 2018.

COMPONENT	DESCRIPTION	TARGET POPULATION	PURPOSE	TYPE OF INTERVENTION
CITYWIDE WALKABILITY COMPARISION	Database of high-level, easy-to-measure qualities of a metropolitan area that facilitate walkability.	• Decision-makers • Advocates • Planners and policymakers	• Facilitate comparisons • Foster understanding • Track progress • Disseminate data	• Urban planning • Zoning • Growth control policies • Subdivision planning
NEIGHBORHOOD WALKABILITY ASSESSMENT	Analysis and data collection tool for accurate and detailed measurement of neighborhood-level walkability.	• Technical practitioners • Technical advocates • Local advocates	• Foster understanding • Facilitate consistent measurement • Facilitate tracking • Facilitate comparisons	• Urban planning • Zoning • Building regulations • Street design
STREET-LEVEL WALKABILITY DESIGN CHECKLIST	Checklist of the detailed design solutions that facilitate walkability at the block level.	• Technical practitioners • Technical advocates • Local advocates	• Foster understanding • Give guidance for implementation and evaluation	• Street design • Urban design

Table 7 summarises the main description of each tool. The three tools measure walkability at different scales, namely the city-level, neighbourhood level and at street level. For the purposes of the Cape Town Railway Station case study, the Walkability Street-level Design Checklist was used. The Design Checklist provides a list of criteria to be assessed when auditing the design solutions of a particular route. This is specifically relevant when looking at street design and urban design features. This tool assists with the identification of areas along the route which could improve the walkability.

The Street-Level Walkability Design Checklist should be used at the individual block level as an audit tool in the field (ITDP, 2018). The Design Checklist was created from a consolidation of sources which includes various measures used by ITDP field office, the World Bank, Centre for Disease Control (CDC), Natural Resources Defence Council (NRDC), the Global Designing Cities Initiative, and Walk Score (ITDP, 2018). The following paragraphs briefly explain the three different tools that comprise the Pedestrian First tool.

4.1.1 Walkability Policy Tool

This tool assesses city measurements at the metropolitan scale to understand what makes a city walkable (ITDP, 2018). These city-level indicators measure people's proximity to everyday needs, like open space, healthcare, education, and transit (ITDP, 2018). At this scale, the tool can give an indication of whether the destinations are close enough for people to be able to walk to them, but the physical features of the route should be assessed at neighbourhood and street level (ITDP, 2018). The city-level indicators that are measured are people near services; people near transit; block density; weighted population density and car-free place (ITDP, 2018). The indicators use open-source data for cities, and the outputs are shown in maps, as seen in **Figure 17**. As part of the city measures tool, there are links to various reference documents and guidelines to assist policymakers with how to make their city more walkable. For the purposes of this study, this tool was not used since the focus of the research is on improving the street design of routes at street level.

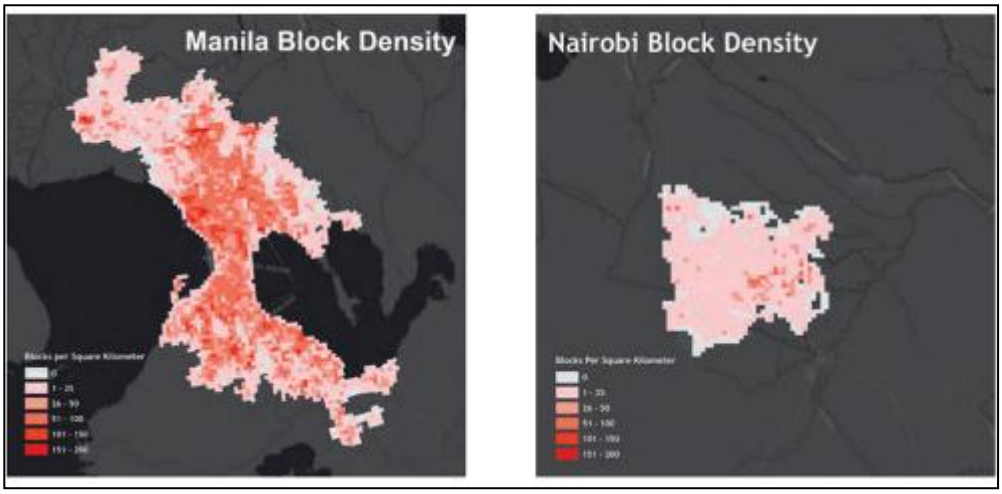


Figure 17: Typical Output from the Citywide Walkability Tool.
Source: ITDP, 2018.

4.1.2 Walkability Neighbourhood Tool

This tool measures walkability at the neighbourhood scale. The 11 indicators are from ITDP's Transit Oriented Development Standard (ITDP, 2017). The eleven indicators that are assessed are the following (ITDP, 2018):

- Walkways: Is provision made for pedestrians to walk?
- Crosswalks: Are there ways for pedestrians to cross the street?
- Visually active frontage: Are the windows in front of buildings transparent, which contributes to eyes on the street?
- Shade and shelter: Are there provisions against different weather elements?
- Small blocks: Are there different ways to reach a destination?
- Prioritised connectivity: Are there places in the neighbourhood where it is easier to walk than to drive?
- Complementary users: Are different kinds of amenities located near each other?
- Access to local services: This indicator looks at the different basic services that can be accessed on foot.

- Driveway density: Do vehicles cross the path of pedestrians?
- Roadway area: Do narrow streets create a safer environment for pedestrians?

The difference between the neighbourhood level tool and the street-level tool is that details at the street level are too specific to measure for an entire neighbourhood (ITDP, 2018). The neighbourhood tool assists with the assessment of proposed developments and neighbourhood plans. Each of the metrics have examples of best practices around the world, and a list of recommendations from guideline documents that can be used to improve the walkability of a neighbourhood (ITDP, 2018).

For the purposes of this study, the Street-level Design Checklist was used to assess the physical design elements along the routes and identify where improvements can be made at street level. Although the neighbourhood level tool was not completed, the resources section was consulted to assist with the development of concept design proposals for the routes to Cape Town Railway Station. Where these resources were used, the reference is added.

4.1.3 Walkability Street-Level Design Checklist

The Design Checklist measures features of walkability at the smallest scale (ITDP, 2018). The 41 checkbox items are divided into nine sections with a list of practical recommendations which links to design guideline documents to assist the technical designer. The nine sections of the Design Checklist are as follow (ITDP, 2018):

- Walkways: This section checks the condition of the sidewalk and if the sidewalk is wide enough. The needs that are assessed are the accessibility of the sidewalk, as well as the comfort level.
- Comfortable and Dignified Environment: The user's perception of the cleanliness of the route is considered. This tests how comfortable and enjoyable the route is from a user perspective.
- Personal Security: Safety from crime is tested in this section and includes two indicators to evaluate the route in the evening.
- Crossings: Pedestrian friendly crosswalk design is evaluated in this section. These indicators are closely aligned to typical traffic engineering aspects, like the turning radii at corners, kerb heights and timings at pedestrian signals. This section tests road safety features.
- Road Safety: Safe pedestrian design and enforcement at crossings are evaluated in this section.
- Parking: The availability of on- and off-street parking facilities are checked, as well as how it is managed.
- Walkway Amenities: This section asks questions regarding the street furniture available along the route, like benches, bicycle parking and garbage bins. It also checks if public toilets and access to drinkable water is readily available. The presence of walkway amenities can add to the enjoyment of the route and to how comfortable it is to use.
- Transit Access: Three indicators are included in this section to evaluate how close the transit options are to the walking route. This adds to the convenience of the user.
- Streets for babies: This section was added in a 2020 update of the Pedestrians First tool. It emphasises that streets that are safe for babies and toddlers will help people of all ages. The Designing Streets for Kids guideline, which was developed by the Global Designing Cities Initiative, is a great resource to consult when designing streets with a particular focus on children (GDCI, 2020).

The Street-Level Walkability Design Checklist should be used at the individual block level as an audit tool in the field (ITDP, 2018). The Design Checklist was created from a consolidation of sources, which includes various measures used by the ITDP field office, the World Bank, Centre for Disease Control

(CDC), Natural Resources Defence Council (NRDC), the Global Design Cities Initiative and Walk Score (ITDP, 2018).

The tool recommends interventions to improve walkability. The recommendations are primarily from ITDP's Footpath Design Guide and ITDP's Better Streets Better Cities publications. In the online version of the tool, there is a "related publications" link, which provides excellent and up to date guidelines on all the sections of the tool to assist the technical designer to improve walkability.

The authors of the Pedestrians First tool recognised that there are limitations to the tool. One of the aspects which was mentioned is that it does not address many of the social factors that limit walkability for members of groups that are marginalised by their gender, ethnicity, or other factors. Pedestrians First measures the physical aspects of streets and does not account for these factors (ITDP, 2018).

To understand the challenges experienced by users regarding sexual harassment and personal security within public transport, the SHE CAN tool is a powerful resource to assist policymakers and transport providers when designing for vulnerable users (Empower, 2023). A study authored by Uteng et al., (2021) found that approximately 84% (from a sample of 16 600 female respondents spread across the world) had experienced sexual harassment for the first time before they were 17 years old. The SHE CAN tool is a web-based resource, which was developed through the EMPOWER project to build capacity of transport professionals to deliver gender-equitable and inclusive transport (Empower, 2023). This tool provides access to evidence-based information and to digital safety auditing tools to assist policymakers and transport officials to address sexual harassment and personal security within public transport.

Another tool that provides information regarding marginalised groups is the SafetiPin app which was developed in India in 2013. The app is a map-based mobile phone application that audits a set of nine parameters that, together, contribute to the perception of safety on a route (Safetipin, 2023).

To overcome the shortcomings in the Pedestrian First tool regarding social factors for members of groups that are marginalised the author included nine additional security criteria from the Safetipin tool (Safetipin, 2023). The Safetipin app was developed by the Safetipin organisation, which is a social organisation working with a wide range of urban stakeholders, including governments, to make public spaces safer and more inclusive for women and other marginalised groups (Safetipin, 2023). The nine parameters include lighting, openness, visibility, crowd, security, walk path, public transport, gender diversity and feeling of safety (Saftipin, 2023). A pin for each audit is provided which indicates the specific location where the audit was performed (Safetipin, 2023). This is an app that was designed for women to provide information regarding how safe certain spaces are in a city (Safetipin, 2023). The nine criteria added from the Safetipin app are not an exhaustive list but it does start to sensitise designers to the needs for vulnerable users.

Another addition to the 41-item checklist was specific criteria for cycling infrastructure provision. The three parameters that were added are bicycle parking, bicycle lane and road marking for cycling. The reason for adding three specific cycling criteria is because the Walkability Street-level Design Checklist is mainly focused on pedestrians. Since the case study is looking at NMT links to the Cape Town Railway Station it was prudent to add some bicycling parameters. The final checklist that was used for the audits is shown in **Appendix A**.

4.2 Case Study: Cape Town Railway Station

4.2.1 Context: Cape Town Railway Station

The Cape Town Railway Station Hub (CT-Hub) is the busiest Public Transport Interchange (PTI) in Cape Town, with 210 000 daily commuters (Draft CITP 2023-2028, 2022). The CT-Hub provides access to work, education, retail and entertainment opportunities to residents of Cape Town travelling from their homes to the Cape Town CBD. The citywide modal split based on the National Household Travel Survey

of 2020 as cited in the CITP 2023-2028 (CCT, 2023), is shown in **Figure 18.** It illustrates that work trips are dominated by private transport usage (56%), followed by road-based public transport (34%) and NMT (mainly walking) at 6%. Education trips are however mainly undertaken by walking (58%). It should also be noted that every public transport trip includes a walking link to the main mode. Behrens 2009, identified in the 2003 NHTS, that walking as the main mode varied from 9% for high-income households, 43% for middle-income households and as high as 61% for low-income users. By improving the walking facilities for people, the most vulnerable can have an improved travel experience. Lessons learned from other Sub-Saharan African cities, supports this statement that improvement to the NMT modes, predominantly used by low income users, could be useful instruments for increasing productivity in urban areas (Pendukar, 2005).

There are five different public transport modes provided at the CT-Hub, namely rail, minibus-taxi (MBT), MyCiTi BRT, Golden Arrow Bus Services (GABS) and metered taxis. These public transport modes form the integrated public transport network for Cape Town and the location of each at the CT-Hub is provided in **Figure 19.** The routes that were chosen to be audited for this study include a best practice route which originates from the CT-Hub and ends at the Cape Town Stadium, a route along Adderley Street which starts at the CT-Hub and ends at the Company Gardens and a route from the CT-Hub to the Cape Peninsula University of Technology.

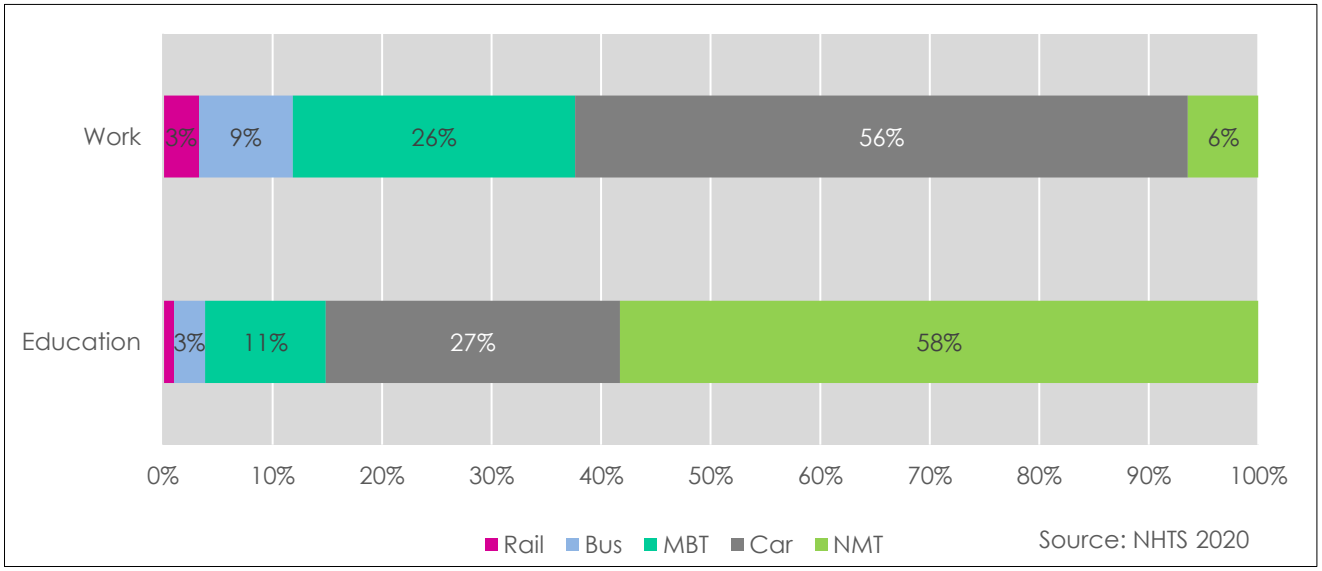


Figure 18: Modal Split: Private, Public Transport and NMT by main mode to work and education.
Source: National Household Travel Survey, 2020. Cited in the CITP 2023 – 2028, CCT, 2023.

Figure 19: Cape Town Railway Station Hub.
Source: Author's own, Google Earth.

4.2.2 NMT Routes

For this study, the ITDP walkability tool has been applied to three different access routes to the Cape Town Railway Station. The three routes that were chosen were all ground-level routes. The three routes have different design features to test the walkability tool. The following routes were assessed.

- No.1: Adderley Street route from the Cape Town Railway Station to the Company Gardens. This 1 km route incorporates walking and cycling elements, as well as MyCiTi stops and MBT services along the route. There is also an underground facility, which links the Cape Town Railway Station to Adderley Street through a tunnel.
- No.2: The 1.5 km walking route to Cape Peninsula University of Technology (CPUT) incorporates walking elements and public transport stops along the route to reach the CPUT facility.
- No.3: The Fan Walk is an NMT route which was designed as part of the preparation for the 2010 FIFA World Cup. This route is seen as a best practice design route. It is approximately 2.5 kms from the Cape Town Railway Station to the Cape Town Stadium and incorporates walking and cycling elements along the route.

Figure 20 shows the three access routes with a 1 000 m radius around the Railway Station.

A 1 km radius circle was drawn around the centre of the Cape Town Railway Station, to identify which routes fall within this area. The 1000 m radius was used in support of research that was done by Hitge and Vanderschuren (2015), which concluded that the average distance that pedestrians walk to Public Transport facilities in Cape Town, is 1.3 km. This distance is longer for rail (Hitge and Vanderschuren, 2015), at around 2 kms, but the Cape Town Railway Station facility accommodates different Public Transport modes in the interchange. Therefore, the average of 1.3 km is a good indication of walking distance. Instead of using the 1.3 km radius, a 1 km radius was used for this study to account for the rich urban infrastructure that is available in the CBD area. This 1 km radius is still larger than the international walking distance of 800 m.

