Share the Road:

Design Guidelines for Non Motorised Transport in Africa

UNEP

FIA Foundation for the Automobile and Society

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Acknowledgments

Authors

UNEP Transport Unit: Regina Orvañanos Murguía

Reviewers

UNEP Transport Unit: Jane Akumu, Liana Vetch and Annemarie Kinyanjui

Goudappel: Tonny Bosch

Language edition: Margie Rynn

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Acronyms

ADT	Average Daily Traffic
BCR	Benefit Cost Ratio
BOP	Bottom of the Pyramid
BRT	Bus Rapid Transit
CBD	Central Business District
GDP	Gross Domestic Product
GEF	Global Environment Facility
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit now Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) (German Society for International Cooperation)
ITDP	Institute for Transportation and Development Policy
KfW	Kreditanstalt für Wiederaufbau (German Reconstruction Credit Institute)
Km/h	Kilometres per Hour
MV	Motorised Vehicle
NM	Non Motorised
NMT	Non Motorised Transport
NRSA	National Road Safety Authority
PABIN	Pan African Bicycle Network
ROW	Right of Way
SSATP	Sub-Saharan Africa Transport Programme
StR	Share the Road
UN	United Nations
UNEP	United Nations Environment Programme
USA	United States of America
WB	World Bank

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Introduction

"Share the Road", a UNEP initiative developed in partnership with the FIA Foundation for the Automobile and Society, brings together environmental and safety agendas in the context of urban transport in the developing world. In developing countries, the majority of people are Non Motorised Transport (NMT) Users, and are disadvantaged on road systems designed with motor vehicles in mind. The overall goal of Share the Road is to catalyse policies in governments and donor agencies for systematic investments in walking and cycling road infrastructure, linked with public transport systems.

The three pillars of the Share the Road programme are environment, safety and accessibility. Investing in road infrastructure for walking and cycling generates massive benefits for all three of these fundamental concerns, as it reduces air pollution and greenhouse gas emissions, protects vulnerable road users from high-speed motor traffic, and increases affordable access to vital services and employment.

Walking and cycling as modes of transport can be seen as carbon mitigation measures/contributors; supporting carbon mitigation through enhanced NMT is both a question of improving safety and utility of infrastructure for current users, as well as promoting these modes among people currently using public transport or private motors vehicles. Share the Road has selected East Africa as the first region where it will implement showcase interventions to test on the ground. Conditions for walking and cycling in African cities can be improved through comprehensive facilities design and countering situations such as lack of access and the risk of severe accidents on the roads. UNEP will continue to encourage interventions that improve conditions for NMT users, both in existing countries of programme implementation, and looking ahead at programme expansion.

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1 Share the Road: Policy for Walking and Cycling

We are all pedestrians. Every single trip, even those in private vehicles, and especially those in public transport, start and end with walking. At some point in the day, we walk. Policies need to reflect this reality ensuring that investments in road infrastructure for walking and cycling can generate massive environmental, safety and accessibility benefits.

Pedestrians and cyclists using a ferry © Regina Orvañanos

Travelling is about moving people from one activity or place to another, from an origin to destination. The social and economic value of a trip is not only dependent on the distance travelled, but also must be assessed in terms of the quality of the activity that can be undertaken as a result of a trip*[1].The economics of pedestrian facilities encompasses user costs incurred by travel delays and inconvenience, as well as commercial values and retail development influenced by pedestrian accessibility*[2]. Accessibility is essentially a quality of locations. The quality of the accessibility of a certain location is inversely proportional to the amount of time, money and effort that it takes from users to travel from their origin to the location (and back) for the purpose of their activities at that location*[3].

The African context

Unlike other regions of the world, conditions in African countries are particularly favourable for implementing NMT policies. While policies in many Western countries are focused in increasing the share of non-motorised trips, African cities already have a substantial proportion of their residents moving in a sustainable way.

Africa's population represents the thirteen per cent of the world's total inhabitants and continues to grow. The continent's annual growth rate is 2.7 per cent, the world's highest. Faced with the challenges of urban mobility, African cities have experienced a rapid motorisation rate, resulting in chronic traffic congestion and extremely high levels of local pollution. Nevertheless, the overwhelming majority of urban inhabitants rely on non-motorised modes of transport for their everyday mobility. Preventing current NMT users from shifting to private motorised vehicles is essential. At the same time, NMT's attractiveness and safety provisions must be enhanced in order to ensure that it remains an effective transport mode in the years to come.

Nowhere else in the world will more roads be built, expanded and tarmacked in the coming decades than in Africa*[4]. Investing in non-motorised mobility throughout this rapid urbanisation process presents an opportunity for the region to leapfrog into sustainable, safe and healthy urban mobility.

The objectives of a NMT policy

- Increase the recognition of NMT facilities as a key elements in every city;
- Integrate NMT as an essential element of public transport and urban mobility;
- Improve safety, attractiveness and convenience of sustainable modes of transport;
- Promote cleaner, healthier, more inclusive and more sustainable mobility infrastructure; and
- Increase urban accessibility.

How to use these guidelines

These guidelines have been developed as a menu of interventions to guide policy makers and local authorities in planning, designing and realizing NMT facilities. Their objective is to increase the capacity of engineers, designers, planners and others involved in urban construction to create safe, intermodal urban transport systems. Providing urban planners and transport engineers with design recommendations that are appropriate for the African continent in facilitating the promotion of walking and cycling in cities. The guidelines' recommendations supplement, rather than replace, any existing detailed engineering guidance and do not supersede any existing law, rule or regulation. Nevertheless, many of the proposed interventions may benefit from a change of policy at the national or local level. Policy changes can introduce new concepts into urban planning, such as recognising bicycles as vehicles and giving them legal support as a transport mode. Increased recognition of NMT as a key transport mode in African cities ought to be reflected both in the built environment, as well as institutional arrangements.

The introductory chapter explains the motivations, policies and objectives of promoting walking and cycling. It is followed by three thematic sections: pedestrian facilities, cycling infrastructure and modifications to road space. These sections are followed by an overview of the interface between non-motorised transport and other transport modes. Finally, the last chapter describes the importance of social infrastructure and suggest further steps to promote, implement and advocate for NMT, offering recommendations drawn from case studies in Africa. Throughout the text, a variety of case studies are presented in highlighted boxes, while key messages are displayed as "Share the Road Key Recommendations".

Box 1: NMT Policies in Kenya

In Kenya, as in many rapidly-developing countries, there is a direct correlation between GDP per capita and private car modal share: as GDP per capita rises, so does the use of motorised vehicles. To prevent this trend from continuing, it will be necessary to change transport policies and make sound investments in NMT facilities. The Kenyan Urban Roads Authority (KURA) has adopted a policy that systematically integrates NMT facilities on all new urban roads, and requires projects to conduct NMT safety audits. To advance this goal, Share the Road supports cooperation with multilateral development banks, bilateral development agencies and government agencies to encourage policies and projects that allocate a portion of transport infrastructure investment for pedestrian and cycling facilities.

Basic principles of design

African cities are experiencing the world's fastest growth rate. This fact poses a huge challenge in terms of providing adequate urban infrastructure to meet increased mobility demand. Starting with the early planning stages, new urban extensions must follow an accessibility paradigm and be connected with NMT infrastructure. Policies for walking and cycling should incorporate five basic principles regarding trips: they should be direct, coherent, comfortable, safe and enjoyable.