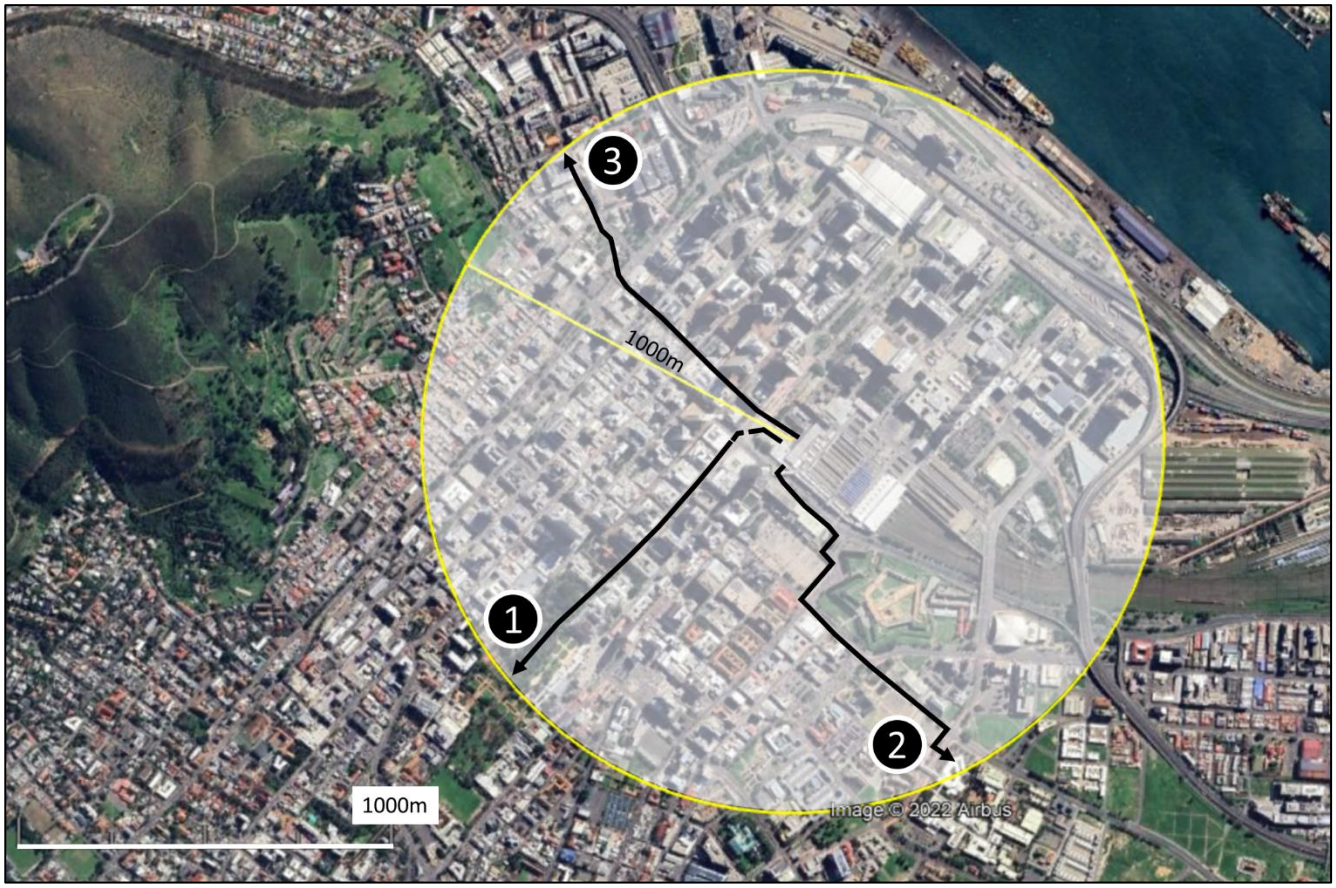


Figure 20: Assessed NMT Routes from the Cape Town Railway Station Hub.
Source: Author's own, Google Earth.

The Street-Level Walkability Design Checklist tool was applied to the three different routes and the results are discussed in **Chapter 5**.

5. WALKABILITY ASSESSMENT

5.1 Ease of Use of the Walkability Street-Level Design Checklist

The Walkability Street-Level Design Checklist is an online tool (ITDP, 2018). It provides an option to download results in pdf or excel format. To develop an audit form to use on site, the excel format sheet was downloaded and a form was created, which could be used. This audit form was supplemented with 9 criteria from the Safetipin app (Safetipin, 2023) and 3 criteria for cycling infrastructure. The form is attached in **Appendix A**. The checklist is easy to understand and use on site. For each section of a route the audit took approximately 1.5 hours. Each route that was assessed took up to 3 hrs to complete. To assist with the analysis and processing of the information, photos were also taken to provide extra information for the design process.

The results from each of the routes is discussed below. The detailed results for the Adderley Street case, are available in **Appendix B**.

5.2 Adderley Street

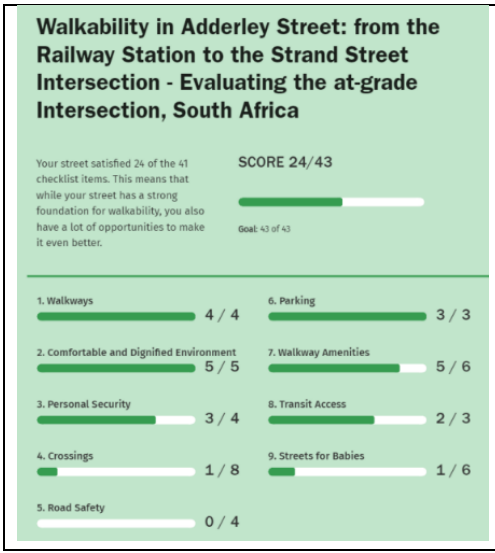
The Adderley Street route was divided into two sections:

- Section 1 is from the Railway Station to the Strand Street / Adderley Street intersection. This includes the underground facility, as well as the at-grade crossing at Strand Street / Adderley Street intersection.
- Section 2 is from the Strand Street / Adderley Street intersection to the entrance of the Company Gardens.

Applying the street-level design checklist to this route, the following results were achieved.

5.2.1 Section 1: from the Railway Station to the Strand Street / Adderley Street intersection

Table 8: Walkability in Cape Town – Adderley Street: from the Railway Station to the Strand Street Intersection.



Strand Street / Adderley Street intersection (source: CityMap Viewer – scale: 1:350)

Westbound Approach: Adderley Street - shows a pedestrian crossing the approach while no provision has been made for pedestrian crossing markings.

Eastbound Approach: Adderley Street – various pedestrians crossing this approach. There are taxi stops on this approach which adds to the pedestrian activity.

Northbound Approach: Strand Street - shows a family with a small child trying to cross.

Southbound Approach: Strand Street - a pedestrian with a trolley observed at this approach.

Figure 21: Photos of the Strand Street / Adderley Street Intersection.
Source: Author's own.

Discussion of Results:

The overall walkability score for this section of the route is 24/43. This indicates that there is a strong foundation for walkability for this section, but that there is opportunity to improve the walkability. The areas which scored low are the crossings, road safety and streets for babies. These three areas are discussed in more detail below.

Crossings: score 1/8

This score refers to the at-grade intersection of Strand Street and Adderley Street. Although an underground facility has been provided for pedestrians to access Adderley Street from the Railway Station, there are a significant number of pedestrians that cross the street at grade. (See the photos in **Figure 21**). Since little to no provision has been made for pedestrians to cross at this intersection, there is an opportunity to improve the walkability of this intersection significantly. During the site visit, vehicles approaching the intersection were driving fast. There are also more than three lanes for

pedestrians to cross on each approach. This intersection will be explored as one of the proposals to improve the street design along Adderley Street.

Road Safety: score 0/4

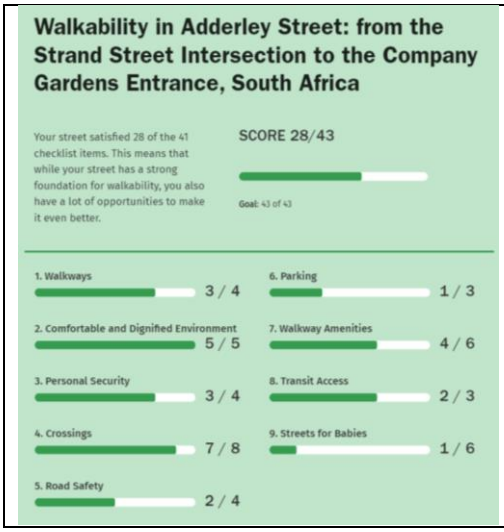
The at-grade intersection at Strand Street / Adderley Street intersection does not provide for pedestrians to cross the intersection. During the site visits pedestrians were observed crossing the intersection at grade. (See photos in **Figure 21**). The fact that no provision is made for pedestrians, at-grade, resulted in this section scoring a 0 for road safety. Improvements need to be made.

Streets for Babies: score 1/6

The score for this section is very low, since little to no provision has been made for children to use this crossing safely. This score reiterates the need for this intersection to be improved.

5.2.2 Section 2: Strand Street / Adderley Street Intersection to Company Gardens

Table 9: Walkability in Cape Town – Adderley Street: from the Strand Street Intersection to Company Gardens.

<table>
<tr>
<td> 
</td>
<td> 
Bicycle lane along Adderley Street (source: CityMap Viewer – scale: 1:750)</td>
</tr>
</table>

Traders encroaching on the walkway: Adderley Street. This photograph shows the informal traders encroaching on to the walkway and pushing pedestrians into the cycling facility. This area requires a reorganising of the cross-section.

Flower Sellers: **Adderley Street**. This section shows the Flower Sellers encroaching on the walkway. The white delivery vehicles park in the loading space provided for the Flower Sellers. These are often parked in this space for the duration of the day and observations confirm that it belongs to the Flower Sellers.

Typical cross-section with side road: Adderley Street. The typical cross section is shown in this photograph. There are two vehicle lanes in each direction with a pedestrian refuge in the median. Where the side roads enter Adderley Street, provision for pedestrian bulb-outs have been made to shorten the crossing distance for pedestrians.

Separated cycle lane facility: This photograph shows the pedestrians using the cycle lane facility as a walkway. The bollards in the lane are not ideal for cyclists, but it was installed to keep unwanted vehicles out of this lane.

Figure 22: Photos of Adderley Street from the Strand Street Intersection to the Company Gardens. Source: Author's own.

Discussion of Results:

The overall walkability score for this section of the route is 28/43. This indicates that there is a strong foundation for walkability for this section, but that there is a lot of opportunity to improve the walkability. The areas which scored 50% or lower are the parking and streets for babies' sections. These areas are discussed in more detail below.

Parking: score 1/3

The street vendors park illegally in parking spaces the whole day. The parking bays are supposed to have a higher turn-over rate and are for short term parking. The parking needs to be managed. Loading bays are also provided in front of the Flower Seller's market, but these bays are also used as parking.

Streets for Babies: score 1/6

The score for this section is very low, since little to no provision has been made for children. More can be done to make this section of the street user friendly for children.

Recommendations for this Section:

- The bicycle lane is not working well along Adderley Street. The Flower Sellers use the walkway space in front of the Flower Seller Market as a vending space. The pedestrians along the route then use the cycle lane as a space to walk. Options to improve the integration of a cycling lane along this street need to be investigated.

5.2.3 SWOT Analysis: Adderley Street

Figure 23: Overview of Adderley Street.
Source: CityMap Viewer (scale 1:1500).

Table 10: SWOT Analysis: Adderley Street.

Strengths:	**Weaknesses:**
• The walkways along Adderley Street are wide, between 2.8 m to 3.5 m at some points. This supports the large volumes of pedestrians using this road. • Comfortable and dignified environment. The route is pleasant to walk and there is shade and cleaners keep the route clean. • The underpass facility is wide and open. The facility is clean with directional signage to good lighting. • Personal safety is good along the street, with the exception during the evening when all shops are closed. • Adequate lighting is provided during the evening.	• The shops close between 5 pm and 6 pm leaving Adderley Street deserted at night. This has an impact on security along the street during this time. • The Strand Street / Adderley Street intersection does not make provision for at-grade pedestrian crossing, although numerous people do cross the intersection at-grade. • The speed limit for both Strand Street and Adderley Street is 60 km/h, which makes it unsafe for high volumes of pedestrians when vehicles speed along the route. The traffic along the street is also higher than 2 000 veh/day. • The Flower Sellers encroach on the walkway which pushes pedestrians into the cycle lane facility. • On-street parking is not managed, and vehicles occupy the bays throughout the day. • The loading facility in front of the Flower Sellers is misused. The Flower Sellers are seen to be using these facilities to park their vehicles during the day, instead of loading and off-loading and parking in another space. • No seating was observed along Adderley Street. The amount of garbage bins along the street seems inefficient. There is no provision made for children using the street, for example, areas where caregivers and children can rest safely.
Opportunities:	**Threats:**
• Improve the at-grade crossing for the Strand Street / Adderley Street intersection. • Improve the provision for streets for children. • Reallocation of the cross-section to allow for a multi-modal design.	• The existing users of the street need to be engaged to co-create the re-design of the cross-section. Ignoring the voices of the users could lead to the re-design not being used as intended. • There needs to be a recognition that streets change over time and that the usage of an infrastructure facility should be able to change accordingly to meet the needs of the users. Careful consideration should be given to existing user needs, as well as possible future needs for the facility.

5.3 Cape Peninsula University of Technology NMT Routes from the Railway Station

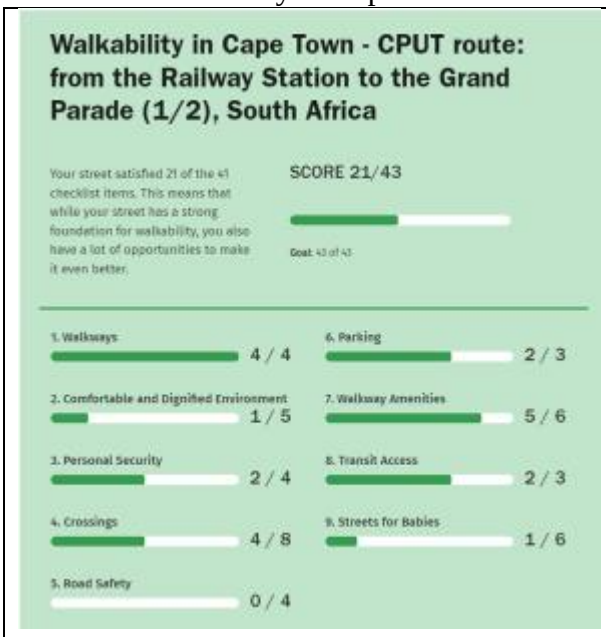
The NMT routes to the Cape Peninsula University of Technology (CPUT) were divided into two sections.

- Section 1 is from the Railway Station to the Grand Parade.
- Section 2 is from the Grand Parade along Darling Street to Sir Lowry Street.

Applying the Street-level design checklist to this route, the following results were achieved:

5.3.1 Section 1: from the Railway Station to the Grand Parade

Table 11: Walkability in Cape Town – CPUT route: from the Railway Station to the Grand Parade.



CPUT route Section 1: Pedestrian crossing across Strand Street as you exit the Railway Station (source: CCT CityMap Viewer – scale: 1:350)

Crossing facility at the exit of the Railway Station: This is the first crossing facility from the Railway Station exit. There is a pedestrian phase for the pedestrians to cross, which runs with the phase on Lower Plein Street. This makes it unsafe for pedestrians, since MBTs rush out of Lower Plein Street to make a left turn into Strand Street. There are also numerous MBTs on Strand Street eastbound approach that make u-turns across Strand Street when pedestrians are crossing the street. This crossing needs to be improved to make it safe for pedestrians.

Crossing facility across Lower Plein Street: The queues for public transport vehicles can be observed in this photo. There is not enough space for pedestrians to walk past this queue and people can be observed using the roadway in this photo. Once Lower Plein Street is crossed, there is a walkway facility with trees along Strand Street towards the Grand Parade.

Walkway along Strand Street: The walkway is wide enough, and streets provide some shade. Although the area looks clean, the smell in the air in this section and along the GABS terminal section is bad.

Pedestrian crossing across Castle Street: The audible pedestrian signals were very faint. The activation of the Pedestrian Signals also took longer than 40 seconds once the push button was pushed. This need to be improved.

Figure 24: Photos of the CPUT route from the Railway Station to the Grand Parade.
Source: Author's own.

Discussion of Results:

The overall walkability score for this section of the route is 21/43. This indicates that there is a strong foundation for walkability for this section, but that there are a plenty of opportunities to improve the walkability. The areas which scored 50% or lower are the comfortable and dignified environment,

personal security, crossings, road safety and streets for babies. These areas are discussed in more detail below.

Comfortable and Dignified Environment: score 1/5

A lot of water puddles were observed during the site visits. The area is also very noisy from motorised vehicles on Strand Street. During the peak hour period the walkways are not wide enough to accommodate all the people. The smell of urine in the section in front of the GABS terminal contributed to the undignified environment.

Personal Security: score 2/4

During the peak period when commuters where rushing to get home, I felt very conscious of the safety of my belongings. The shops around this area close between 5 pm and 6 pm and the Railway Station closes the entrances around 7 pm at night. Therefore, the score for personal security is affected.

Crossings: score 4/8

The at-grade crossing facility from the Railway Station across Strand Street is very unsafe. Some MBT vehicles were making u-turns across the intersection while the pedestrians had a green light to cross Strand Street. The vehicle phase of Lower Plein Street and the Pedestrian phase runs concurrently. Some vehicles make a very fast left-turn into Strand Street, which compromises the safety of the pedestrians crossing the street. During observations it was clear that there is little priority given for pedestrians. This crossing needs improvement.

Road Safety: score 0/4

The at-grade crossing facility from the Railway Station across Strand Street is very unsafe. Some MBT vehicles were making u-turns across the intersection while the pedestrians had a green light to cross Strand Street. The speed limit on Strand Street is 60 km/h but vehicles speed on this road. Traffic is excessive on Strand Street.

Streets for Babies: score 1/6

The score for this section is very low since little to no provision has been made for children to use the crossing facility safely. This score reiterates the need for this crossing to be improved.

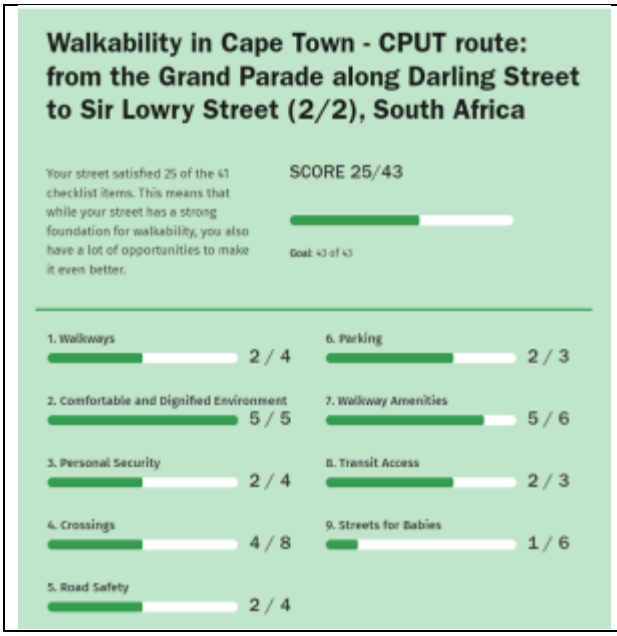
Recommendations for this Section:

There is a need to improve the Pedestrian Crossing across Strand Street.

- The NMT crossing facility needs to be improved to allow for pedestrians and wheelchair users to cross Strand Street.
- Options to improve road safety also need to be investigated.

5.3.2 Section 2: from the Grand Parade along Darling Street and Hanover Street

Table 12: Walkability in Cape Town – CPUT Route: from the Grand Parade along Darling Street and Hanover Street.



CPUT route Section 2: The route along Darling Street and Hanover Street. (Source: CCT CityMap Viewer – scale: 1:1500)

Southbound Approach – Buitenkant Street towards the Darling Street intersection: Adequate provision is made for walkways on both sides of the road. The driveways to the Grand Parade could be somewhat of a challenge to wheelchair users.

Darling Street intersection – Pedestrian Wayfinding: The wayfinding signage is visible in this photo.

Darling Street intersection: The intersection made provision for universal accessible crossings on each approach and includes tactile paving and audible traffic signals. There are walkways on both sides of Darling Street towards the CPUT campus.

Southbound Approach on Hanover Street: This photo of the typical cross section along Hanover Street shows the provision of walkways on both sides of the road. There is also a refuge island in the median which assists pedestrians when crossing the street. The different coloured paving blocks provides a visual indication of the walkways.

Figure 25: Photos of the CPUT Route from the Grand Parade along Darling Street.
Source: Author's own.

Discussion of Results:

The overall walkability score for this section of the route is 25/43. This indicates that there is a strong foundation for walkability for this section, but there is opportunity to improve the walkability. The areas which scored 50% and lower are the walkways, personal security, crossings, road safety and streets for babies. These areas are discussed in more detail below.

Walkways: score 2/4

Although provision is made for walkways on both sides of the road, there are some intersections that do not have universally accessible ramps at the crossings. This needs to be rectified in future to improve the walkability of this section of the road.

Personal Security: score 2/4

This area of the CBD is much quieter than the area in front of the Railway Station. This makes the area feel less safe, especially for a woman walking by herself. The area is mostly well lit at night, but all shops close between 5 pm and 6 pm at night, which makes it less safe. There are also two sections, in particular, where homeless people live along the Castle wall and on an open field next to the Darling Street and Sir Lowry Street intersection. During the site visit, the field agent did not want to walk further than the Sir Lowry Street intersection, since the perception was that it is not safe to walk alone. Photographs of the route further along were taken at a different time of the day when the field worker could return with an assistant.

Crossings: score 4/8

The audible pedestrian traffic signals are very faint at the first crossing from the GABS bus terminal to the Grand Parade. At the Strand Street / Castle Street crossing the pedestrian signals are not audible. The signals need to be upgraded to ensure they are audible.

Road Safety: score 2/4

The speed limit on the road is 60 km/h and the design does not encourage slower driving. There is room for improvement.

Streets for Babies: score 1/6

The score for this section is very low, since little to no provision has been made for children along this route.

Recommendations for this Section:

- The pedestrian signals need to be upgraded or serviced to ensure they are audible for users wanting to cross the street. The activation time after a pedestrian push button is pushed also needs to be adjusted for the Castle Street crossing.

5.3.3 SWOT Analysis: CPUT Route

Figure 26: Overview of the CPUT Route.
Source: CityMap Viewer (scale 1:1500).

Table 13: SWOT Analysis: CPUT Route.

Strengths:	**Weaknesses:**
• The walkways along Strand Street are wide, between 2.8 m to 4.3 m at some points. This supports the large volumes of pedestrians using this road. • Walkway Amenities. Due to the proximity to the Railway Station, there are adequate amenities available for users, for example, bathrooms, drinking water and places to rest. • The streetlights provide adequate lighting during the evening. • Good wayfinding signage is provided which indicates the main destinations that can be reached by foot, including the CPUT campus. • Different coloured paving blocks are used to indicate the pedestrian walkways which adds to the legibility for pedestrians. • Universal Access design features are provided at crossings and intersections for NMT users.	• Unsafe crossing facility when you exit the Railway Station. • The speed limit for Strand Street is 60 km/h, which makes it unsafe for high volumes of pedestrians when vehicles speed along the route. • Wheelchair users will struggle to use the pedestrian walkway during peak hours when high volumes of pedestrians are present. • Public Transport users' queue along the walkways, taking up space on the walkway. • There are puddles of water along the pedestrian walkways. • The smell of urine along the walkway in front of the GABS bus terminal makes it unpleasant to walk along this section. • Pedestrian signals are not providing priority for pedestrians i.e., a leading phase.
Opportunities:	**Threats:**
• Improve the pedestrian crossing facility at the exit to the Railway Station. • Improve the provision for streets for children. • Reallocation of the cross-section to allow for a multi-modal design. • The pedestrian signals need to be upgraded or serviced to ensure they are audible for users wanting to cross the street. The activation time after a pedestrian push button is pushed also needs to be adjusted for the Castle Street crossing.	• The MBT operators need to be engaged to encourage better driver behaviour. The drivers making U-turns across Strand Street, while pedestrians use the crossing facility, is a critical challenge which needs to be addressed. • There needs to be a recognition that streets change over time and that the usage of an infrastructure facility should be able to change accordingly to meet the needs of the users. Careful consideration should be given to existing user needs, as well as possible future needs for the facility.

5.4 Fan Walk

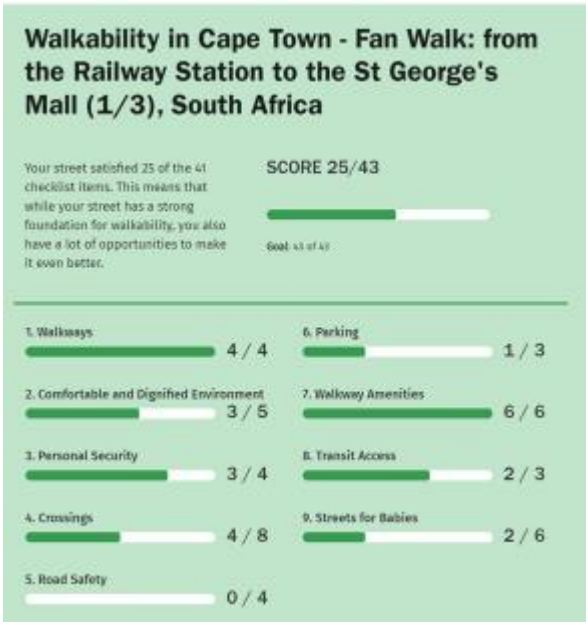
The Fan Walk route was divided into three sections.

- Section 1 is from the Railway Station to the St George's Mall. There is one pedestrian crossing across Adderley Street in this section.
- Section 2 is from St George's Mall to the Buitengracht Street crossing.
- Section 3 is the section from Buitengracht walking through St Alexander Square to Chiappini Street.

Applying the street-level design checklist to this route, the following results were achieved.

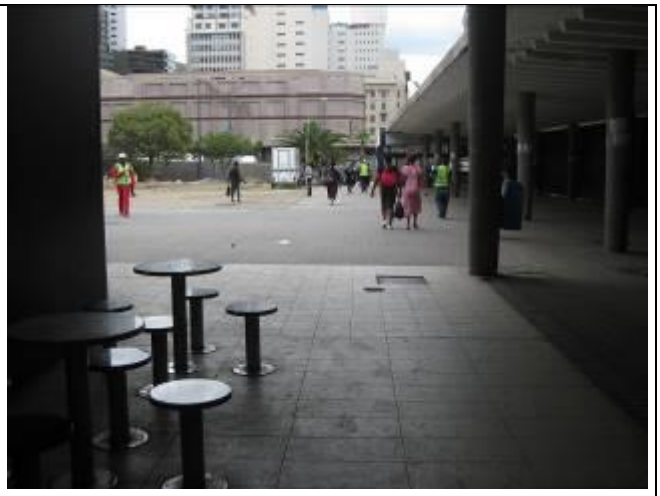
5.4.1 Section 1: from the Railway Station to the St George's Mall

Table 14: Walkability in Cape Town – Fan Walk: from the Railway Station to the Strand Street Intersection.



Crossing at Adderley Street (source: CityMap Viewer – scale: 1:350)

The Arrival Hall at the Cape Town Railway Station: It is clear that the arrival hall at the Cape Town Railway Station is a welcoming space full of light. There is appropriate signage directing pedestrians and the area is kept clean by cleaning staff. Although the railway is not working optimally, this area is still used by commuters as a thoroughfare when arriving on the Station Deck by MBT. This area is closed around 7 pm at night.



Northbound Approach exiting the Railway Station: From the photo it can be seen how dirty the walkway is. There is currently a new building being constructed on the Railway Square and a large part of the area is fenced off. This section from the Railway Station to the pedestrian crossing needs some maintenance work to fix paving blocks, and more regular cleaning to make the area comfortable and enjoyable for pedestrians.

	
Pedestrian Crossing across Adderley Street: It is clear from the picture that the road markings need to be repainted. The standing water in the picture also needs to be improved. Apart from what can be seen in the photo, the pedestrian signals are taking a very long time to activate. During site visits, it was observed that pedestrians do not push the push button and just cross the street when safe.	**Northbound Approach towards St George's Mall:** The traders are well organised and there is enough provision for pedestrians to walk along this route. The area is being kept clean by Cape Town Central Improvement District (CCID) staff. The photo shows the metallic studs demarcating the bicycle lane.

Figure 27: Photos of the Fan Walk Route Section 1: From the Railway Station to the St George's Mall
Source: Author's own.

Discussion of Results:

The overall walkability score for this section of the route is 25/43. This indicates that there is a strong foundation for walkability for this section, but that there is opportunity to improve the walkability. The areas which scored low are the crossings, road safety, parking, and streets for babies. These four areas are discussed in more detail below.

Crossings: score 4/8

The pedestrian crossing across Adderley Street need improvement. Vehicles approach the crossing fast. The pedestrian signal took more than 3 min to activate once the push button was pushed. During the site visit it was observed that pedestrians do not even push the push button anymore, but rather cross the street when it is safe to do so. The pedestrians must also cross more than two lanes which affected the score for this section negatively. From the photo (**Figure 27**) it is apparent that the road markings need to be repainted. This crossing will be explored as one of the proposals to improve the street design along the Fan Walk.

Road Safety: score 0/4

The low score for road safety is caused by the design of this section of road, which does not encourage slow driving. The speed limit is 60 km/h and the pedestrian signal does not provide priority for pedestrians over private cars, since it takes more than 3 min to activate. The traffic volumes on Adderley Street are also high. This is one of the first streets to cross when arriving at the Cape Town Railway Station, and improvements to prioritise pedestrians need to be made.

Parking: 1/3

There is illegal parking of construction vehicles in one of the lanes. Enforcement of this area needs to be improved.

Streets for Babies: score 2/6

The score for this section is very low, since little to no provision has been made for children to use this crossing safely. This score reiterates the need for this intersection to be improved.

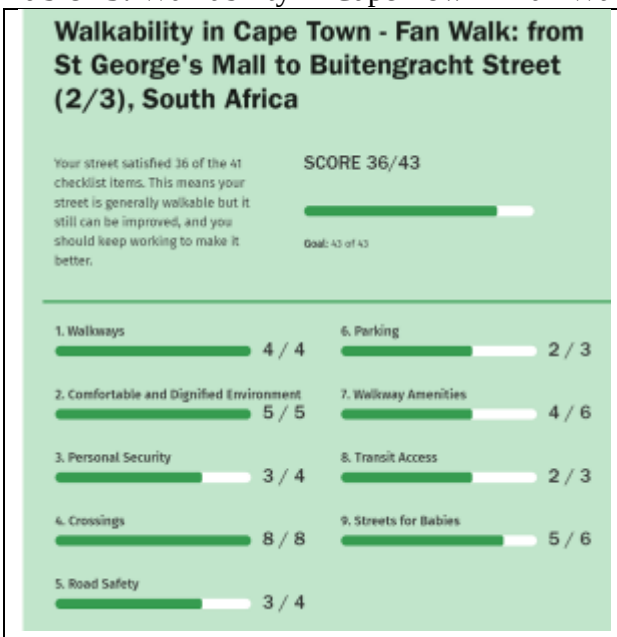
Recommendations for this Section:

There is a need to improve the Pedestrian Crossing across Adderley Street. Other recommendations – law enforcement of illegal parking and maintenance and cleaning in the section from Rail Station to the crossing.

- Elements of the pedestrian crossing across Adderley Street need to improve. This includes adjustment to the pedestrian signal, road markings and maintenance.
- Law enforcement to manage the illegal parking along Adderley Street.
- Cleaning and maintenance of the section from the Railway Station to the pedestrian crossing.

5.4.2 Section 2: from St George's Mall to Buitengracht Street

Table 15: Walkability in Cape Town – Fan Walk: from St George's Mall to Buitengracht Street.



Section of route along Waterkant Street (source: CityMap Viewer – scale: 1:750)

Waterkant Street section between Lower Burg Street and Long Street: The provision of a walkable area is clearly visible in this section of Waterkant Street. The only disadvantage of this section is that it is on a steep incline, which would make it very difficult for wheelchair users to use. The photo also shows vehicles parked in the loading bays illegally.

Northbound Approach along Waterkant Street: The photo shows a typical cross section along the Fan Walk. Trees are to make the route more comfortable and enjoyable. The street is also clearly demarcated to show the different uses along the route. Benches are visible and pedestrians and cyclists use this section of the route.

Crossing across Loop Street: The pedestrian crossing area is clearly marked with different coloured paving blocks. Road markings are also provided, as well as accessible ramps for wheelchair users. The pedestrian push buttons activate the pedestrian phase very quickly and the signals are also audible. This intersection prioritises pedestrians and cyclists crossing the road.

Night-time along Waterkant Street: The photo was taken without a flash and lighting is provided to improve safety. All shops are closed though, with only a few restaurants and bars open along the route. CCID safety officers were still visible between 8 pm and 9 pm at night along this area.

Figure 28: Photos of the Fan Walk Route Section 2: From St George's Mall to Buitengracht Street. Source: Author's own.

Discussion of Results:

The overall walkability score for this section of the route is 36/43. This indicates that the section is generally walkable, but there is still opportunity for improvements. The walkways, comfortable and dignified environment, and crossings section scored full marks. The areas where small improvements

can be made are personal security, road safety, parking, walkway amenities, transit access and street for babies. The results are discussed below.

Personal Security: score 3/4

This section did not achieve full marks since most shops close during the evening. This is not a design challenge but requires the inner city of Cape Town to have more residential areas, which can support a 24-hour city. See photo during night-time in **Figure 28**.

Road Safety: score 3/4

The streets in the inner city crossing the Fan Walk route all have a speed limit of 60 km/h. Therefore, the section for road safety cannot get a score of 100%. This is not a design issue, but a road safety principle. There are numerous cities around the world that are recognising the importance of slower speed in built-up areas to improve road safety. A speed limit of 30 km/h greatly increases pedestrians and cyclists' chances of survival if hit by a car (see **Figure 3**). Where there is a great number of different users using the street, lowering the speed limit can contribute to making the streets safer for all.

Parking: score 2/3

There are loading bays provided along Waterkant Street (the Fan Walk). During site visits vehicles were observed using these loading bays. These bays are supposed to be used during loading and off-loading activities and not for vehicles being parked. Law Enforcement needs to be improved to ensure that the bays are used correctly.

Walkway Amenities: score 4/6

It was not clearly observed during site visits if access to public toilets and drinkable water were available in this section. Therefore, it could not get a 100% score.

Transit Access: score 2/3

One of the three criteria for this element is transit boarding that is accessible and barrier-free for people of all ages and physical abilities. Since the only public transport mode that is accessible is the MyCiTi, the decision was made not to give any sections this point. Rail, Buses and MBTs provide most of the public transport services and these modes are not fully accessible. Improvements to the different modes needs to be made for this indicator to improve.

Streets for Babies: score 5/6

There was no clear indication of public toilets and whether baby-changing facilities are available. This section could not receive a 100% score.