Pedestrian facilities are a basic component of every neighbourhood or urban area. Any transport infrastructure should respect the hierarchy of modes: pedestrians have priority over bicycles, which have priority over public transport, which in turn has priority over private motorised vehicles. Any alteration to existent infrastructure should be undertaken with the objective of reducing space for cars and should never encroach on space designated for pedestrians.

There are two levels of design: the network level and the facility level. The network level refers to the connection between the main origin and destinations within the city, while the facility level relates to the design of road sections, intersections and road surface. NMT infrastructure should be part of a coherent, city-wide network that is integrated into the public transport system. Even when public transport is used, walking will be involved in the first and last section of the trip. The provision of NMT infrastructure should therefore follow three principles: universal accessibility, complete streets and incremental learning.

Share the Road Key Recommendation 1:

Integrate NMT networks with other transport modes, especially public transport, in order to maximise usage and impact. Walking and cycling are best suited for short trips of less than 30min, for distances of 3 km to 15 km respectively.

a) Principle of universal accessibility

Universal accessibility refers to the adaptability of urban infrastructure and facilities to the widest range of potential users, including people with mobility and visual impairments, the elderly, people in wheelchairs, people walking with small children, pregnant women, and people carrying heavy loads such as water or firewood. The principle of universal accessibility stipulates that urban spaces are suitable for 8-years-olds as well as 80-year-olds; if spaces are adapted for the most vulnerable users, then they will be suitable for everybody. Universal accessibility promotes wider social inclusion and invites everybody to profit from the urban experience.

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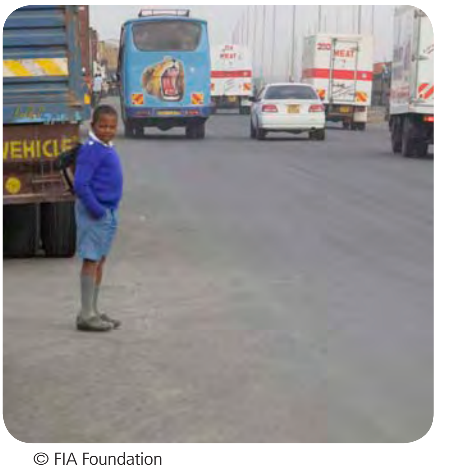

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Box 2: Uganda NMT National Policy

The Government of Uganda has agreed to a national policy for improving non-motorised travel within the country. The policy was developed after a comprehensive situation analysis assessed the current state of NMT in both rural and urban settings. With the support of UNEP's Share the Road programme, the policy recommendations were designed to increase awareness of walking and cycling in transport planning, as well as supporting effective design and infrastructure provision at a national level.

The policy recognizes walking and bicycling as non-polluting, sustainable, environmentally friendly and healthy transport options, and the promotion of these modes is part of its environmental policy. The strategy also acknowledges the importance of using universal accessibility principles for all new and refurbished transport infrastructures and requires all urban road designs to include a non-motorised transport statement explaining how the needs of pedestrians and cyclists have been incorporated. Finally, it recommends the establishment a National Road Safety Authority (NRSA) responsible for road safety, management and coordination.

b) Principle of complete streets

A complete street is the one that is designed from edge to edge of the buildings. Complete streets incorporate infrastructure for walking and cycling, including signage, ramps and other facilities for the physically challenged. They also include urban furniture like covered bus stops, street lamps, trees and vegetation according to the context and infrastructure for rain harvesting. Complete roads promote safety for all users, and incorporate all of the principles of universal accessibility. Certain street components are non-negotiable and should be present in any street. Building complete streets that have adequate provisions for all modes and functions is a basic principle for building pedestrian facilities. A complete street is welcoming to pedestrians, bicycles, wheelchairs and motorised vehicles. Besides adequate sidewalks and cycling facilities, they incorporate urban furniture, signage and street lighting into their design.

c) Principle of incremental learning

Each city is unique, and so are its inhabitants. While some urban solutions have a great degree of replicability in different cities, others need to be carefully tested on the ground. Some measures, such as cycleways and intermodal transport stations are new infrastructure elements, both for engineers as well as users. Pilot projects provide excellent opportunities to learn-by-doing while experiences from other regions are being taken into consideration. Documenting these pilot project experiences will facilitate the learning process.

Box 3: NMT Policies in China

After having banned bicycles from certain city-centre roads, the Chinese government made a policy U-turn in favour of urban non-motorised transport. In 2006, the government ordered cities that had narrowed or removed bike lanes to restore them. Today, cities like Huangzhou, Beijing and Shanghai are examples of large cities that have moved away from car-centric urban models*[5].

Range and limits of NMT trips

The share of walking trips in sub-Saharan Africa is higher than in any other region of the world, particularly in smaller urban centres. Pedestrian and cycling facilities can enhance this form of sustainable mobility, making it comfortable and safe. However, adequate connections must be provided so that intermodal trips can span longer travel distances.

The average speed of a walking trip varies between 3.5 to 5km/h, depending on walkway conditions and age. A normal walking trip of 3km takes 40min to walk. Likewise, the average cycling trip depends on road conditions and interruptions that break its continuity; a cyclist's speed can vary between 10 and 30km/h. In general, a daily trip from home to work is less than15km; trips beyond that distance are not considered representative for planning a cycling network.

Small and medium-sized cities have more optimal dimensions for walking and biking trips as a primary transport mode. The larger the city is, the more emphasis needs to be placed on integrating intermodal transport systems. There must be continuity in sidewalks and cycle lanes so that an actual network is created, a key factor in making NMT a viable mobility option. Transport infrastructure should allow young children, the elderly and disabled to move about the city and cross intersections without risk.

For trips longer than 6km, special attention should be paid to intermodal trips, which require adequate connections between public transport, cycling and walking. This type of intermodal trip should be supported with long-term parking places at bus, taxi or Bus Rapid Transport (BRT) stations. When integrated with a public transport system, the bicycle requires a catchment area that is much larger than that for pedestrians. The bicycle can partially replace the function of a feeder system when safe and convenient parking places are provided at stations. Walking and cycling networks should connect residences to the work place within each mode's catchment area.

Conditions for implementing NMT

There are several urban conditions that can facilitate non-motorised travel. Slowing traffic can allow bicycles to be incorporated into general traffic, while space for NMT can be gained by reducing road space from motor vehicles. In the end, however, pedestrian and cycling interventions will only be successful if they are combined with the attractive and compact use of the urban landscape.

A pedestrian hit by a car at 64.4km/h has an 85 per cent chance of being killed; at 48.3km/h the likelihood goes down to 45 per cent, while at 32.2km/h the fatality rate is only 5 per cent*6.

a) Speed reduction

Traffic calming measures have been applied in the past decades in several countries around the world as a way of increasing safety for pedestrians, cyclists, and other road users. Moreover, there are multiple side-benefits of calming traffic, including improved general environmental conditions. Other benefits may include the creation of more open green spaces for pedestrians and cyclists.