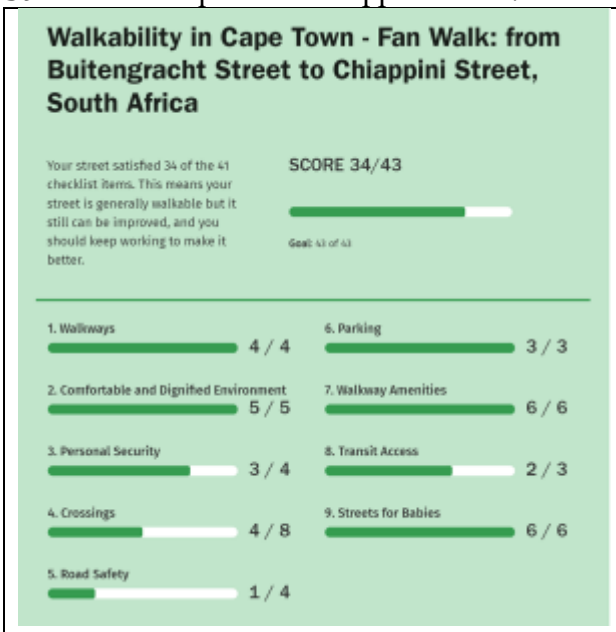
Recommendations for this Section:

The Waterkant Street Fan Walk was designed and developed for the 2010 Fifa World Cup. It is a great legacy project, and it is clear from the photos that this route is used by both commuters and tourists during the day. It is an example of a good walkable route with only a few minor improvements that can be considered. This route clearly shows that providing walkable routes in Cape Town is possible. For this section there are no specific design improvements identified. The main recommendation for this section is the following:

- The overall recommendation for the CBD area of Cape Town is to implement a speed limit of 30 km/h on certain streets to improve safety for pedestrians and cyclists. This will also create a nicer environment for pedestrians to walk.
- The CBD also needs to incentivise and support more residential development which will improve the city's safety and liveability at night-time.

5.4.3 Section 3: from the Railway Station to the St George's Mall

Table 16: Walkability in Cape Town – Fan Walk: from Buitengracht Street Intersection through St Andrew's Square to Chiappini Street.



Crossing at Buitengracht Street (source: CityMap Viewer – scale: 1:350)

The NMT Crossing facility across Buitengracht Street: The NMT crossing across Buitengracht Street provides traffic signals for pedestrians and cyclists. When the push buttons are pushed, the signals take more than 40s to activate. The time for pedestrians to cross is not enough for users to walk across both carriage ways. During the site visit a wheelchair user had to scramble across one carriageway to make it in time. The timing for the pedestrian signal needs to be improved.

The NMT Crossing facility across Buitengracht Street: From the photo it is observed that a pedestrian bridge is provided for pedestrians. This facility was only used once during a 1.5 hours' period on site. Most pedestrians crossed at-grade. Vehicles approach the crossing quite fast on Buitengracht Street, which is a Class 2 distributor road. Improvements should be investigated.

Buitengracht Street Eastbound Approach: It is clear from the picture that a lot of traffic approaches this crossing. There are 3 lanes to cross for each carriageway.

St Andrew's Square: The provision, in terms of walkway amenities, is very good through this square which connects Waterkant Street to Chiappini Street. Art work is displayed in this square, with a coffee shop and a clean public toilet facility.

Figure 29: Photos of the Fan Walk Route Section 3: From Buitengracht Street Crossing through St Andrew's Square to Chiappini Street.
Source: Author's own.

Discussion of Results:

The overall walkability score for this section of the route is 34/43. This indicates that there is a strong foundation for walkability for this section, but there is opportunity to improve the walkability. The areas which scored low are the crossings and road safety. These two areas are discussed in more detail below.

Crossings: score 4/8

The NMT crossing across Buitengracht Street provides traffic signals for pedestrians and cyclists. When the push buttons are pushed, the signals take more than 40s to activate. The time for pedestrians to cross is not enough for users to walk across both carriage ways. During the site visit a wheelchair user had to scramble across one carriageway to make it in time. The timing for the pedestrian signal needs to be improved.

Road Safety: score 1/4

The low score for road safety is achieved because the design of this section of road does not encourage slower driving. The speed limit is 60 km/h and the pedestrian signal does not provide priority for pedestrians over private cars, since it takes more than 40s to activate. The traffic volumes on Buitengracht Street are also high. Options to improve this crossing across the Class 2 distributor road need to be investigated.

Recommendations for this Section:

There is a need to improve the Pedestrian Crossing across Buitengracht Street.

- The NMT crossing facility needs to be improved to allow for pedestrians and wheelchair users to cross Buitengracht Street.
- Options to improve road safety also need to be investigated.

5.4.4 SWOT Analysis: Fan Walk

Figure 30: Overview of Fan Walk.
Source: CityMap Viewer (scale 1:1500).

Table 17: SWOT Analysis: Fan Walk.

Strengths:	**Weaknesses:**
• The walkways are wide and provide space for walking and cycling. • Overall, the route is comfortable and has a dignified environment. • This route has CCID safety officers all along the route. This route is well used by commuters and tourists visiting the city. • The crossings along the route are well designed to prioritise pedestrians by providing bulb-outs and audible pedestrian signals with universal access infrastructure. The only exception is the crossing at Adderley Street. • The walkway amenities like benches, garbage bins, ablutions and parking for bicycles are well catered for.	• The area from the Cape Town Railway Station arrival hall to the intersection across Adderley Street is dirty. This could be due to the construction currently taking place. • Maintenance of paving bricks and walk amenities along the section at the Railway Station. • The pedestrian crossing at Adderley Street needs to be prioritised for pedestrians. The signal takes more than 3 min to activate after the push-button is pushed. • Road safety at the pedestrian crossing at Adderley Street. Pedestrians cross the street without using the pedestrian push buttons. Vehicles approach this crossing at high speeds. • Construction vehicles are parked in the left turning lane along Adderley Street. • The infrastructure is not designed to be particularly child-friendly, and improvements can be made.
Opportunities:	**Threats:**
• Improve the pedestrian crossing at Adderley Street. • Some improvements to the pedestrian signals should be made at the crossing at Buitengracht Street. • Opportunity to implement a speed limit of 30 km/h on certain streets in the CBD area to improve safety for pedestrians and cyclists. This will also create a nicer environment for pedestrians to walk.	• The Fan Walk route needs to be maintained to ensure that the high quality of the environment is sustained. This will prolong the lifespan of the infrastructure that was implemented.

5.5 Sections of Routes to be Improved

By using the Walkability Street-Level Design Checklist tool, the main improvements for each route can be categorised as follows:

- **Multi-modal design:** Cross-sections in Adderley Street and Strand Street should be re-designed to ensure cyclists are given space.
- **Road Safety:** The intersection of Strand Street and Adderley Street needs to improve. The pedestrian crossing facility, when exiting the Railway Station on Strand Street, needs to be made safer.
- **Operations and Maintenance:** Maintenance of NMT infrastructure is essential as part of a Pavement Management System. The traffic signal operations need to improve to ensure priority is given to the most vulnerable users, especially close to the Public Transport interchange.

To assist with the improvements in these three categories, various design guidelines were consulted. This includes International Best Practice Guidelines as well as South African Design Guidelines. The following section discusses the general design principles which need to be applied to each of the categories.

6. APPLYING THE DESIGN GUIDELINES TO THE THREE DESIGN CATEGORIES

For the three different categories, the available design guidelines are considered to assist with the development of concept design proposals. The following sections discuss the main principles to be applied to these three categories. The guidelines are consulted to assist with design improvements for cross-section design, intersections, crossing facilities, bicycle lanes, maintenance requirements and pedestrian signals. The guidelines that were used are both South African design guidelines and International Best Practice design guidelines. The general principles from the guidelines are discussed in the sections below, after which the relevant application to the case studies is applied in **Chapter 7**.

6.1 Multi-Modal Design

"We are in a period of deep uncertainty about future transport; to help address this, we need to deepen our understanding of the role played by spatial proximity and digital connectivity".
Lyons, 2021.

Multi-modal design refers to how we provide for all the modes in the transport system. Lyons and Davidson (2016), explain that the way we access opportunities are through a triple access system where the transport system provides access through physical mobility, the land-use system provides access through spatial proximity, and the telecommunications system provides access through digital connectivity. This is illustrated in **Figure 31** below.

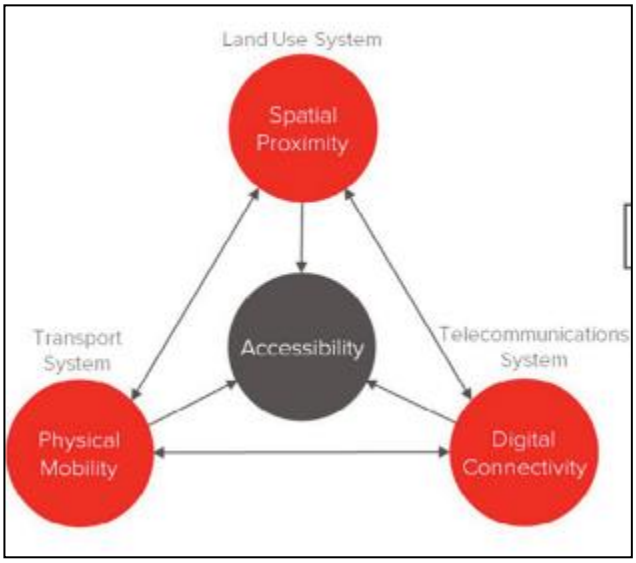


Figure 31: The Triple Access System.
Source: Lyons, 2016.

By improving the infrastructure provision for NMT facilities, the spatial proximity side of the triple access system is being improved. Apart from providing more options to the user of the system, active travel has other benefits, such as environmental, social and health benefits (Lyons, 2021).

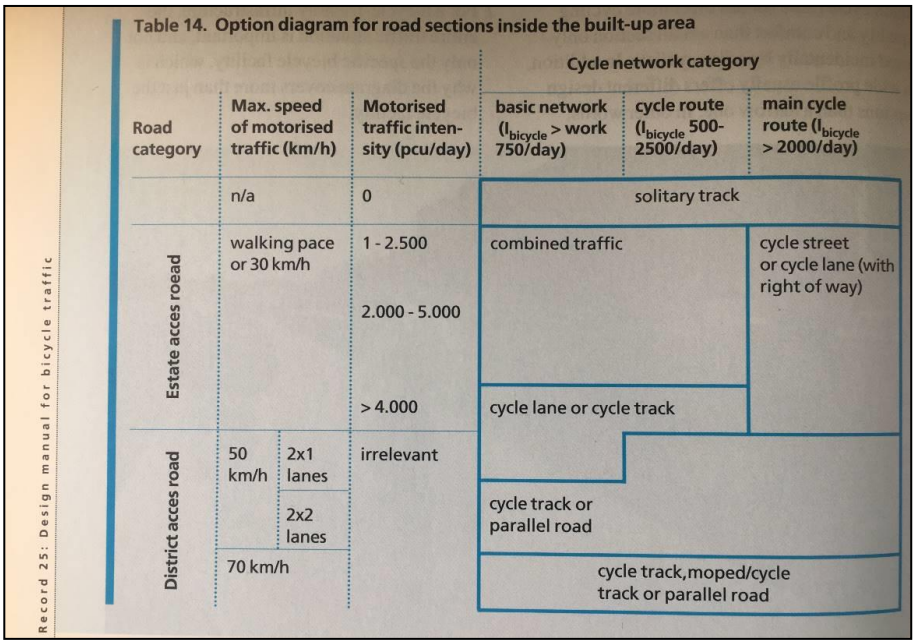
An integrated systems approach is needed to provide adequate and safe infrastructure for active travel modes, in South African cities. To see how we can improve the multi-modal design for cycling and walking, the guidelines provide the following advice regarding the cross-section in the roadway.

CROW (2007) provides a particular section on bicycles and motorised traffic. In general, the principle is that road sections, fulfilling a distributor function for motorised traffic, require specific bicycle facilities. The guideline mentions that designers must determine the best solution for bicycle traffic in each situation to ensure safety of cyclists. The CROW manual provides an option diagram for road sections inside built-up areas to assist with the decision of when to provide separate cycle facilities. **Table**

18 shows the relevant table and provides guidelines for making choices for each road section where cycling facilities need to be provided (CROW, 2007). The diagram is based on three basic principles (CROW, 2007):

- The most preferable situation for cyclists is key. In other words, prioritise the safety of the cyclist over the private car user.
- For a bicycle-friendly infrastructure, the entire traffic situation is important, and not only the specific bicycle facility. This is why the diagram covers more than just the bicycle facility.
- There is often more than one possible solution and the boundary between possible solutions is not always fixed. This is why there are limit values that overlap in the diagram.

Table 18: Option Diagram for Road Sections Inside Built-Up Area
Source: CROW, 2007, p108.



Furthermore, Cerema (2009) mentions the speed differential criterion, which is a critical informant when deciding how the cross-section should be designed for different users of the road. See **Figure 32**.

Both guidelines support a separation of the cycle lane facility when the speed differential is more than 20 km/h. Comparing the City of Cape Town (CCT, 2022a) guidelines, which proposes that road markings on Class 3 roads are sufficient to indicate a cycle lane facility (see **Figure 33**), there is a clear difference. The CCT (2022a) guidelines do, however, promote pedestrians and cyclists as the modes that should receive priority when designing roads, but the application of this in practice would suggest that motorised vehicles still enjoy priority. **Figure 33**indicates the typical cross-section to use on Class 3 roads. Class 3 roads all have a speed limit of 60 km/h and the guideline suggests that road markings, indicating the cycle lane in the roadway, should be provided. It can be argued that the most vulnerable user in the roadway would be the cyclist, proving that road markings, as the only improvement, could put the cyclists in danger when sharing the road with fast driving vehicles. This is confirmed by the international guidelines which advise on separating the cycle lane facilities when speed differential is high.

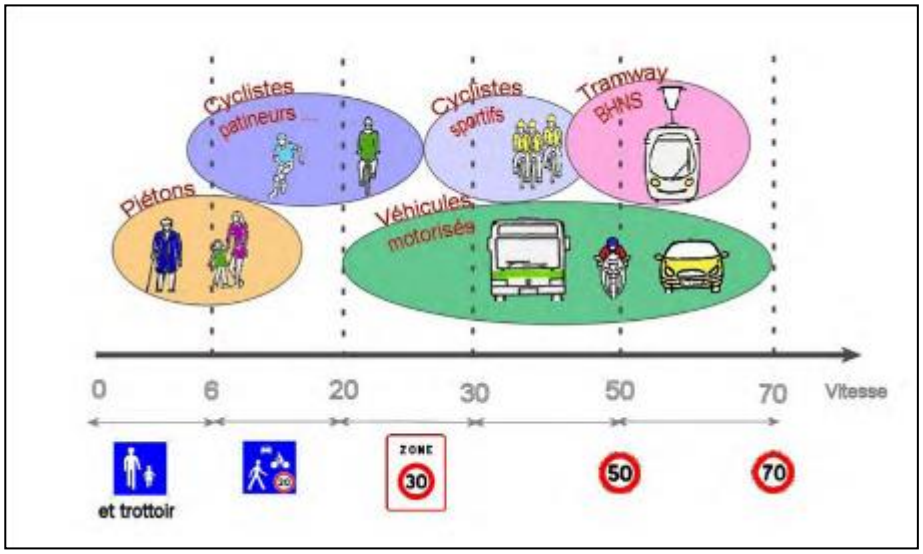


Figure 32: Speed Practiced by Users in the City: An Essential Criterion
Source: Cerema, 2009.

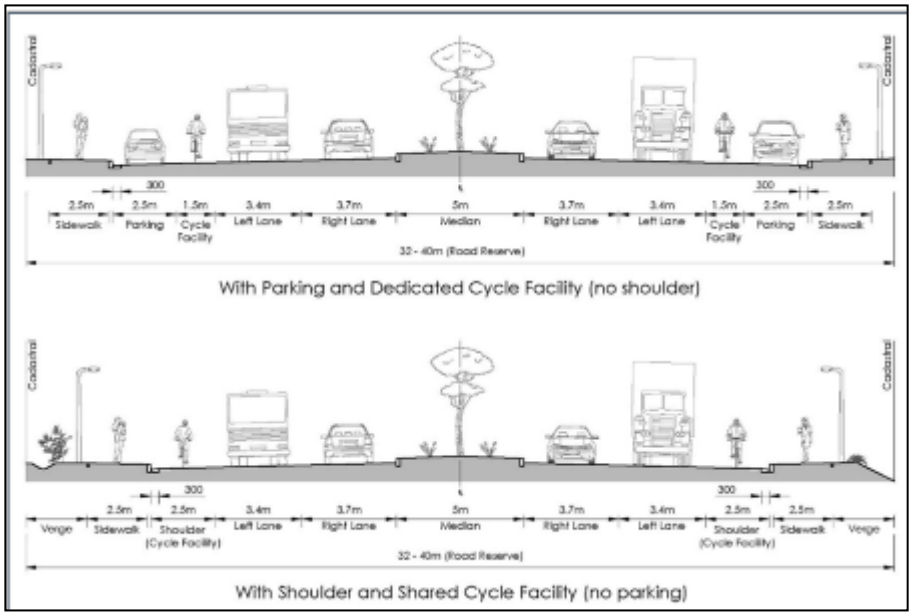


Figure 33: Typical Cross-Section of a Class 3 Minor Arterial Road
Source: CCT, 2022a.

The NDoT (2015) NMT guidelines recommend partial separation on minor arterials, which is in conflict with the CCT (2022) guidelines. The NDoT (2015) guidelines recommend that speed limits, on access streets with significant NMT users, should be reduced to 40 km/h. The suggested international speed limit for areas, where high NMT users are present, is 30 km/h.

The focus of this discussion was around the insertion of cycle lane facilities in the cross-section, since the examples in the case study included good provision for the pedestrians in the cross-section. Generally, the provision of the walkways was wide enough and comfortable. Therefore, this section focused on how to improve the insertion of cycle lane facilities.

6.2 Road Safety

As identified in **Chapter 1**, road safety challenges in South African cities are vital to address. The guidelines offer numerous suggestions of how road safety can be improved. The ITDP (2018) Pedestrian First tool also provided links to the latest best practice guidance on this.

One of the elements which could improve safety on our roads is the lane widths provided for motorised vehicles. WRI (2015) provides an overview of comparative lane widths with a safety index for the widths. South African lane width norms are 3.7 m for through lanes and 3.4 m for turning lanes, which is on the higher side of the width spectrum and encourages vehicles to speed. By making travel lanes narrower for motorised vehicles, it can improve the safety for more vulnerable NMT users, especially where high volumes of these users are present.

Figure 34: Comparative Illustration of Travel Lane Widths
Source: WRI, 2015.

Other ways of adjusting existing road sections to improve safety, is to provide traffic calming features such as speed humps, speed tables, chicanes, neck downs, chokers, and half closures (NDoT, 2015). The NMT guidelines (NDoT, 2015) provide guidance on how to use these elements in design, as well as the latest NACTO guideline documents (NACTO, 2012 and GDCI, 2016, 2020).

6.3 Maintenance and Operations

6.3.1 Maintenance Requirements

Ongoing street maintenance can increase the usable lifespan of infrastructure (GDCI, 2016). Regular cleaning and sweeping of a street and ensuring potholes and other elements are fixed, as soon as damage occurs, ensures good practice. The following strategies are identified in the GDCI (2016) guideline:

- Prevention includes surveys, inspections, preventative management, and utility management to ensure timely identification of elements in need of maintenance. To assist with this strategy, the designer needs to understand the lifecycle of materials and elements to ensure that timely maintenance and replacements are scheduled (GDCI, 2016).
- Street cleaning helps keep the streets and public spaces in a safe and clean condition (GDCI, 2016). Along Adderley Street, the City of Cape Town Improvement District (CCID) ensures that streets are cleaned. This provides extra eyes on the street which improves not only the aesthetics of the street, but also safety.
- Local stewardship, where constituents are engaged in the design and upkeep activities of the street, can support with daily maintenance activities (GDCI, 2016).

- Involvement of Stakeholders can provide partners to support the maintenance of the street (GDCI, 2016).
- A short- and long-term maintenance plan is needed to keep the street in good condition (GDCI, 2016).

The NMT Facility Guidelines, developed by NDoT (2015), recognises the importance of maintenance and Chapter 9 is dedicated to this aspect. The guideline recognises that the management of road pavements and the related maintenance practices are generally well established in South Africa, but that the maintenance of NMT facilities tends to receive less attention (NDoT, 2015). Condition monitoring should be done according to the TMH22 generic indicators for condition and functional rating for each NMT element (NDoT, 2015). The maintenance needs of NMT facilities ranges from routine maintenance to reconstruction and construction of new facilities. Section 9.8 in the NMT Facility Guidelines (NDoT, 2015) provides a summary of the different maintenance activities to apply to NMT facilities.

The City of Cape Town has a Pavement Management System (PMS) which ensures that maintenance of roads gets done in Cape Town (CCT, 2022). All the NMT infrastructure elements should form part of this system to ensure maintenance activities are scheduled and completed when needed.

6.3.2 Traffic Signal Improvement

Apart from regular maintenance on the audible pedestrian signals, NACTO (2012) advise using a leading pedestrian phase to provide priority for pedestrians when crossing a street. The principles to improve signal operations is discussed below (NACTO, 2012, p127):

- Shorten the signal cycles to increase turnover.
- Prioritise walking, bicycling and transit. Use signal priority tools, such as leading pedestrian intervals, synchronising signals for bicycles, or transit signal priority along corridors with established or desired modal priority.

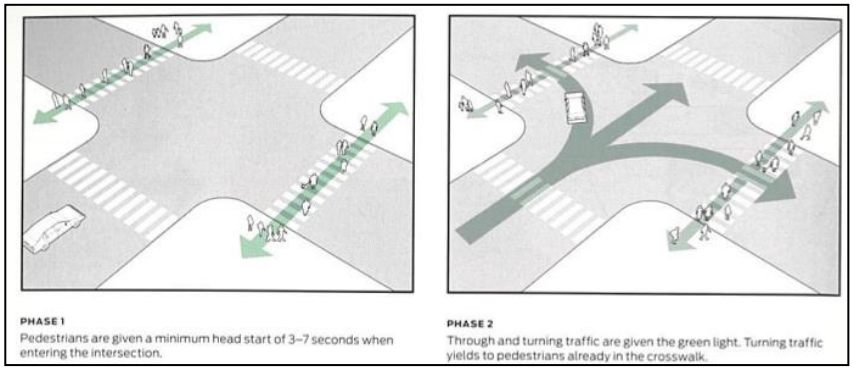


Figure 35: Leading Pedestrian Interval.
Source: NACTO, 2012, p128.

The City of Cape Town does provide audible pedestrian signals at crossings and intersections, but during the site surveys, some of these signals were not operating optimally. It is, therefore, proposed that regular maintenance of these signals should form part of an overall maintenance plan.

7. CONCEPT DESIGN PROPOSALS

7.1 Design Process

ITDP and UN-Habitat (2018) summarise the design process in three steps and confirm the importance of public participation. Participation in the design should include residents, businesses and other stakeholders in the planning and design of streets (ITDP, 2018). This can help to improve a community's active use and sense of ownership of the street, as well as improving transparency between the local government and the users of the street (ITDP, 2018). To assist with a participatory approach, tactical urbanism can be used to encourage participation and test ideas. Tactical urbanism allows for temporary installations, such as using plant boxes to demarcate the street improvements, to test new street designs before they are fully implemented (ITDP, 2018).

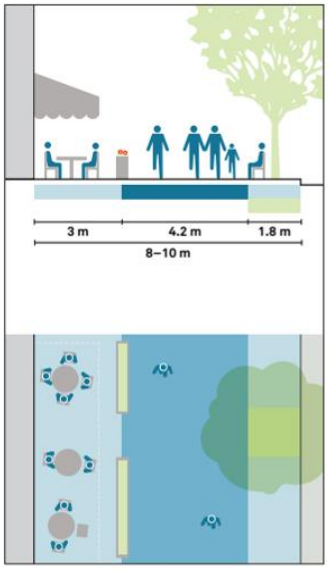
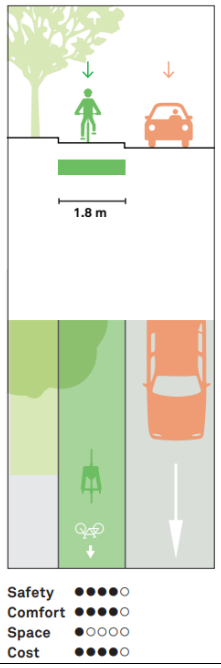
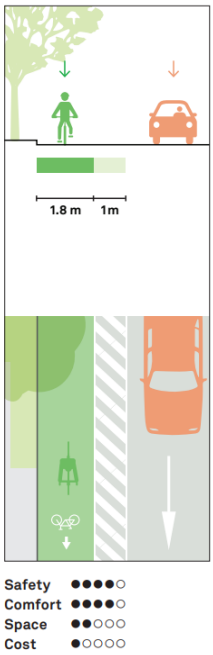
For this study, public participation was not undertaken due to limited resources. The design process that was followed is available in **Appendix C**.

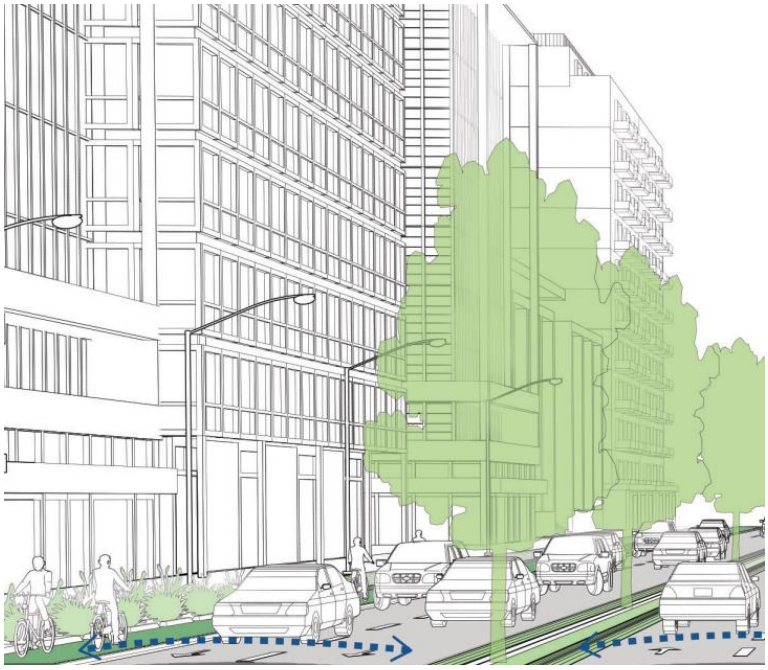
7.2 Multi-Modal Design Proposals

7.2.1 Cross-Section Improvements

The cross-section for Adderley Street is used as an example to show how the guidelines could be applied to suggest design improvements. The principles applied to Adderley Street can also be used for Strand Street, where a cycle lane facility is planned as part of the overall network (CCT, 2017b). To suggest some improvements for the Adderley Street cross-section, some best practice examples are show below.

Table 19: NMT Cross-Section Examples to use along Adderley Street.
Source: GDCI, 2016.

		
To improve the area in front of the Flower Sellers, the cross-section indicated above can be used as a guideline. A frontage area of 3 m for the Flower Sellers, then a 4.2 m thoroughfare for pedestrians and a 1.8 m cycle lane in the roadway.	This shows a raised cycle track which is also called a Copenhagen-style cycle track. This cross-section could be added to the overall cross-section of Adderley Street when providing for cyclists along the street. The two options to add cycle lanes show the difference in criteria such as safety, comfort, space, and cost. Comparing these elements will provide the best option for Adderley Street.	To achieve a cycle lane in the roadway, the speed limit for this section of Adderley Street should be reduced to 30 km/h.



This cross-section is the preferred design proposal to improve Adderley Street. It includes the following:

- On the side where the Flower Sellers operate there is a 3 m frontage area with a 4 m pedestrian thoroughfare.
- A 1.8 m cycle lane on each side.
- Two 3.1 m vehicle lanes on either side of the median.
- 2 m median which includes the line of trees.

Removed:

- With this configuration, the on-street parking needs to be removed in Adderley Street to make space for the new cross-section.

Figure 36: Proposed Cross-Section for Adderley Street
Source: GDCI, 2016.

The final proposed cross-section for Adderley Street is shown in **Figure 37**. This cross-section makes provision for the historic Adderley Street Flower Sellers by providing a 3 m space for them to trade. The existing cycle lane facility is changed to become a 4 m thoroughfare space for pedestrians. This is followed by a 1.8 m raised cycle track. Two vehicle lanes of 3.2 m each are provided and a 2.2 m median.

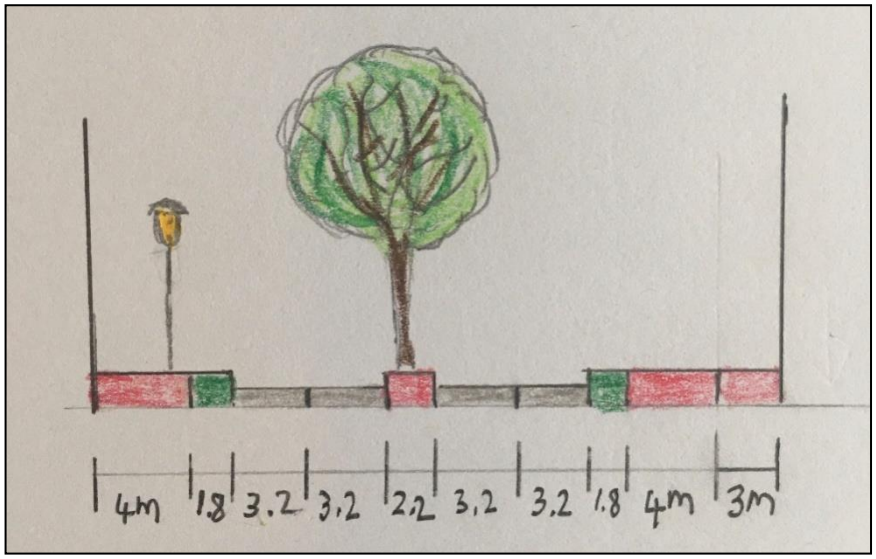


Figure 37: Preferred Cross-Section for Adderley Street.
Source: Author's own.

The Streetmix cross-section tool is an online platform that makes street design available to anyone (Streetmix, 2023). The tool is easy to use to test different cross section elements in the available width and can provide many cross section examples quickly. **Figure 38** illustrates the Adderley Street cross section as designed by the author.

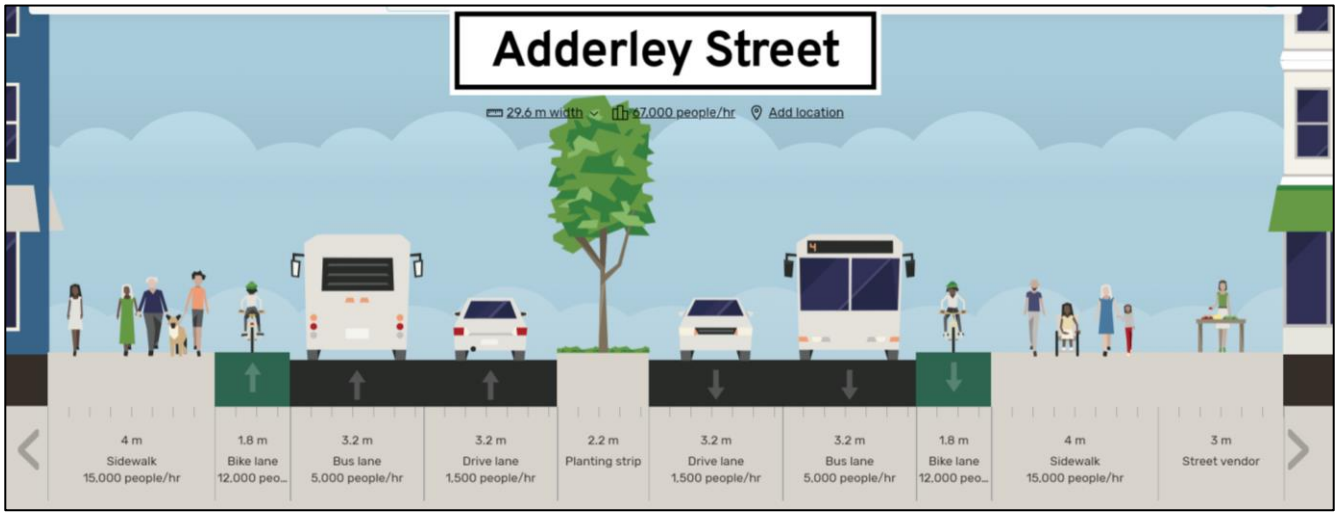


Figure 38: Preferred Cross-Section for Adderley Street using the Streetmix online tool.
Source: Streetmix.net, 2023.

7.3 Road Safety

The Adderley Street / Strand Street intersection was identified as an area where design improvements should be made to improve road safety. To analyse this intersection, traffic and pedestrian counts (FWJK, 2016) were used to understand the users of this intersection. The count data, as well as best practice examples from the design guideline documents, provide solutions to improve the intersection. Similar principles can be applied for the pedestrian crossing on Strand Street, which also needs to be improved.

Count Data

Specific hourly pedestrian volume counts at the crossing facility on Adderley Street were carried out in 2016 for the FWJK Zero2One Tower project (FWJK, 2016). **Figure 39** shows the counts at this crossing.

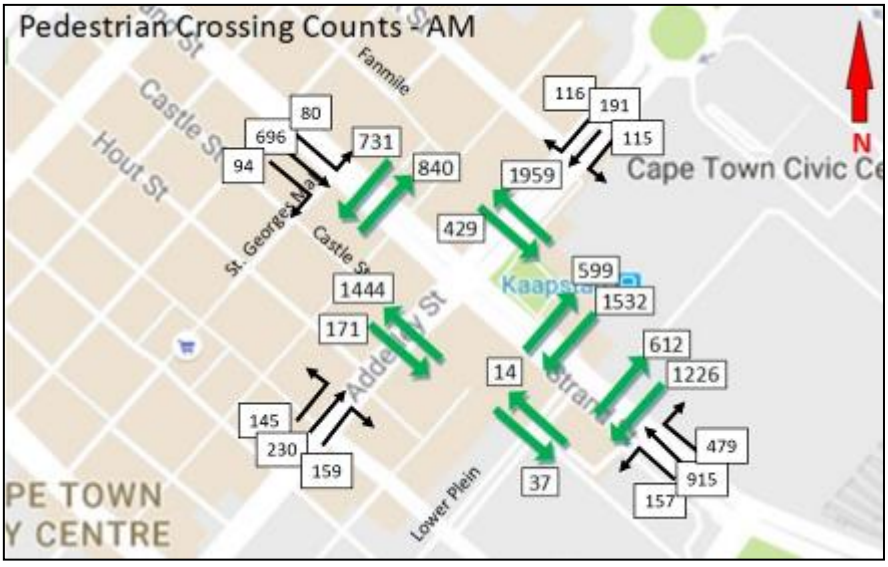


Figure 39: 2016 Pedestrian Peak Hour counts
Source: FWJK Architecture, 2016.

From **Figure 39** the green arrows show the AM peak hour counts, and the black arrows shows the AM peak hour vehicle counts. The split for pedestrians to vehicle counts shows a ratio of 57:43 (1 615 pedestrians: 1231 vehicles).