The effectiveness of speed reduction depends on how it is integrated into the broader transport strategy. Aiming for an improved redistribution of transit modes that favour NMT and public transport, that strategy should also establish a road hierarchy that discourages through traffic on smaller streets and promotes lower speeds where there is a high concentration of pedestrians. Slowing traffic can also permit bicycles to be incorporated into general traffic, therefore reducing the need for segregated infrastructure.

b) Space allocation

Improving conditions for NMT requires reallocating space for its use and enjoyment. Using valuable urban space for walking and cycling improvements can be a cost-effective investment, as urban dwellers that take NMT on a daily basis can make more efficient use of that space.

c) Urban use of land

A compact city optimises urban mobility and can reduce the need for motorized travel. As urban transport services become more accessible, this phenomenon becomes even more pronounced. Land use policy that promotes mixed and dense urban environments can enhance commerce and economic activity, and make walking an attractive option. Compact cities also optimise infrastructure investments by reducing the need for roads. For lasting and sustainable urban transport, systems must be planned in concert with a clear urban development strategy and land use plan.

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NMT network planning

A city-wide NMT network can not only lower household transport expenditures but also increase travel range, productivity and accessibility to urban services. In other words, the benefits of non-motorised transport are exponentially multiplied when a city-wide network is envisioned.

A good NMT network:

- Builds upon a complete network plan;
- Provides direct routes to main destination points;
- Avoids conflicts with crossing traffic;
- Prevents the creation of urban barriers; and
- Reduces vehicle volumes and speeds in places with a high concentration of pedestrians.

Neighbourhood areas with calmed traffic are also known as "Zone 30" referring to the speed limit of 30km/h. Zone 30 areas have been extremely successful in reducing accidents. For example, in London casualties were reduced by 45 per cent and fatal and serious casualties by 57 per cent after the introduction of 32km/h zones*[7]. Traffic calming is not meant to exclude through traffic, but rather to moderate driving behaviour.

While new city expansions may benefit from incorporating NMT facilities from the start, retrofitting existing urban areas can be a more difficult process. Some of the best places to start improving the network are routes linking residential areas with commercial zones or study centres. Industrial areas can potentially attract large numbers of pedestrians and bike users, while slum areas originate the vast majority of walking trips. Many cities have established "safe routes to school programmes" which involve improving pedestrian facilities surrounding elementary schools and intensifying enforcement and traffic education along these corridors.

Box 4: Kigali Urban Growth

The urban population of Africa is set to triple in the next 40 years*[8]. Kigali, the capital of Rwanda is one of the fastest growing cities in East Africa with a 5.45% growth rate due to an intense rural-urban migration. Only 50% of the city area is buildable due to topographic conditions: 35% of its territory are slopes greater than 20%, 14% are wetland areas and forest outside slopes and wetlands comprise for the 1%. The future strategy for the city of Kigali to absorb such increase in population, is to structured new urban growth into walk-able mixed-use urban and neighbourhood centres with a high density core. Pedestrian oriented urban centres are to be located on tops of hills, and less density areas on steeper slopes. Efficient living patterns where basic services, markets and education centres are located within walking distances will reduce the reliance on expensive transportation modes to meet basic needs. Share the Road pilot project in Kigali will test innovative street design principles within the Central Business District.

a) Methodology

The methodological process comprises two steps: 1) planning the city-wide NMT network, and 2) prioritising the areas of intervention.

"Eighteen bikes can be parked in the space of one car, and 30 of them can move along in the space devoured by a single automobile"*[9].

For planning the city-wide NMT network, it is advisable to create a starting point by mapping the existing pedestrian layer of the city. The next step requires improving the efficiency and safety of the pedestrian route network by adjusting the distribution of activities over the urban area in line with the accessibility principle. The final step is to fill in the roles of the other modes of transport one by one, according to the hierarchy of modes: bicycle, walking, public transport, and private car*[10].

To select locations for improvement, we recommend the overlapping priorities method*[11]. This method consists of 1) defining a prioritised list of criteria, 2) using the selected criteria to evaluate potential sites, and 3) creating a prioritised list of sites for NMT improvements.

b) Criteria for selecting priorities

Below is a list of suggested criteria for establishing priorities. The methodology recommends selecting three or more:

- Speed: high speed facilities may rank higher in priority;
- Street hierarchy: arterial streets should take precedence because they have higher pedestrian use;
- Crash data: focus on locations where pedestrian accidents are recurrent;
- School walking zones: areas in a residential zone that surround an elementary school.
Children are especially vulnerable road users;
- Public transport routes: public transport users need sidewalks to access stops;
- Neighbourhoods with low vehicle ownership: in slums and low income neighbourhoods people walk and use bicycles as their primary mode of transport;
- Urban centres and commercial areas: commercial areas attract a high number of pedestrians
- Pedestrian generators: hospitals, factories, community centres, and public facilities generate pedestrian trips;
- Missing links: connecting pedestrian areas to each other creates continuous walking systems.

c) Application of criteria

One approach to indentifying priority areas is through graphical spatial representation. The aim of this method is to easily identify locations that meet multiple criteria over a map. The process starts by assigning a colour to each of the selected criteria, then identifying the areas with the highest levels of selected criteria on a map. Some of these areas might be a 2km band around school areas or public transport stops, roads with a high number of accidents, or arterial roads with high speeds. This visual representation makes it easy to identify priority areas and plan for required improvements.

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Box 5: NMT in Informal Settlements

UN-Habitat launched a programme for promoting NMT in informal settlements in Kenya. The policy is part of a slum upgrading programme and it focuses on the delivery of services like water, sanitation and waste management in an efficient and sustainable way. The promotion of NMT has also proven to be a tool for generating new revenue and business opportunities in low-income communities. The project has been implemented in three informal settlements in Kenya: Kibera, Mirera-Karagita and Kamere. Among the project's activities is a utility bicycle workshop that has been set up for design, production and sale of NMT load-carrying vehicles*[12].

Share the Road Key Recommendation 2:

Medinas and slums have the advantage of being car-free areas. While ensuring access to urban services, the car-free neighbourhood model should be preserved.

Showcase projects

Showcase projects are helpful in testing people's response to improved cycling infrastructure. They can also demonstrate the benefits of NMT facilities to stakeholders and potential users. Showcase projects should be carefully selected for areas where there is an existing demand and high visibility. They should be incorporated into a city-wide network plan and accompanied by promotional and educational campaigns.

The desirable conditions for selecting showcase projects are:

- Existing high demand;
- Possibility of integration with public transport nodes;
- Availability of urban space;
- Active involvement of stakeholders;
- Optimum topographic conditions (e.g. flat paths);
- A high rate of accidents and road insecurity for pedestrians and cyclists, who would be likely to experience major improvements.