- AM Westbound traffic total: 94 + 191 + 157 = 442 veh/hour
- AM Eastbound traffic total: 80+230+479 = 789 veh/hour

From these hourly counts provision needs to be made for both vehicles and pedestrians. Adderley Street is one of the areas in Cape Town with the highest pedestrian volumes due to its proximity to the Cape Town Railway Station.

Cycling is not observed at such high volumes. This could be because the existing cycle lane facility along Adderley Street is not connected to a cohesive cycling network. The cycle lane stops abruptly at the Strand Street intersection. Although low cycling volumes are present on Adderley Street, it is part of the NMT network, and improvements to the road section need to include provision for cycling (CCT, 2017b).

The existing intersection is shown in **Figure 40**. It shows the wide section of road that need to be crossed by pedestrians at grade. **Figure 41** and **Figure 42** propose some improvements to this intersection.

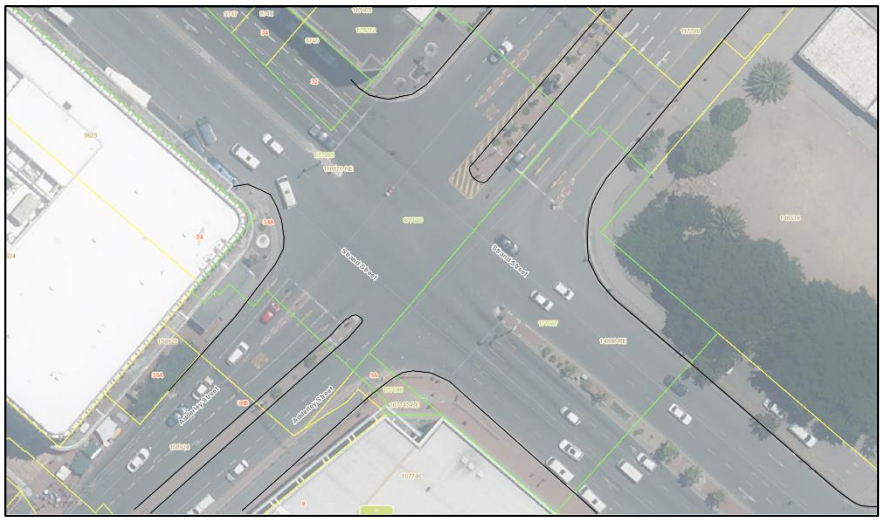


Figure 40: Existing Adderley Street / Strand Street Intersection.
Source: Author's own (CityMap Viewer).

This design proposal is focused on the Strand Street / Adderley Street intersection. Although there are underground facilities available to cross the intersection, there is a need to improve the at-grade NMT crossing facility.

Figure 41 shows an intersection with more than two lanes which could be used as a guideline to improve the Adderley Street / Strand Street intersection.

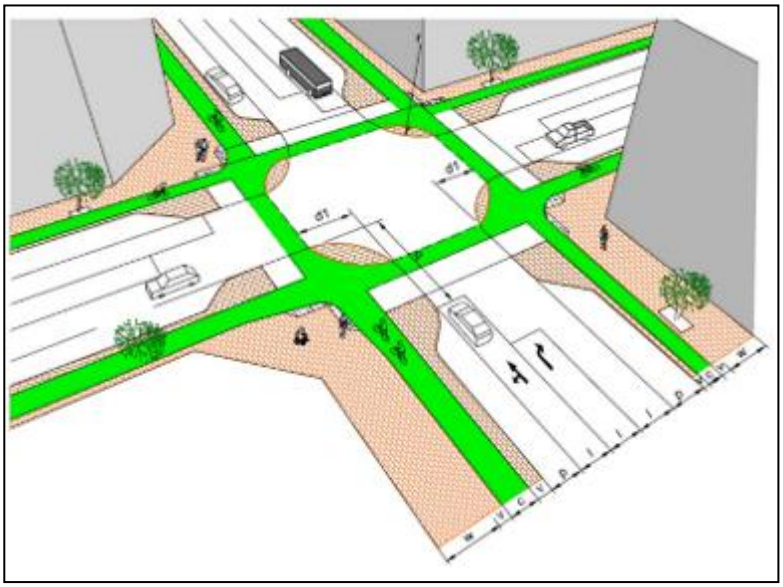


Figure 41: Intersection with More Than Two Lanes.
Source: NDoT, 2015.

Applying the guidelines, **Figure 42** is an attempt at providing for cyclists and pedestrians at the Adderley Street / Strand Street Intersection. This concept design will have to be tested in the detail design process.

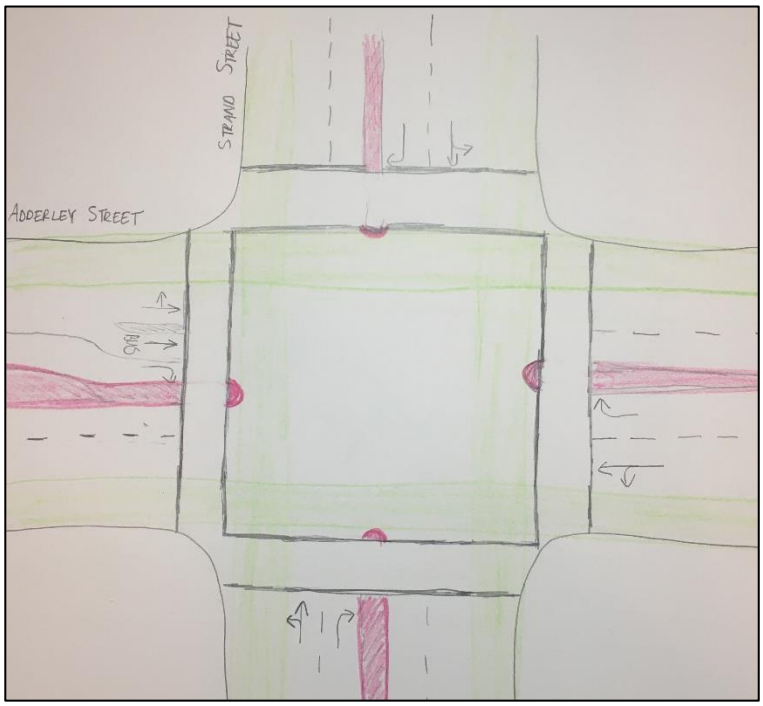


Figure 42: Design Proposal Adderley Street / Strand Street Intersection.
Source: Author's own.

7.4 Maintenance and Operations

7.4.1 Maintenance

The City of Cape Town has a Pavement Management System (PMS) which ensures that maintenance of roads gets done in Cape Town (CCT, 2022). All the NMT infrastructure elements should form part of this system to ensure maintenance activities are scheduled and completed when needed. Requirements for appropriate NMT surfaces include: smooth and even surfaces, stable pavement structures, sufficient surface friction, obstruction free walkways and well drained facilities (NDoT, 2015). These elements should be included in a PMS maintenance plan for NMT facilities.

7.4.2 Traffic Signal Improvement

The City of Cape Town does provide audible pedestrian signals at crossings and intersections, but during the site surveys, some of these signals were not operating optimally. It is, therefore, proposed that regular maintenance of these signals should form part of an overall maintenance plan.

Investigating the option to provide a leading pedestrian phase should also form part of this upgrade.

8. DISCUSSION AND CONCLUSION

8.1 Applying the Pedestrians First Street-Level Design Checklist

The comparison of four different tools to use to assess the walkability of three different routes to the Cape Town Railway Station, led to the decision to use the Pedestrian First Street-Level Design Checklist tool (ITDP, 2018). The main reasons for using this tool was that it included a category for transit access, which is essential to test walkability of linkages to a public transport facility. It also included a parking category as well as a "street for babies" category, which add to the importance of designing streets with the most vulnerable users in mind. The application of the tool to test the walkability of a section of road, is an appropriate tool to incorporate as part of the design process. The tool covers nine categories to assist with the identification for improvement of road sections. These categories are walkways, comfortable and dignified environment, personal security, crossing, road safety, parking, walkway amenities, transit access and streets for babies (ITDP, 2018). It is a holistic tool, which includes engineering design elements, urban aesthetics, as well as safety and security aspects. The tool is easy to use by both technical professionals and non-technical experts and is not data intensive. The tool incorporates the latest best practice criteria to use when evaluating a route for walkability. The online links to best practice design guidelines are also valuable resources for designers of streets. These online publications were consulted when the design improvements were made.

Furthermore, the tool ensures that the Sustainable Development Goals (SDGs) as defined in **Chapter 1** of the document is enhanced. The tool includes categories to make the walkable link safe which links to Goal 3 of the SDGs. By improving the design elements of the walking and cycling links to the Cape Town Railway Station, the goal of making cities and human settlements inclusive, safe, resilient and sustainable is also achieved.

8.2 Complex Street Design

Designing urban streets is a complex process which needs to take various elements into account. Constantly updating best practice references and guidelines is needed. The designer should consult these resources when street design is conducted to ensure the best possible resources are used for street design. The process includes input from multiple professionals, input from the users of street environments, and an understanding of the existing conditions and future vision for a particular street. There is no one solution to the problem, but multiple design alternatives that can be applied to the street. Experience as a designer is required to improve the designing practice. Caution should be taken not to just apply tried and tested methodologies but to constantly strive to improve the way a street design is done to ensure citywide goals and desired outcomes are achieved (GDCI, 2016). **Figure 43** summarises the Street Design Approach around place, people, and impact (GDCI, 2016).

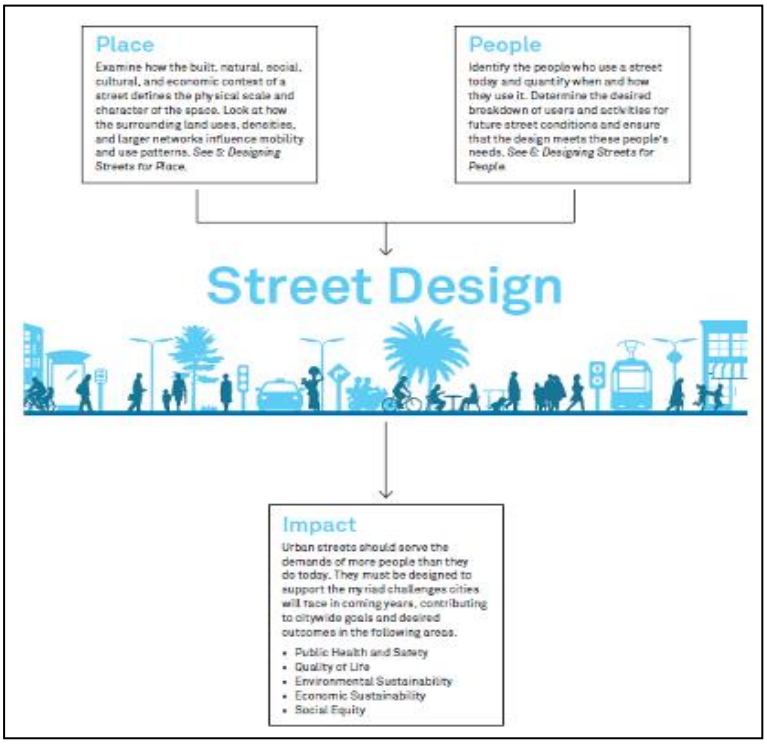


Figure 43: Street Design Approach.
Source: GDCI, 2016.

8.3 NMT Challenges in South African Cities

Chapter 1 introduces the main NMT challenges in South African Cities, namely road safety, personal security, and the provision of infrastructure for NMT. The results from applying the Design Checklist (ITDP, 2018) were grouped into three categories, namely multi-modal design, specifically referring to the cross-section and how provision is made for NMT, road safety and maintenance and operational challenges. From this it can be concluded that the same challenges posed at the beginning of the research are confirmed as challenges on the existing routes.

8.4 Who Design Streets

It is clear that a multi-disciplinary team is needed when designing streets. The input from the user is also critical and need to be taken into account through a co-designing process. The streets in Cape Town shows some evidence that urban design elements have been taken into account, especially the Fan Walk example, but there is still room for improvement. The user perspective need to be incorporated through a collaborative process.

8.5 NMT Policy in South African Cities

The policy and strategy environment for NMT is well developed at national, provincial and at the local government level. It is recognised that there is a large captive market of NMT users in South Africa and, by providing facilities for these users, social upliftment and job creation can be progressed. The policies recognise the importance of access to jobs, education, recreational activities, and other basic services for users, and emphasises the important role that NMT plays in achieving this goal. NMT is also recognised as a sustainable form of transport, which is an important part of the Public Transport system.

Beukes et al., (2017) make the point that, to successfully implement policy, guidance is required to assist practitioners. Based on the results from the Design Checklist, it seems that NMT provision falls short at

the implementation stage. There is a need to better integrate the objectives of policy into updated design guideline documents to ensure the policy objectives can be achieved.

8.6 Cycling Facility Design

The international best practice design guidelines provide recommendations regarding when to provide separated cycle lane facilities for users. To be able to support a triple access system (Lyons, 2016), policies and guidelines for NMT in South African cities should take a more pro-active approach on cycling as a mode to support the transport system. Baufeldt and Vanderschuren (2017) confirm this in a study, which looked at NMT facility implementation in Cape Town, that infrastructure for pedestrians is well catered for, but that the needs for cyclists are not of an adequate standard. The gaps in providing for cyclists needs to be addressed to grow cycling volumes, while improving road safety for this mode.

8.7 South African Design Guidelines

The NMT design guidelines (NDoT, 2015) is a valuable resource to improve the NMT infrastructure provision in South African cities. To support the inclusion of the most vulnerable user in the transport system, the NMT design guidelines should form part of any road design. This is supported by De Jager (2016) in a research study comparing South African design guidelines to international street design guidelines.

The current version of the City of Cape Town's Standards and Guidelines for Roads & Stormwater (Version 3.0, Feb 2022) does not refer to the NDoT (2015) NMT design guidelines. This is an important oversight that should be addressed. In the meantime, designers should be encouraged to familiarise themselves with the NDoT guidelines (2015).

9. RECOMMENDATIONS

9.1 Applying the Pedestrians First Street-Level Design Checklist

As part of the development of the site survey checklist, the Pedestrian First Street-Level Design Checklist was enhanced by adding three specific criteria for cycling. It is recommended that the UITP considers including additional criteria to enhance cycling. Another category that could be added to the tool, in more detail, is a specific section to check the provision for vulnerable users. Overall, the Pedestrians First Street-Level Design Checklist should be used by design practitioners to assist with the investigation and data gathering stage of the design process.

9.2 Street Design Approach is Complex

The Design Thinking approach, which is an approach to understanding and solving complex problems which are intrinsically human-centred (Hasso Plattner d-school Afrika, 2023), should be incorporated into the design process for streets. This could include interacting with users of the street and using the Street-Level Design Checklist (UITP, 2018) as a prompt to collect user perspectives as an input to the design process. These interactions with the users of the road should be done on-site. This is supported by Vanderschuren et al. (2022), which identified the following recommendations to improve NMT provision in a socially inclusive way: reconfigure the management structure to break down silos between departments, include a representative from vulnerable groups during the infrastructure design process and during the implementation stage, and increase the budget allocation for NMT infrastructure projects.

9.3 NMT Challenges in South African Cities

Road safety, security and the provision of infrastructure for NMT, are challenges experienced in South African Cities. The Pedestrians First Street-Level Design Checklist (ITDP, 2018) should be incorporated into the design process to identify if challenges are experienced on the road sections. The online links to the best practice Design Guidelines provide a wealth of information that can be consulted to address the challenges.

9.4 Who Design Streets

To improve street design, one guideline document, which include road and NMT design guidelines into one document, should be developed which could be used in South African cities. This guideline document should also recommend who needs to be involved in street design and provide a method for co-creating street with users.

9.5 NMT Policy in South African Cities

With the NMT policy direction in South African cities saying all the right things, the design guideline documents should be updated to ensure the policy objectives can be achieved.

9.6 Cycling Facility Design

To improve the gaps in providing for cyclists, it is recommended that design guidelines should consider including separated cycle lane facilities when speed differentials with other users is more than 20 km/h. This principle was also applied during the development of the NDoT Guidelines (2015).

9.7 South African Design Guidelines

The current version of the City of Cape Town's Standards and Guidelines for Roads & Stormwater (Version 3.0, Feb 2022) does not refer to the NDoT (2015) NMT design guidelines. This is an oversight and should be included in the next revision of the document.

The NMT Facility Guidelines (NDoT, 2015) should be promoted as a standard design guideline document for any road design.

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APPENDIX A – Street Level Design Checklist Survey Form

1/3	Route:	Date / Time / Weather:
	Section of Route:	
	Question	Answer: Yes / No (Provide description / observations)
1	1. Pedestrian walkways on both sides of the street are dedicated, paved, and separated from vehicles. Alternatively, the entire street is primarily for pedestrians and only rarely used by vehicles, in which case separated walkways are not needed.	
1	2. The walkway clear paths are wide enough for the pedestrian volume. (e.g. >2.5m). Take picture so I can measure later on Google Earth.	
1	3. Unobstructed, clear of anything that would prevent a wheelchair user from moving from one end of the sidewalk to the other, including encroachment by parked vehicles, debris, signs, and street vendors. UN guidelines suggest an unobstructed width of 1.8 meters for wheelchair users.	
1	4. The walkways are easy to use and barrier-free for people with physical challenges.	
2	5. The walkways are clear of dirt, trash, water, and dust.	
2	6. The walkways are quiet enough to have a conversation.	
2	7. The walkways are adequately covered by shade or shelter that protects pedestrians from direct sun.	
2	8. There is room to walk comfortably on the walkways without feeling crowded.	
2	9. The walkways and street are clean and free of trash.	
3	10. You feel safe and comfortable in the walkway.	
3	11. The area is lively and active. Other people are walking around on foot, and they are comfortable and relaxed.	
3	12. Most shops and buildings remain open in the evening.	
3	13. The area is well lit, including at night.	
4	14. Cars approach the **intersection** slowly enough for an elderly person or young child to feel safe crossing the street. Table top crossings or speed bumps to slow down traffic when approaching unsignalised crosswalks where pedestrians continue at the same level.	
4	15. Pedestrians never have to cross more than two lanes of traffic at once. (Pedestrian bridges over roads do not count, as they increase the distance traveled and physical effort exerted by pedestrians.).	
4	16. Corners are sharp enough to discourage cars from making fast turns.	
4	17. Curbs are not more than 15cm high.	
4	18. There are pedestrian ramps at every crossing so that people who use wheelchairs can cross the street.	
4	19. If there are crossing signals, they are timed so that the pedestrian waiting time is always less than 40 seconds. Signals timed so that pedestrian waiting time is not excessive (i.e., generally less than 30 to 45 seconds).	