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a) Kenya

Nairobi, Kenya: Nairobi was the first pilot country for "Share the Road". A showcase road has been constructed that was entirely financed by the government. The adaptation of the 1.70km UN Avenue included the construction of a three-metre wide sidewalk on both sides, and a three-metre two-way segregated cycle lane. The rehabilitation also included redesigning the intersection into Limuru road, adding a slip-turn lane with a corner island to facilitate pedestrian crossing. The bus stop was relocated a few meters to avoid conflict with turning vehicles. The road was selected because there were recurrent severe accidents over a short period of time, which highlighted the need to improve road conditions. The rehabilitation work is almost completed.

b) Rwanda

Kigali, Rwanda: A pilot project for Kigali will show the application of "streetscape" principles that incorporate pedestrian and greenway systems in to other elements of sustainable urbanism. The demonstration project will take place along 1.5km of Rue de la Revolution between Kigali Institute of Science and Technology, Serena and the Centreville Roundabout. The pilot project built on previous designs for this stretch that had not yet been implemented. One of the design concepts is the result of a partnership between Kigali institute of Science and Technology and the city of Kigali, setting the stage for positive collaboration.

c) Uganda

Kampala, Uganda: In Kampala, a main commercial corridor in the central business district has been selected for a pilot project (Namirembe road and Luwum Street). The road has been divided in three sections to test different road typologies: the first section encompasses two moving car lanes along with a buffered cycle lane; the second section is a pedestrianised street with a cycle lane in the centre; and the last section is a shared road with a calmed one-way street with parallel parking on both sides. The project incorporates a plan to reorganise two taxi (minibus) parks, as well as a proposed BRT corridor running transversal to the pilot street.

d) Burundi

Bujumbura City, Burundi: Bujumbura is Share the Road's fourth pilot city. The first steps have included an awareness-raising workshop to sensitize stakeholders to the issues and to develop an action plan. The approved action plan includes targets and a detailed timeline for developing and adopting an NMT policy.


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2 Improving Pedestrian Facilities

Pedestrian facilities refer to any infrastructure built to enhance the ease of pedestrian travel, including sidewalks and crosswalks. A more extensive definition encompasses walkways; trails; kerb ramps; as well as pedestrian-friendly urban furniture such as benches, urban trees and streetscapes. To improve urban pedestrian facilities, existing infrastructure must be retrofitted. The key to improving walking conditions is to manage pedestrian flows so they are appropriately isolated from vehicles. Pedestrian facilities come in a variety of forms, including, off-street footpaths, connector pathways, sidewalks and road shoulders.

Priority NMT areas

Areas with high-intensity pedestrian activity are often priority zones for improving "walkability". These areas are typically public transport nodes, commercial areas and educational centres. Typical priority areas for improving pedestrian facilities include:

- Urban centres with high-volume commercial activity;
- Public transport stations;
- Neighbourhood markets;
- Slum area environs and access routes;
- Primary schools, secondary schools and universities;
- Public service facilities (hospitals, markets, public offices, city hall); and
- Recreational hubs like parks and green corridors.

Obstacles to walking

Urban mobility can be improved significantly by eliminating obstacles to walking. Common obstacles include: loss or inexistence of sidewalks, open drains, posts, urban furniture and other sidewalk obstructions; tree roots causing breaks in the pavement; dense vegetation covering footpaths; potholes; unprotected culverts; misplaced drains; and accumulated garbage or runoff; as well as street vendors, shopkeepers, cars and motorcycles encroaching public space designated for pedestrians.

Urban barriers are larger obstacles that prevent communication and continuity and impede non-motorised trips. Obstacles and urban barriers can make trips much slower, unsafe, or even impossible, and consequently discourage potential users.

Box 6: Mobility Rate

Many cities in Africa have low trip rates. A rate of less than two trips per day indicates significant suppressed travel demand. People cannot afford to make trips due to lack of money or time (to walk a long distance),[*13] and become obliged to use non-motorised modes. Low mobility particularly affects residents of cities' informal settlements, where lack of planning and investment means roads are either non-existent or become flooded and unusable in wet weather[*14].

Mobility rates are tied to a variety of factors including culture and urban form. While cities like Ouagadougou in Burkina Faso have a trip rate of 3.7 per person over thirteen years old, Bamako, Mali has a rate of only 2.8[*15]. Even though this rate is less than Ouagadougou's, Bamako has a higher mobility rate than the average large African city. Bamako's inhabitants are more mobile than those of Abidjan, for example, even though their purchasing power is inferior[*16].

Share the Road Key Recommendation 3:

Neighbourhoods outside central business districts can enhance their economies considerably by increasing the efficiency and speed of pedestrian trips[*17].

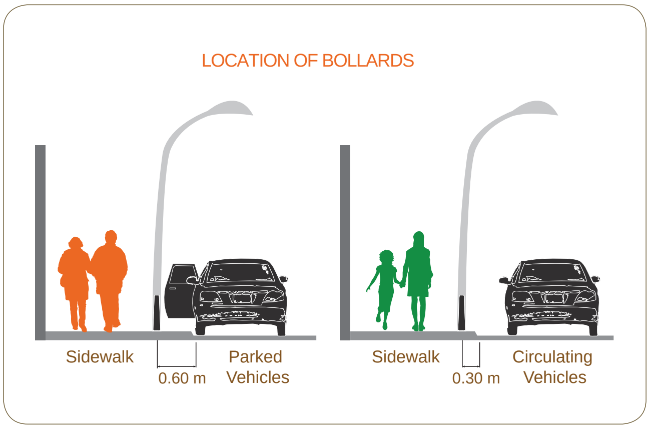
Box 7: Walking Audits and Walkability Index

A walking audit is a formal process that identifies hazards that increase the risk of traffic-related accidents involving pedestrians. In many countries, local authorities and community organisations carry out pedestrian audits to improve local facilities for walkers[*18]. The methodology consists of a field survey to measure pedestrian infrastructure in residential, educational, commercial and public transport terminal areas. The results are then recorded in a walkability index, an indicator developed by the World Bank to identify specific actions that cities can take to improve their pedestrian infrastructure. It measures the availability of walking paths and crossings, the existence of conflicts with other transport modes, safety and security, obstruction, amenities, disabilities infrastructure, user behaviour, etc. The Clean Air Initiative Asia organization has been a strong supporter of walkability measurements and has adapted these methodologies for Asian cities[*19].

The most common urban barriers include:

- Urban highways or high-speed/high-volume roads, which often divide cities into disconnected sectors. Overpasses and freeways make non-motorised trips particularly difficult, creating impassable barriers for pedestrians and cyclists.
- Rivers, streams and channels. In general, bodies of water can pose barriers to urban mobility. Even when bridges are present, they are often conceived exclusively for motorised transport.
- Mountains and cliffs. Steep topography can be an obstacle as it makes routes difficult, unappealing and sometimes impossible for non-motorised transport.

A simple diagnostic tool is to create a list of urban barriers, and mark them on a city map. With this visual aid, policy makers can start to envision strategic solutions. Removing urban barriers is often more cost-effective than other forms of pedestrian-friendly infrastructure.



A survey in Bamako, Mali showed that one of the social benefits of walking is travelling in a group, something that is less likely to happen when travelling by bicycle*[20].

Footpaths

Footpaths are pedestrian walkways not associated with roads. A large part of urban pedestrian travel occurs along tracks that are not part of the official road system. If ignored these tracks may disappear as urban density increases*[21]. Protecting and upgrading these pathways has proven to be very beneficial for pedestrians.

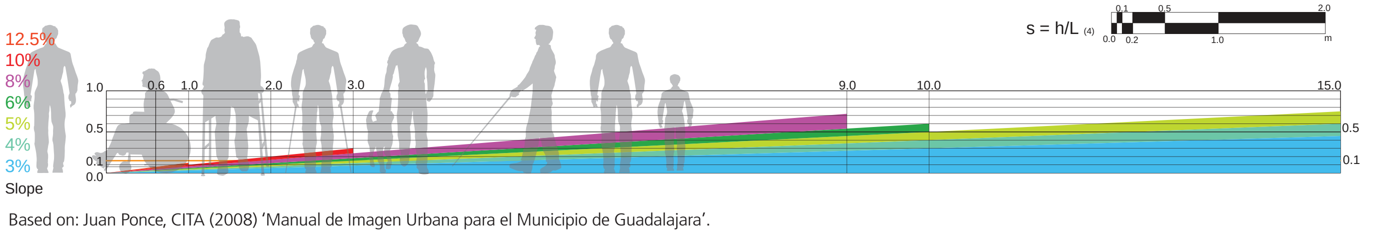
Share the Road Key Recommendation 4:

In order to preserve off-road footpaths, land reserves must be officially established and enforced by municipalities.

Similar to sidewalks, footpath width varies according to the number of users. As a general guideline, in pedestrian-only zones, secondary walkways should be 2 to 3 metres wide, while primary walkways can be anywhere from 3 to 6 metres wide.

Considerations: Two types of slopes affect footpath design: cross slopes and running slopes. Cross slopes are perpendicular to the direction of travel. To facilitate natural drainage, footpaths should have a cross slope of at least 2% but not greater than 4%. Running slopes are parallel to the direction of travel. On extended slopes, the maximum running inclination should be 8%, with a landing of at least 1.50m every 9 metres. The following graph shows the maximum slope in relation to the distance and rise covered.

Benefits: In hilly locations, building footpaths along topographic curves can ease the ascent and prevent soil erosion. Placing blocks of soil-retaining vegetation along the footpath can lessen topsoil runoff and hereby provide environmental value.



Based on: Juan Ponce, CITA (2008) 'Manual de Imagen Urbana para el Municipio de Guadalajara'.

Widened shoulder pathway

Application: The road shoulder is the most common pedestrian facility immediately adjacent to the roadway. When equipped with appropriate safety provisions and width, the shoulder can serve the same purpose as a sidewalk, particularly in rural areas.

Considerations: If the width of the shoulder is not sufficient for the number of pedestrians, it can become dangerous, especially when heavy vehicles are circulating at high speed, or when vehicles use the shoulder due to poor road conditions. While the minimum recommended standard for shoulders is 1.20m, it should be wider close to commercial centres and areas with dense concentrations of people, where ideally it should be replaced by a sidewalk.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Sidewalks

Sidewalks or footways are necessary on all roads, except on some sections of highways where there is no pedestrian traffic. Space for sidewalks can be obtained by reducing the number and/or width of carriageway lanes, which will also serve as a traffic-calming measure.

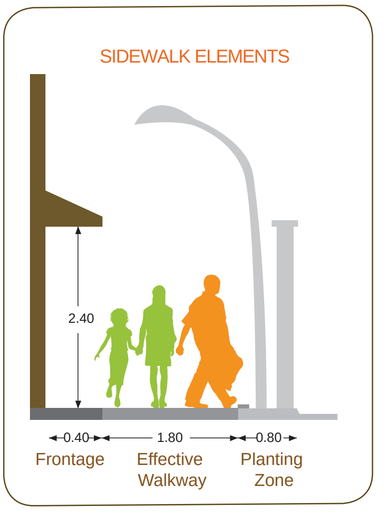
Sidewalks are composed of three elements: frontage or death width (the area adjacent to construction), effective walkway (obstacle-free area), and planting area (zone for trees, urban furniture and any other road uses).

a) Frontage

Frontage is a variable area whose width depends on the surrounding urban environment and the intensity of activity. Since pedestrians will not walk too close to a wall, this area becomes a "death width". A minimum frontage width of 0.30-0.50m must be observed when sidewalks are adjacent to a fence or a building, while in commercial areas, the death width should be at least 1.00m. This will prevent shoppers and window watchers from obstructing passers-by. Extended frontages can also act as designated areas for café tables or merchandise display.

b) Effective walkway

The effective walkway is the area that is actually used for walking. It must be continuous in order to connect different walking areas and free of any obstacle, both horizontally and vertically. A zone 2.40m high and 1.80m wide should be free from any obstruction. No utility boxes, posts, boxes, trees, signage or other urban furniture should be in this area; these types of installations should be placed in the planting zone.



c) Planting zone

The planting zone is a buffer area used for landscaping purposes that is also a protective area separating cars and pedestrians. The ideal width of a planting zone is 1.80m; enough to accommodate space for urban vegetation. If not used as landscape element, this buffer zone should still be used to protect pedestrians. Open drains between sidewalks and carriageway can also serve as buffer areas, providing that crossing zones are included where necessary. The minimum buffer widths are:

Type of street	Buffer width
Local or collector streets	0.60 to 1.20m
Arterial or major streets	1.20 to 1.80m

Parts of the planting zone can be designated for street commerce, a policy that can help prevent vendors from encroaching on the effective walkway. Street commerce should be regulated so that certain public health requirements are met. In countries like India where there are many street vendors, its national street vendor policy, for example, recommends the establishment of designated zones every 500-1000m on public streets. The policy also requires provisions for waste water disposal, public toilets, aesthetic design of mobile/push carts, provision of electricity and drinking water, protective elements from the elements, and storage facilities*[22].

d) Sidewalk width

Sidewalk width should be suited to expected or existent needs. For two pedestrians to pass each other comfortably, each one requires a space of at least 0.80m wide. Standards for sidewalk width vary from country to country. While the standard width recommendation is 1.80m, in residential areas the minimum width should be 1.50m. Where there is no planting zone and the walkway is adjacent to the kerb, the minimum sidewalk width should be 2.10m. For commercial areas, sidewalk width should be at least 2.40m.

When bollards or posts are located in the sidewalk area to protect pedestrians from cars, the effective walkway width must be measured from the inner border of the bollard. When there is not enough room, covering drainage can be an effective way of gaining space for sidewalks.

Capacity in persons in one hour		Required width of footpath in metres
All in one direction	In both directions	
1220	800	1.50m
2400	1600	2.00m
3600	2400	2.50m
4800	3200	3.00m
6000	400	4.00m

Based on: CSE (2009) Footfalls: Obstacle Course to Livable Cities

Crossing facilities

Crossing the road without proper facilities is one of the biggest dangers for pedestrians. The speed difference between cars and pedestrians makes the latter very vulnerable and highly prone to fatal accidents, particularly when they are children or the elderly.

Application: Designated crossings should be placed in safe and appropriate locations, and at regular intervals. Crossing design requires site-specific and detailed investigation so that they are properly integrated into footpath improvements and barrier installation, which will in turn encourage their use. The elements of safe and accessible crossings include[*23]:

- Identification of good crossing locations;
- Reduction of crossing distances;
- Provision of direct crossings;
- Use of appropriate traffic control and signals;
- Reduction of motor vehicle speeds.

> **Share the Road Key Recommendation 5:**
>
> Painted zebra crossings with no other speed reducing devices are known to increase accident risk for pedestrians as they offer a false sense of security.