2/3	Question	Answer: Yes / No (Provide description / observations)
4	20. Signals, if present, have a leading pedestrian interval.	
4	21. There are safe crossings at least every 100m in dense areas and every 200m in all areas where there is continuous activity on both sides of the corridor. These safe crossings are aligned with key destinations and clear paths.	
5	22. The legal speed limit is below 30kph. Posted speed limits set to prioritise safety (e.g., below 30 kilometers per hour in dense urban centers).	
5	23. Drivers rarely, if ever, go faster than the speed limit. Design that matches posted speed limits to prevent speeding and help with enforcement.	
5	24. There are curb bulb-outs, medians, raised crossings, or other traffic-calming features that reduce the speed of motor vehicles.	
5	25. Traffic is not excessive on the street: fewer than 2,000 motor vehicles per day and fewer than 100 per hour.	
6	26. On-street parking is well managed and regulated. Payment is required, and rules are enforced.	
6	27. There is little off-street parking (including underground parking and parking facilities).	
6	28. There are no cars parked illegally. Parking has a cost high enough to prevent illegal parking.	
7	29. There are comfortable **public seats, like benches,** intended for anyone to be able to sit and relax. Seats are available at intervals of 100m to 200m. (more info). Seating facilities. Do not count informal seating such as ledges or curbs not specifically designed for sitting. UN guidelines suggest that a facility be provided at intervals of between 100 and 200 meters and that seating is	
7	30. The street is well-lit throughout the night.	
7	31. There are functioning, clean, and **affordable public toilets** open to all.	
7	32. There are well-maintained **garbage and recycling bins**.	
7	33. Pedestrians have easy, **free access to drinkable water**.	
7	34. There are **street vendors** who do not obstruct the walkable clear path. Presence of street vendors. Vendors include any non-permanent salesperson with wares on the sidewalk who contributes to the active nature of the area without obstructing the walkable path of the sidewalk.	
8	35. The nearest transit station (rapid transit, frequent bus stop, etc.) is within walking distance (less than 500m). The nearest transit station (rapid transit, bus stop, etc.) is within walking distance (less than 1km).	
8	36. Within walking distance (less than 500m) there are different transit options that carry passengers to several destinations around the city. There are many different transit options that are within walking distance (1km).	
8	37. Transit boarding is accessible and barrier-free for people of all ages and physical abilities. Transit stops have shelter and seating, and they are integrated with amenities like real-time transit information, cycle racks, public toilets, drinking fountains, and vendors or kiosks.	
9	38. The street regularly closes to vehicle traffic, such as for a ciclovía, market day, play street, or school street. Toddlers can safely play in it during this time.	

3/3	Question	Answer: Yes / No (Provide description / observations)
9	39. There is a play structure, public art, or sculpture that toddlers and young children can interact with.	
9	40. There are prominent, well-maintained street plants accessible to young children.	
9	41. Transit stops are comfortable, with sheltered areas where a caregiver can sit and relax while waiting.	
9	42. On every block, there is an area where caregivers can pause to interact with babies.	
9	43. Baby-changing tables are available in free public bathrooms on the street.	
S	**Lighting:** Availability of enough light to see all around you. None; Little; Enough; Bright	
S	**Walk Path:** Either a pavement or road with space to walk. None; Poor; Fair; Good	
S	**Openness:** Ability to see and move in all directions. Not open; Partly Open; Mostly Open; Completely Open	
S	**Visibility:** Vendors, shops, building entrances, window / balconies from where you can be seen. No Eyes; Few Eyes; More Eyes; Highly Visible	
S	**Public Transport:** Availability of Public Transport like metro, buses, autos, rickshaws. Unavailable; Distant; Nearby; Very Close	
S	**Security:** Presence of police or security guards. None; Minimal; Moderate; High	
S	**People:** Number of people around you. Deserted; Few people; Some crowd; Crowded	
S	**Gender Usage:** Presence of women and children aroudn you. Not Diverse; Somewhat Diverse; Fairly Diverse; Diverse	
S	**Feeling Safe:** How safe do you feel. Frightening; Uncomfortable; Acceptable; Comfortable	
B	Bicycle Parking: Adequate provision; Easy use; Limit risk of damage; Provide chaining facilities; Protected from weather.	
B	Bicycle Lane: Exclusive parth; Shared path; Continues facility; Position of tunnels / bridges; Avoid one-ways;	
B	Road Marking: Segregated traffic; Mixed traffic; Coloured pavements	

APPENDIX B – Results of Walkability Analysis

An example of the Results from Adderley Street is provided. Detail results of the other routes can be sourced from the Author.

Walkability in Adderley Street: from the Railway Station to the Strand Street Intersection - Evaluating the at-grade Intersection, South Africa

Your street satisfied 24 of the 41 checklist items. This means that while your street has a strong foundation for walkability, you also have a lot of opportunities to make it even better.

SCORE 24/43

Goal: 43 of 43

1. Walkways 4 / 4
2. Comfortable and Dignified Environment 5 / 5
3. Personal Security 3 / 4
4. Crossings 1 / 8
5. Road Safety 0 / 4
6. Parking 3 / 3
7. Walkway Amenities 5 / 6
8. Transit Access 2 / 3
9. Streets for Babies 1 / 6

PEDESTRIANS FIRST

ITDP

1/2	Route: Adderley section 1 of 2	Date / Time / Weather: 15 December 2022 / 09:35am - 10:54am / Good		
	Section of Route: From the Station to the Strand Street Intersection - evaluating the at-grade intersection			
	Question	Answer: Yes / No (Provide description / observations)	Y=1; N=0	
1	1. Pedestrian walkways on both sides of the street are dedicated, paved, and separated from vehicles. Alternatively, the entire street is primarily for pedestrians and only rarely used by vehicles, in which case separated walkways are not needed.	The walkways underneath Strand Street is nice looking and wide. The are is being kept clean by CCT cleaners. Area is well-maintained and there are offices for the CCT as part of this area.	1	
1	2. The walkway clear paths are wide enough for the pedestrian volume. (e.g. >2.5m). Take picture so I can measure later on Google Earth.	Yes. The walkway is wide enough and comfortable for walking.	1	
1	3. Unobstructed, clear of anything that would prevent a wheelchair user from moving from one end of the sidewalk to the other, including encroachment by parked vehicles, debris, signs, and street vendors. UN guidelines suggest an unobstructed width of 1.8 meters for wheelchair users.	Yes. The walkway is wide enough and comfortable for walking. The ramp to the underground area from the Station is quite steep. A wheelchair use will need assistance. The directions to the nearest elevator is not clear for wheelchair users.	1	
1	4. The walkways are easy to use and barrier-free for people with physical challenges.	Yes, although the directions to the nearest elevator is not clear for a wheelchair user.	1	4/4
2	5. The walkways are clear of dirt, trash, water, and dust.	Yes. Cleaners are visible and are constantly cleaning the underground area.	1	
2	6. The walkways are quiet enough to have a conversation.	Yes. Quiet enough and comfortable enough to walk and have a conversation.	1	
2	7. The walkways are adequately covered by shade or shelter that protects pedestrians from direct sun.	Yes. This is an underground facility which is protected from the elements	1	
2	8. There is room to walk comfortably on the walkways without feeling crowded.	Yes. The area is very comfortable and wide to walk through. Pedestrians use it during the day as a thoroughfare.	1	
2	9. The walkways and street are clean and free of trash.	Yes. Cleaners are visible and are constantly cleaning the underground area.	1	5/5
3	10. You feel safe and comfortable in the walkway.	Yes.	1	
3	11. The area is lively and active. Other people are walking around on foot, and they are comfortable and relaxed.	Yes. This gets used as a thoroughfare for commuters from the Railway Station through to Adderley Street. It also provides access to the Golden Acre Mall.	1	
3	12. Most shops and buildings remain open in the evening.	No. The underpass closes at around 8pm at night. The Railway Station is also closed from around 7:30pm. All shops in the area are closed at night.	0	
3	13. The area is well lit, including at night.	Yes. The area is well lit but everything is closed from around 7:30pm onwards.	1	3/4
4	14. Cars approach the **intersection** slowly enough for an elderly person or young child to feel safe crossing the street. Table top crossings or speed bumps to slow down traffic when approaching unsignalised crosswalks where pedestrians continue at the same level.	Strand Street intersection: The cars drive fast and there are lots of lanes to cross. Some of the approaches do not provide pedestrian road markings. Although no provision is made for pedestrians to cross the intersection, there are people who cross this intersection. This needs upgrading to make it safer for pedestrians.	0	
4	15. Pedestrians never have to cross more than two lanes of traffic at once. (Pedestrian bridges over roads do not count, as they increase the distance travelled and physical effort exerted by pedestrians.).	No. Pedestrians have to cross four lanes on each approach. There is a median for pedestrians to rest.	0	
4	16. Corners are sharp enough to discourage cars from making fast turns.	No. Fast turning movements were observed on site.	0	
4	17. kerbs are not more than 15cm high.	There is not provision made for pedestrians to cross the intersection. It needs to be improved.	0	
4	18. There are pedestrian ramps at every crossing so that people who use wheelchairs can cross the street.	No.	0	
4	19. If there are crossing signals, they are timed so that the pedestrian waiting time is always less than 40 seconds. Signals timed so that pedestrian waiting time is not excessive (i.e., generally less than 30 to 45 seconds).	No. A signal for cyclists is provided. The waiting time is 35 seconds for the signal to be activated.	0	

2/3	Question	Answer: Yes / No (Provide description / observations)		
4	20. Signals, if present, have a leading pedestrian interval.	No. A signal for cyclists is provided. The waiting time is 35 seconds for the signal to be activated.	0	
4	21. There are safe crossings at least every 100m in dense areas and every 200m in all areas where there is continuous activity on both sides of the corridor. These safe crossings are aligned with key destinations and clear paths.	Not Applicable for this section. Will mark as 1.	1	1/8
5	22. The legal speed limit is below 30kph. Posted speed limits set to prioritise safety (e.g., below 30 kilometres per hour in dense urban centres).	No. Adderley Street and Strand Street speed limit are 60km/h. Both streets are class 3 minor arterials. The section of Adderley Street south of Strand Street is classified as a Class 4 collector road.	0	
5	23. Drivers rarely, if ever, go faster than the speed limit. Design that matches posted speed limits to prevent speeding and help with enforcement.	No. The design does not encourage slower driving. The section of Adderley Street to the south of Strand Street does encourage slower driving behaviour due to the amount of pedestrians along the road. The pedestrians cross the street whenever needed.	0	
5	24. There are kerb bulb-outs, medians, raised crossings, or other traffic-calming features that reduce the speed of motor vehicles.	No. Provision are not made for pedestrians to cross at grade at the intersection	0	
5	25. Traffic is not excessive on the street: fewer than 2,000 motor vehicles per day and fewer than 100 per hour.	No.	0	0/4
6	26. On-street parking is well managed and regulated. Payment is required, and rules are enforced.	Not Applicable for this section. Will mark as 1.	1	
6	27. There is little off-street parking (including underground parking and parking facilities).	Not Applicable for this section. Will mark as 1.	1	
6	28. There are no cars parked illegally. Parking has a cost high enough to prevent illegal parking.	Not Applicable for this section. Will mark as 1.	1	3/3
7	29. There are comfortable public seats, like benches, intended for anyone to be able to sit and relax. Seats are available at intervals of 100m to 200m. (more info). Seating facilities. Do not count informal seating such as ledges or kerbs not specifically designed for sitting. UN guidelines suggest that a facility be provided at intervals of between 100 and 200 meters and that seating is	No. Seating is not provided.	0	
7	30. The street is well-lit throughout the night.	Yes, but everything closes from around 7:30pm.	1	
7	31. There are functioning, clean, and **affordable public toilets** open to all.	Yes. At the underground CCT facilities.	1	
7	32. There are well-maintained **garbage and recycling bins**.	Yes. Garbage bins are provided along the walkway from the Railway Station to the intersection.	1	
7	33. Pedestrians have easy, **free access to drinkable water**.	Yes. At the underground CCT facilities.	1	
7	34. There are **street vendors** who do not obstruct the walkable clear path. Presence of street vendors. Vendors include any non-permanent salesperson with wares on the sidewalk who contributes to the active nature of the area without obstructing the walkable path of the sidewalk.	No. Not applicable for this section - will mark as 1. There are CCT offices in the underground facility. Offices: Social Development; Municipal Court; SmartCape Business; Urban Management; and Woolworths.	1	5/6
8	35. The nearest transit station (rapid transit, frequent bus stop, etc.) is within walking distance (less than 500m). The nearest transit station (rapid transit, bus stop, etc.) is within walking distance (less than 1km).	Yes. The Railway Station Hub provides access to four different modes namely Rail, MBT, MyCiTi BRT and metered taxis.	1	
8	36. Within walking distance (less than 500m) there are different transit options that carry passengers to several destinations around the city. There are many different transit options that are within walking distance (1km).	Yes. The Railway Station Hub provides access to four different modes namely Rail, MBT, MyCiTi BRT and metered taxis.	1	
8	37. Transit boarding is accessible and barrier-free for people of all ages and physical abilities. Transit stops have shelter and seating, and they are integrated with amenities like real-time transit information, cycle racks, public toilets, drinking fountains, and vendors or kiosks.	The only transit option that is barrier-free and provides amenities is the MyCiTi BRT. This is 1/4 transit options that provides this service. So for scoring purposes this will be scored No.	0	2/3
9	38. The street regularly closes to vehicle traffic, such as for a ciclovía, market day, play street, or school street. Toddlers can safely play in it during this time.	No. This street is not closed regularly.	0	

3/3	Question	Answer: Yes / No (Provide description / observations)		
9	39. There is a play structure, public art, or sculpture that toddlers and young children can interact with.	No.	0	
9	40. There are prominent, well-maintained street plants accessible to young children.	No. Mostly trees in this area. Homeless people use these spaces so not comfortable for children to play in the tree areas.	0	
9	41. Transit stops are comfortable, with sheltered areas where a caregiver can sit and relax while waiting.	The only transit option that is comfortable with sheltered areas for a caregiver is the MyCiTi BRT. This is 1/4 transit options that provides this service. So for scoring purposes this will be scored No.	0	
9	42. On every block, there is an area where caregivers can pause to interact with babies.	No.	0	
9	43. Baby-changing tables are available in free public bathrooms on the street.	Yes. There is baby-changing tables available in the free public bathrooms in the underground bathroom facilities.	1	1/6
S	**Lighting:** Availability of enough light to see all around you. None; Little; Enough; Bright	Enough light around the Railway Station area. All the shops close early and the Station entrances closes around 7:30pm	1	
S	**Walk Path:** Either a pavement or road with space to walk. None; Poor; Fair; Good	Good.	1	
S	**Openness:** Ability to see and move in all directions. Not open; Partly Open; Mostly Open; Completely Open	The underground facility is well-lit at night and feels open. Ability to see and move in all directions.	1	
S	**Visibility:** Vendors, shops, building entrances, window / balconies from where you can be seen. No Eyes; Few Eyes; More Eyes; Highly Visible	More Eyes. The people in the underground facility passing through provides eyes. The CCT offices are not see-through facilities.	1	
S	**Public Transport:** Availability of Public Transport like metro, buses, autos, rickshaws. Unavailable; Distant; Nearby; Very Close	Very close.	1	
S	**Security:** Presence of police or security guards. None; Minimal; Moderate; High	Moderate. CCID safety officers and security personnel around the railway station.	1	
S	**People:** Number of people around you. Deserted; Few people; Some crowd; Crowded	Some crowd.	1	
S	**Gender Usage:** Presence of women and children around you. Not Diverse; Somewhat Diverse; Fairly Diverse; Diverse	Diverse. Women and Men. Children with their parents.	1	
S	**Feeling Safe:** How safe do you feel. Frightening; Uncomfortable; Acceptable; Comfortable	Acceptable. Conscious of taking care of my belongings.	1	9/9
B	Bicycle Parking: Adequate provision; Easy use; Limit risk of damage; Provide chaining facilities; Protected from weather.	Yes.	1	
B	Bicycle Lane: Exclusive path; Shared path; Continues facility; Position of tunnels / bridges; Avoid one-ways;	Yes. Took photo of cycling lane along the route.	1	
B	Road Marking: Segregated traffic; Mixed traffic; Coloured pavements	Road marking across the road and a bicycle signal.	1	3/3

Walkability in Adderley Street: from the Strand Street Intersection to the Company Gardens Entrance, South Africa

Your street satisfied 28 of the 41 checklist items. This means that while your street has a strong foundation for walkability, you also have a lot of opportunities to make it even better.