Design: A good pedestrian crossing has the following characteristics:

- Standard zebra stripes and stop lines;
- Location at a grade crossing where pedestrians cross a maximum of two lanes before reaching a pedestrian refuge (sidewalk or median);
- Medians are at least two metres wide to provide enough space for a bicycle to stop;
- If crossing more than two lanes at once, it ideally includes pedestrian-activated traffic lights;
- Sufficient lighting;
- Kerb ramps that are aligned to the pedestrian crossing; and
- Present at an intermittent distance (every 70-250m) depending on the urban context and concentration of pedestrians.

a) Crosswalks

Design: As a general rule, the shorter the distance that pedestrians have to cross, the safer and easier it will be for them. Reducing the grade difference will also make the crossing more convenient. Raised crosswalks or elevated zebra crossings make the pedestrian surface continuous and obstacle-free. This type of crossing also necessitates motor vehicles to go up a ramp above the roadway (10 to12cm high, 3 to 6m long), which reduces their speed.

b) Mid-block crossing

Application: Mid-block crossings are advisable under the following circumstances[*24]:

- In commercial areas;
- When blocks are longer than 250m;
- If the crossing is farther than 60m from the intersection;
- When medians are wider than two metres and run the length of the block;
- When there is a long median in a single carriageway road; or
- When there are large mid-block crossing islands where there is a high volume of pedestrians.

© Wikimedia Commons / Agamitsudo

Considerations: Mid-block crossings must be accompanied by a traffic calming measure, traffic signal, or raised zebra crossing. Short mid-block medians are advised against in African cities.

c) Roundabout crossing

Design: Roundabouts must accommodate pedestrians and cyclists. Split islands at approaches reduce vehicle speed and allow pedestrians to cross one lane at a time, making it easier to get across. Roundabouts with single-lane approaches can also be designed to keep car speeds down to safer levels, allowing pedestrians to cross. On the other hand, multi-lane approaches can create multiple risks for pedestrians and are not recommended.

e) Pedestrian tunnel

Benefits: NMT tunnels are advantageous in comparison to pedestrian bridges. They require a lower cleared height, 3.50m as compared to 5.50m for an auto tunnel, which means that ramps are shorter and cyclists can use the speed gained on the descent for the ascent that follows. On a bridge, cyclists face an incline when crossing that slows their progress.

Considerations: The construction of a tunnel is more costly than a pedestrian bridge and creates a higher perception of insecurity. Tunnels should be wide enough to avoid situations that put personal security at risk. It is advisable that the tunnel should be straight and that the exit should be visible from the entrance. Additionally, a tunnel should have excellent illumination and drainage[*25]. In many places, tunnels include complementary commercial spaces to help insure their continuous use.

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d) Pedestrian bridges

Application: Footbridges can be introduced when there is no feasible option for a crosswalk at the street level due to a high volume of heavy vehicles (roads of 90m ROW and average speed above 50km/h). Footbridges should be located where there is demand for them, usually in front of places that attract a high number of people. The access to the ramp or stair should be no farther than 200m to 300m from any pedestrian concentration, otherwise it is unlikely that they will be used.

Design: Pedestrian bridges should include adequate ramps for pedestrians, wheelchairs, tricycles, cyclists and handcarts. A minimum width of 3.50m will help avoid conflicts between different types of user. Ramps should not have a grade larger than 8%, ideally 5% with landings every 6m. Stairs of any sort are not advisable since they are not universally accessible.

Share the Road Key Recommendation 6:

When building new roads, pedestrian bridges and crossing facilities should be made available to users during the project's preliminary stages.

Considerations: It is always preferable to eliminate the need for footbridges through a better road network design. The ideal situation for different-grade crossings is when the motorised vehicles change grade and the pedestrians and cyclists remain at ground level. This demonstrates that the priorities for urban infrastructure are walkers and cyclists, who are the majority of urban commuters.

Box 8: NMT, Social Inclusion and Informal Settlements

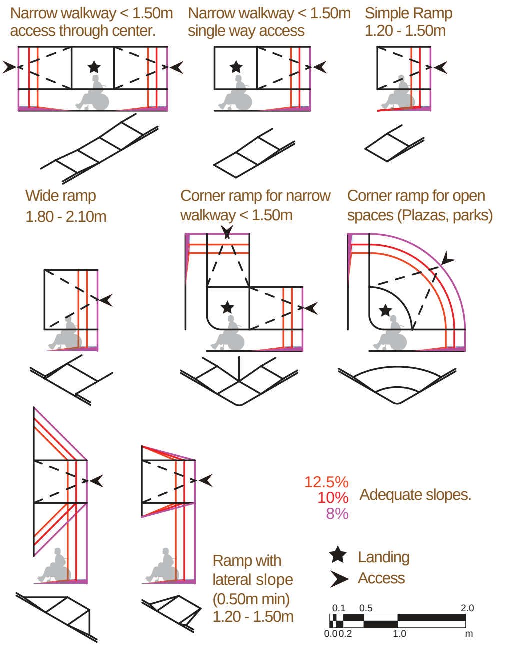
In cities in Colombia, Venezuela and Brazil, strong efforts have been made to improve NMT facilities in hilly informal settlements, turning them into active car-free zones.

The city of Medellin, Colombia has used innovative measures to increase accessibility to informal settlements located on slopes. Interventions currently in place include aerial ropeway transit systems (cable-cars), and escalators ascending 400m that turn a 30-story climb into a five-minute ride, benefitting 12,000 residents. Other measures include pedestrian bridges that connect previously isolated neighbourhoods, leading to impressive improvements in social inclusion and a reduction in urban violence.

Pedestrian bridge built to connect missing links between neighbourhoods
© Alejandro Echeverri / Empresas de Desarrollo Urbano, Medellin

Kerb ramps

KERB RAMP TYPOLOGIES



Based on: Juan Ponce, CITA (2008) 'Manual de Imagen Urbana para el Municipio de Guadalajara'

Application: Kerb ramps provide access between the sidewalk and the roadway for people using wheelchairs, strollers, walkers, etc. These ramps should be provided at crossings, bus stops and any other access point. Ramps at appropriate locations should make it easy for a wheelchair or bicycle to access their designated space. Their design should prevent cars from encroaching those spaces. Bollards or trees can prevent cars from invading spaces meant for pedestrians; however, the space between bollards should be at least 1.20m and ideally 1.50m, to allow easy wheelchair access. Ramp location must allow continuous and smooth transit and maintain coherence with the location of pedestrian crossings.

Design: Ramp typology can be: simple, corner-ramps or lateral slopes, depending on the urban environment. The slope of the ramp is directly dependant on the rise and length it should cover. The maximum kerb height should be 150mm, to allow easy access for all users. The maximum slope for a kerb ramp should be 12.5%. Extended ramps require a landing every 6m to prevent wheelchairs from gaining excessive speed

Pedestrian stairways

Application: In hilly locations, infrastructure for motorised transport is a challenge, as it requires large amounts of space. However, if appropriate facilities are present, hilly areas can be good locations for car-free zones. Pedestrian stairways can shorten the distances along the slopes, while footbridges can easily connect previously isolated areas. Both can also provide excellent landscape elements and be integrated into small public spaces.

Design: Stairs include two elements: treads and risers. Their dimensions are measured in relation to a human step. A comfortable stair should follow the following rule: (riser x 2) + (tread) = between 610-640mm, though for unprotected, outdoor stairways the riser should generally be smaller (150-160mm). A minimum width of 1200mm will allow two people to cross in opposite directions, while 1800mm is the minimum for three people. A landing of 1200mm ought to be present between every 1200-1500mm rise, or 9 steps. Stairways require handrails at two heights to facilitate the climb for people with lower mobility and children. Handrails should be continuous and gripping surface uninterrupted, maintaining an open space of 40mm between handrail and wall.

Considerations: Pedestrian stairways should incorporate a storm water drainage system into its design to facilitate drainage during the rainy season. When they are built out of a durable material, they can help stabilise the soil. Prefabricated modules that incorporate drainage and sewage are feasible and effective.

Sidewalk materials

Footpath and bus stop surfaces should have a matte finish and be anti-skid. They should be locally produced and easy to replace: ideally materials used should be available within 250km of the site. Materials should be selected according to durability, life cycle and maintenance considerations. Using recycled components can make materials more sustainable and even reduce their cost. To make materials more environmentally-friendly and help create a more comfortable urban environment, pavement materials should also be selected with low heat absorption, low radiation, and permeability in mind.

Concrete is the most commonly used sidewalk surface as it has the longest service life and requires the least amount of maintenance. However, it is one of the world's most environmentally unsustainable materials due to the extremely high greenhouse gas emissions involved in its production. Among building materials, cement is the biggest source of carbon emissions on the planet. Substituting some of its components can make it more

Box 9: Transport and Economic Development

The transport sector can expand employment and income opportunities for poor people by creating jobs in transport infrastructure rehabilitation and maintenance, and by giving women equal access to transport jobs. This requires choosing appropriate standards and designs, making optimal use of local resources (labour, equipment and materials), using local contractors and consultants, and supporting local construction industries*[26].

environmentally sustainable. "Class C" or "Class F" fly ash is a non-expensive and widely available replacement for Portland cement. It can replace from 30-70% of the mass of Portland cement, resulting in a stronger and more durable concrete. Concrete aggregates can also be substituted with recycled glass cullet or some portion of crushed recycled concrete. The substitution of concrete aggregates should only be used for footpaths, bike paths and non-structural works*[27].

Asphalt is also acceptable in rural areas and park settings. Asphalt pavement is potentially 100% recyclable. It can incorporate recycled materials such as ground rubber tyres and coal fly ash. High-albedo coatings and light-coloured materials can reduce heat absorption, reducing the urban heat island effect.

Permeable materials such as interlocked pavers will reduce the drainage overflow, reducing pollutants in storm water runoff. Permeable paving is most suitable for large areas without heavy foot traffic. The porous surface must have a depth of at least 150mm to achieve the desired permeability.

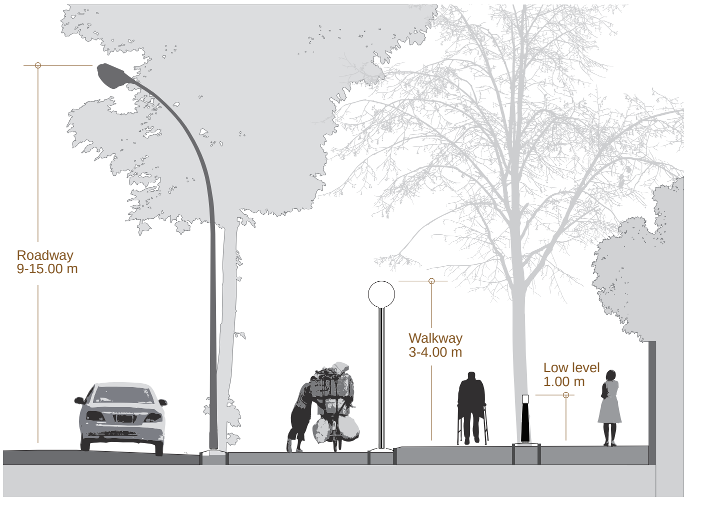
Street lighting

Application: Good street lighting improves comfort and safety while enhancing the productivity of road users. Street lighting should be a priority in corners and intersections where visibility is most important. Lighting is recommended in areas where there is a high concentration of night-time pedestrian activity, such as shops, city centres, transport pickup/drop points, places of worship, schools and community centres.

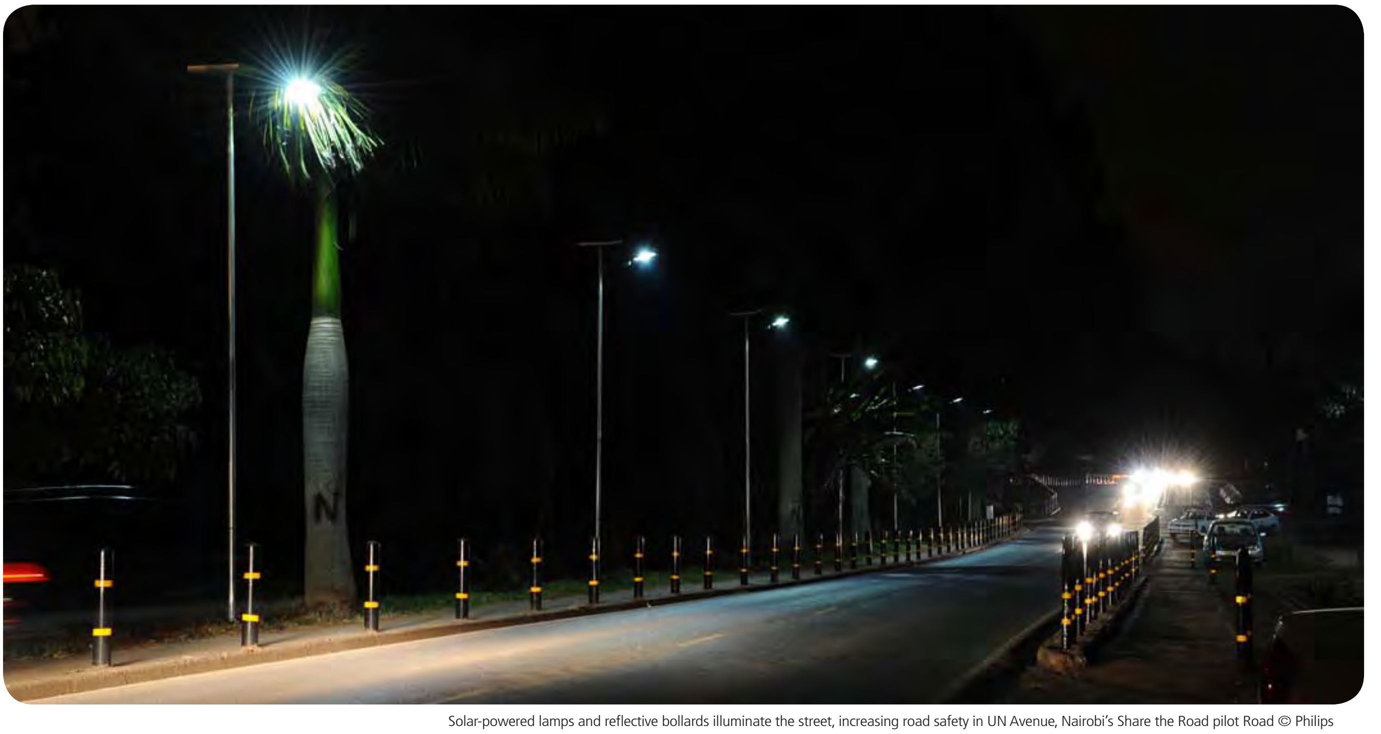
Design: Street lighting height can be adapted to scale, context and user profile: low level/bollards (1m height), walkway or cycleway (3-4m height), or roadway (9-15m height).

Consideration: For more effective illumination, street lighting should not interfere with urban vegetation. When located along the same line as street vegetation, lights should be placed between trees. Where vegetation is dense, lighting should remain below the tree canopy level.