SCORE 28/43

Goal: 43 of 43

1. Walkways 3 / 4
2. Comfortable and Dignified Environment 5 / 5
3. Personal Security 3 / 4
4. Crossings 7 / 8
5. Road Safety 2 / 4
6. Parking 1 / 3
7. Walkway Amenities 4 / 6
8. Transit Access 2 / 3
9. Streets for Babies 1 / 6

PEDESTRIANS FIRST

ITDP

2/2	Route: Adderley section 2 of 2	Date / Time / Weather: 15 December 2022 / 11:00am - 12:00pm / Good		
	Section of Route: From Strand Street to Company Gardens entrance			
	Question	Answer: Yes / No (Provide description / observations)	Y=1; N=0	
1	1. Pedestrian walkways on both sides of the street are dedicated, paved, and separated from vehicles. Alternatively, the entire street is primarily for pedestrians and only rarely used by vehicles, in which case separated walkways are not needed.	Yes. There are dedicated walkways on both sides of Adderley Street. Due to the demand of pedestrians at certain times of the day, the space do feel crowded at times.	1	
1	2. The walkway clear paths are wide enough for the pedestrian volume. (e.g. >2.5m). Take picture so I can measure later on Google Earth.	Yes. The walkway is wide enough and comfortable for walking. It is >2.5m (measured from Google Earth).	1	
1	3. Unobstructed, clear of anything that would prevent a wheelchair user from moving from one end of the sidewalk to the other, including encroachment by parked vehicles, debris, signs, and street vendors. UN guidelines suggest an unobstructed width of 1.8 meters for wheelchair users.	No. There are vendors along the walkway. Also observed a lot of delivery motor cycles along one of the sections which will make it difficult for a wheelchair user.	0	
1	4. The walkways are easy to use and barrier-free for people with physical challenges.	Yes, it is reasonable.	1	3/4
2	5. The walkways are clear of dirt, trash, water, and dust.	Yes. CCID cleaners are observed.	1	
2	6. The walkways are quiet enough to have a conversation.	Yes. Adderley Street is a busy street with a lot of activity. It is not a quiet street but you can have a conversation.	1	
2	7. The walkways are adequately covered by shade or shelter that protects pedestrians from direct sun.	Yes. The buildings overhang provides shelter along Adderley Street.	1	
2	8. There is room to walk comfortably on the walkways without feeling crowded.	Yes. There are dedicated walkways on both sides of Adderley Street. Due to the demand of pedestrians at certain times of the day, the space do feel crowded at times.	1	
2	9. The walkways and street are clean and free of trash.	Yes. CCID cleaners are observed.	1	5/5
3	10. You feel safe and comfortable in the walkway.	Yes. Conscious of the safety of my belongings.	1	
3	11. The area is lively and active. Other people are walking around on foot, and they are comfortable and relaxed.	Yes. Adderley Street is a busy street with a lot of activity. The activity along the street makes it feel safe and interesting.	1	
3	12. Most shops and buildings remain open in the evening.	No. All shops in the area are closed at night.	0	
3	13. The area is well lit, including at night.	Yes. The area is well lit but everything is closed from around 7:30pm onwards.	1	3/4
4	14. Cars approach the **intersection** slowly enough for an elderly person or young child to feel safe crossing the street. Table top crossings or speed bumps to slow down traffic when approaching unsignalised crosswalks where pedestrians continue at the same level.	The cars along Adderley Street travel slower due to the pedestrian activity along the street. Pedestrians cross the street whenever they feel comfortable to do so. The amount of pedestrians and activity along Adderley Street helps to make the cars drive slower.	1	
4	15. Pedestrians never have to cross more than two lanes of traffic at once. (Pedestrian bridges over roads do not count, as they increase the distance travelled and physical effort exerted by pedestrians.).	Yes. The pedestrians do not have to cross more than two lanes at a time. There is a median along Adderley Street for pedestrians to take a break while crossing the street.	1	
4	16. Corners are sharp enough to discourage cars from making fast turns.	Yes. The corners from the streets entering Adderley Street is sharp enough. At the intersections the crossing have bulb-outs to assist the pedestrians.	1	
4	17. kerbs are not more than 15cm high.	Yes.	1	
4	18. There are pedestrian ramps at every crossing so that people who use wheelchairs can cross the street.	Yes.	1	
4	19. If there are crossing signals, they are timed so that the pedestrian waiting time is always less than 40 seconds. Signals timed so that pedestrian waiting time is not excessive (i.e., generally less than 30 to 45 seconds).	Yes. Signal timings for pedestrians at the crossing facilities are timed to be less than 40 seconds.	1	

2/3	Question	Answer: Yes / No (Provide description / observations)		
4	20. Signals, if present, have a leading pedestrian interval.	No.	0	
4	21. There are safe crossings at least every 100m in dense areas and every 200m in all areas where there is continuous activity on both sides of the corridor. These safe crossings are aligned with key destinations and clear paths.	Yes.	1	7/8
5	22. The legal speed limit is below 30kph. Posted speed limits set to prioritise safety (e.g., below 30 kilometres per hour in dense urban centres).	No. Adderley Street and Strand Street speed limit are 60km/h. Both streets are class 3 minor arterials. The section of Adderley Street south of Strand Street is classified as a Class 4 collector road.	0	
5	23. Drivers rarely, if ever, go faster than the speed limit. Design that matches posted speed limits to prevent speeding and help with enforcement.	Yes. The design does encourage slower driving. There is also a lot of activity of pedestrians walking along Adderley Street which also reduces the speed at which the vehicles travel along Adderley Street.	1	
5	24. There are kerb bulb-outs, medians, raised crossings, or other traffic-calming features that reduce the speed of motor vehicles.	Yes. kerb bulb-outs and medians are provided.	1	
5	25. Traffic is not excessive on the street: fewer than 2,000 motor vehicles per day and fewer than 100 per hour.	No.	0	2/4
6	26. On-street parking is well managed and regulated. Payment is required, and rules are enforced.	No. The on-street parking is not well managed. The areas in front of the flower sellers and the vendors are used by them the whole day to park their vehicles.	0	
6	27. There is little off-street parking (including underground parking and parking facilities).	Yes.	1	
6	28. There are no cars parked illegally. Parking has a cost high enough to prevent illegal parking.	No. Vendors and the flower sellers park their vehicles in front of the trading areas the whole day.	0	1/3
7	29. There are comfortable public seats, like benches, intended for anyone to be able to sit and relax. Seats are available at intervals of 100m to 200m. (more info). Seating facilities. Do not count informal seating such as ledges or kerbs not specifically designed for sitting. UN guidelines suggest that a facility be provided at intervals of between 100 and 200 meters and that seating is	No. Seating is not provided.	0	
7	30. The street is well-lit throughout the night.	Yes, but everything closes from around 7:30pm.	1	
7	31. There are functioning, clean, and **affordable public toilets** open to all.	Yes. At the underground CCT facilities and at the Golden Acre Mall	1	
7	32. There are well-maintained **garbage and recycling bins**.	Not many. Garbage bins are not really observed along Adderley Street.	0	
7	33. Pedestrians have easy, **free access to drinkable water**.	Yes. At the underground public toilet facilities at the CCT facility and the Golden Acre Mall.	1	
7	34. There are **street vendors** who do not obstruct the walkable clear path. Presence of street vendors. Vendors include any non-permanent salesperson with wares on the sidewalk who contributes to the active nature of the area without obstructing the walkable path of the sidewalk.	Yes. The street vendors are well organised at one section of the road which provides space for pedestrians to use the remainder of the sidewalk.	1	4/6
8	35. The nearest transit station (rapid transit, frequent bus stop, etc.) is within walking distance (less than 500m). The nearest transit station (rapid transit, bus stop, etc.) is within walking distance (less than 1km).	Yes. The Railway Station Hub provides access to four different modes namely Rail, MBT, MyCiTi BRT and metered taxis.	1	
8	36. Within walking distance (less than 500m) there are different transit options that carry passengers to several destinations around the city. There are many different transit options that are within walking distance (1km).	Yes. The MyCiTi service has a bus stop along Adderley Street. There are also MBT taxis available along Adderley Street.	1	
8	37. Transit boarding is accessible and barrier-free for people of all ages and physical abilities. Transit stops have shelter and seating, and they are integrated with amenities like real-time transit information, cycle racks, public toilets, drinking fountains, and vendors or kiosks.	The only transit option that is barrier-free and provides amenities is the MyCiTi BRT. This is 1/4 transit options that provides this service. So for scoring purposes this will be scored No.	0	2/3
9	38. The street regularly closes to vehicle traffic, such as for a ciclovía, market day, play street, or school street. Toddlers can safely play in it during this time.	No. This street is not closed regularly.	0	

3/3	Question	Answer: Yes / No (Provide description / observations)		
9	39. There is a play structure, public art, or sculpture that toddlers and young children can interact with.	No.	0	
9	40. There are prominent, well-maintained street plants accessible to young children.	No. Mostly trees in this area.	0	
9	41. Transit stops are comfortable, with sheltered areas where a caregiver can sit and relax while waiting.	The only transit option that is comfortable with sheltered areas for a caregiver is the MyCiTi BRT. This is 1/4 transit options that provides this service. So for scoring purposes this will be scored No.	0	
9	42. On every block, there is an area where caregivers can pause to interact with babies.	No.	0	
9	43. Baby-changing tables are available in free public bathrooms on the street.	Yes. There is baby-changing tables available in the free public bathrooms at the CCT facilities.	1	1/6
S	**Lighting:** Availability of enough light to see all around you. None; Little; Enough; Bright	Yes well-lit. Everything closes during the night time.	1	
S	**Walk Path:** Either a pavement or road with space to walk. None; Poor; Fair; Good	Good.	1	
S	**Openness:** Ability to see and move in all directions. Not open; Partly Open; Mostly Open; Completely Open	Yes, completely open.	1	
S	**Visibility:** Vendors, shops, building entrances, window / balconies from where you can be seen. No Eyes; Few Eyes; More Eyes; Highly Visible	High visibility. Adderley Street is a high activity street which provides for a lot of eyes on the road.	1	
S	**Public Transport:** Availability of Public Transport like metro, buses, autos, rickshaws. Unavailable; Distant; Nearby; Very Close	Very close.	1	
S	**Security:** Presence of police or security guards. None; Minimal; Moderate; High	Moderate. CCID cleaners around.	1	
S	**People:** Number of people around you. Deserted; Few people; Some crowd; Crowded	Crowded.	1	
S	**Gender Usage:** Presence of women and children around you. Not Diverse; Somewhat Diverse; Fairly Diverse; Diverse	Diverse. Women, Men and Children.	1	
S	**Feeling Safe:** How safe do you feel. Frightening; Uncomfortable; Acceptable; Comfortable	Acceptable. Conscious of taking care of my belongings.	1	9/9
B	Bicycle Parking: Adequate provision; Easy use; Limit risk of damage; Provide chaining facilities; Protected from weather.	Yes. Bicycle parking spaces available in the median.	1	
B	Bicycle Lane: Exclusive path; Shared path; Continues facility; Position of tunnels / bridges; Avoid one-ways;	Yes. Took photo of cycling lane along the route. This facility is not well used. During the site visit a cyclist rather used the road than the cycling facility. The cycling facility is used by pedestrians. This should be looked at as a possibility to re-design the facility.	1	
B	Road Marking: Segregated traffic; Mixed traffic; Coloured pavements	Road marking across the road and a bicycle signal. Road markings need repainting / maintenance.	1	3/3

Appendix C – Design Process

Design Process (methodology)

ITDP and UN-Habitat (2018) summarise the design process in three steps and confirms the importance of public participation. Participation in the design should include local residents, businesses and other stakeholders in the planning and design of streets (ITDP, 2018). This can help to improve a community's active use and sense of ownership of the street as well as improving transparency between the local government and the users of the street (ITDP, 2018). To assist with a participatory approach, tactical urbanism can be used to encourage participation and test ideas. Tactical urbanism allows for temporary installations, like for example using plant boxes to demarcate the street improvements, to test new street designs before it is fully implemented (ITDP, 2018).

The three steps of the design sequence is set out below (ITDP, 2018):

Step 1: The designer draws the new centreline within an available right-of-way. Next, the space required for footpaths, cycle tracks and public transport is demarcated. It is important that the space provision for the walkways and cycle lanes do not fall below the minimum requirements.

Step 2: Once the centreline and overall kerb alignment are fixed, the positions of elements such as parking bays, trees and turning lanes can be determined.

Step 3: The completion of the detail design phase which includes the placement of street furniture and utility boxes.

A similar process was followed for the identified design cases and the overall design process is shown below.

Step 1: Investigate the three routes to the Cape Town Railway station by using the Pedestrians First Walkability tool. During the site visits, photographs were taken and observations were recorded on the audit sheet.

Step 2: Apply the Pedestrian First Walkability tool to the different sections of the routes. Once the scores are finalised, the areas which need improvement are clearly identified. These were generally sections that scored 50% or less.

Step 3: After analysing the results of the Pedestrian First Walkability tool, different cases for improvement were identified

Step 4: The available right-of-way is identified using the CCT City Map viewer which shows the building lines for each section of the routes. Next, the available guideline documents are consulted to assist with the development of design options. Once a design option is chosen, the space required for footpaths, cycle tracks and public transport is demarcated along the carriageway. Care was taken to ensure that the space provision for the walkways and cycle lanes did not fall below the minimum requirements.

Step 5: Once the centreline and overall kerb alignment are fixed, the positions of elements such as parking bays, trees and turning lanes can be determined.

Step 6: The completion of the detail design phase which includes the placement of street furniture and utility boxes.

This study did not include public participation, but the author recognises that this step is crucial.

Appendix D – Alternative Design Proposals

Appendix D – Alternative Designs

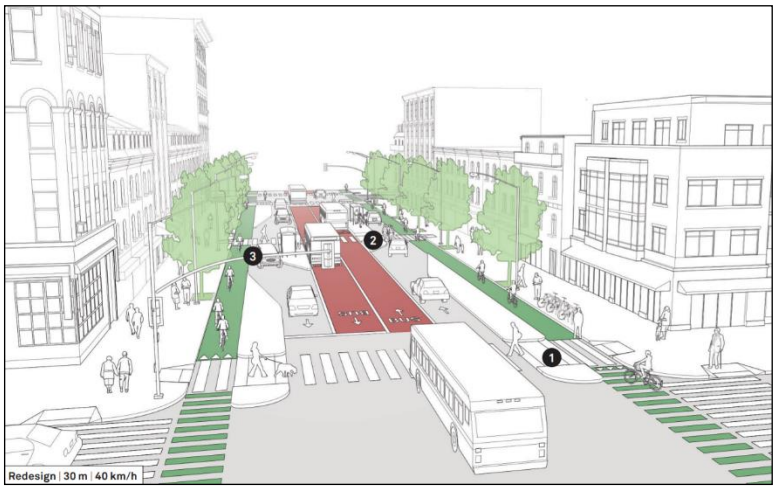

Figure: Alternative cross section for Adderley Street with bus-only lanes in the middle of the cross section. (GDCI, p.263).

Although the preferred design proposal for Adderley Street is as discussed in Section 6.2.1, there are more options that can be tested. Design of streets can have more than one solution and the usage and objectives of the street need to be understood to ensure the best design is applied. The **Figure** shows a possible cross section that can be applied to Adderley Street. This could be a future cross section that can be adjusted when buses use the street more frequently.

Other options for Adderley Street includes a transit mall where only public transport vehicles and NMT users can use the street.

Appendix E – Ethics Clearance

EBE Faculty: Assessment of Ethics in Research Projects

Any person planning to undertake research in the Faculty of Engineering and the Built Environment at the University of Cape Town is required to complete this form before collecting or analysing data. When completed it should be submitted to the supervisor (where applicable) and from there to the Head of Department. If any of the questions below have been answered YES, and the applicant is NOT a fourth year student, the Head should forward this form for approval by the Faculty EIR committee: submit to Ms Zulpha Geyer (Zulpha.Geyer@uct.ac.za; Chem Eng Building, Ph 021 650 4791). Students must include a copy of the completed form with the thesis when it is submitted for examination.

Name of Principal Researcher/Student: MARLI SWART Department: CIVIL ENGINEERING

If a Student: Degree: M. Eng (Transport Studies) Supervisor: A/Prof M Vanderschuren

If a Research Contract indicate source of funding/sponsorship: N/A

Research Project Title: INTEGRATED DESIGN PRINCIPLES AT A TRANSIT ORIENTED NODE

Overview of ethics issues in your research project:

Question 1: Is there a possibility that your research could cause harm to a third party (i.e. a person not involved in your project)?	YES	(NO)
Question 2: Is your research making use of human subjects as sources of data? If your answer is YES, please complete Addendum 2.	YES	(NO)
Question 3: Does your research involve the participation of or provision of services to communities? If your answer is YES, please complete Addendum 3.	YES	(NO)
Question 4: If your research is sponsored, is there any potential for conflicts of interest? If your answer is YES, please complete Addendum 4.	YES	(NO)

If you have answered YES to any of the above questions, please append a copy of your research proposal, as well as any interview schedules or questionnaires (Addendum 1) and please complete further addenda as appropriate.

I hereby undertake to carry out my research in such a way that

- there is no apparent legal objection to the nature or the method of research; and
- the research will not compromise staff or students or the other responsibilities of the University;
- the stated objective will be achieved, and the findings will have a high degree of validity;
- limitations and alternative interpretations will be considered;
- the findings could be subject to peer review and publicly available; and
- I will comply with the conventions of copyright and avoid any practice that would constitute plagiarism.

Signed by: MARLI SWART

	Full name and signature	Date
Principal Researcher/Student:	MARLI SWART	25-02-2014

This application is approved by:

Supervisor (if applicable):		25/2/14
HOD (or delegated nominee): Final authority for all assessments with NO to all questions and for all undergraduate research.		14/3/14
Chair : Faculty EIR Committee For applicants other than undergraduate students who have answered YES to any of the above questions.		