LEVELS OF STREET LIGHTING



In commercial areas, street illumination improves safety conditions and increases activity, making it easier for business to stay open later, thus generating economic benefits.



Solar-powered lamps and reflective bollards illuminate the street, increasing road safety in UN Avenue, Nairobi's Share the Road pilot Road © Philips

Streetscape and climate comfort

Box 10: Solar-Powered LED Lighting on UN Avenue

Kenya Urban Roads Authority (KURA) has installed solar-powered LED road lighting on UN Avenue in Nairobi, as part of a Share the Road showcase project, reinforcing the environmental benefits of the program. The lights, provided by Philips, are an efficient, reliable and cheap road lighting alternative that can potentially generate up to 100% energy savings.

The use of energy-efficient lamps can bring significant environmental, safety and economic benefits. Funds invested in energy-efficient lamps can be recovered through savings in electricity, maintenance cost and longer lifespan of the equipment. During trials, LED lifespan ranged between 50,000 and 100,000 hours. Failure rate over 6,000 hours was around 1%, while the equivalent rate for conventional lighting is around 10%.*[28].

Climate comfort refers to the overall conditions that make a walking trip comfortable. This includes protection from excessive heat by shading elements. In rainy season, spaces where pedestrians can take shelter from the rain should be provided at regular intervals. Trees are an essential element on all streets. They provide comfort, increase footpath usage and augment the environmental benefits of a NMT network. Placing trees on footpaths and cycleways reduces the heat island effect, and helps clean the air. Trees should carefully be located in the planting zone, where they do not obstruct walkways.

People walk farther when the walking environment has attractive urban features.

Drainage should always be integrated into pedestrian planning. In rainy areas, a drainage channel (covered or open) should be included in the street design. Adequate drainage and storm water management limits puddles and other water deposits and makes the walking experience more pleasant. Permeable pavements help absorb storm water and reduce flooding potential in cities' lower areas.

Following traditional urban patterns in Arab and North African cities, narrow pedestrian streets can save energy by shading buildings and creating pleasant, walk-able areas that reduce motorised travel. Water channels or fountains can help keep the area cool, while vegetation walls and soil coverage can control dust and combat desertification.

Matrix of pedestrian interventions

The following table shows a menu of proposed interventions:

Matrix of pedestrian facilities interventions	Share the Road Pillars			Condition achieved		
	Environment	Safety	Accessibility	Speed reduction	Space allocation	Better use of land
Create NMT priority areas	x	x	x	x	x	x
Consolidate and protect Footpath	x		x			
Eliminate sidewalk obstacles			x		x	x
Extend sidewalk widths		x	x		x	
Improve crossing facilities		x		x	x	
Instal pedestrian bridges, tunnels and stairways		x	x		x	
Create kerb ramps			x		x	
Improve street lighting		x				x
Incorporate green materials	x					x
Create urban furniture		x	x		x	x
Plant urban vegetation						x
Protect from the elements, improve climate comfort	x		x		x	x
Improve stormwater drainage	x		x			x

© Patricia Kim / UNEP

3 Cycling Infrastructure

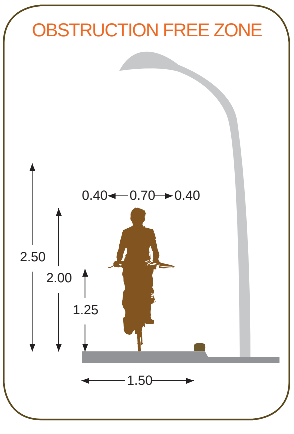
Cities all over the world are building cycling infrastructure in order to enhance accessibility, safety and health conditions for bicycle riders. As the number of motor vehicles rises in African cities, cyclists are increasingly vulnerable, and bicycles are becoming a less attractive mode of transport. This trend must be reversed. Not only does bicycle travel give cities a human dimension, it also contributes to the ecological, economic, and physical health of the population at large. In order for cycling to become a widely used, sustainable mode of transport, road safety must be improved and reinforced.

Investments in bicycle infrastructure are highly cost-effective. By upgrading existing roads that are already regularly used by cyclists, travel conditions will incrementally improve, benefiting bicycle riders' health and safety while enhancing air quality for the entire city. Cycling is not new in Sub-Saharan cities; in small and medium-sized cities there is already a high share of bicycle users. Some African countries, including Burkina Faso, Ghana, Kenya, Mali and South Africa, have some dedicated bicycle paths*[29]. However, cycling infrastructure remains a novelty in many cities. Its incorporation into the urban fabric should be evaluated on a case-by-case basis, learning from experiences from similar contexts. Design standards must be adapted to best meet users' needs in each region.

Creating new infrastructure must start with a city-wide vision of the cycling network. The network must be part of an integrated transport plan that takes into account the relationship between walking facilities, public transport and the automobile network. This city-wide vision will make it possible to avoid expensive investments in routes without clear origins or destinations.

In parallel with the creation of new infrastructure, effective education campaigns are necessary for both cyclists and vehicle drivers. Many common problems are related to road user behaviour. These issues can only be corrected through education and enforcement programmes. Furthermore, new users must be shown how to interact with cars and pedestrians in a safe manner, and in some cases, even be taught how to effectively ride a bicycle.

Basic design considerations



A variety of two and three-wheeled self-propelled vehicles co-exist in African streets. Bicycle dimensions, as well as infrastructure considerations, vary depending on vehicle type. The average length of a bicycle is 1.75m, while its widest part is the handlebar, which varies between 600mm and 800mm. In order to allow for manoeuvring, there should be 400mm of free space on each side of the handlebars. Thus, the total amount of space needed for a single bike lane is 1.50m. The height of the handlebars can vary between 750mm and 1250mm, while the height of the person riding it can reach 2.00m. A minimum clearance height of 2.50m will allow safe circulation, although clearance should be a minimum of 3.50m for tunnels and underpasses.

The majority of the bike trips are made for productive purposes. In many cases, bicycles are "tools of the trade" that enable people to be more productive in earning their livelihoods. Infrastructure built for cyclists should consider the variety of functions and dimensions of existent bicycles and tricycles, including handcarts. Failing to consider a wider range of vehicles will result in both cyclists and handcarts on the carriageway despite the construction of designated infrastructure.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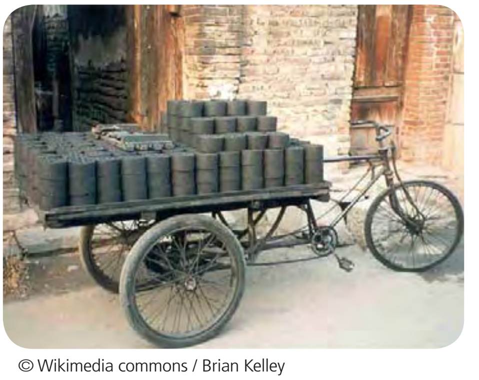
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Box 11: SSATP, the Sub-Saharan African Transport Programme

Since 1987, the World Bank has worked on the Sub-Saharan Africa Transport Policy (SSATP) programme to ensure that transport sector strategies of 36 Sub-Saharan African counties are fully anchored in poverty-reduction strategies*[30]. As part of the programme's activities, non-motorised transport studies in East and West Africa were conducted between 1992 and 2000. For East Africa, pilot projects were implemented and cities in Kenya and Tanzania were evaluated, while in West Africa, studies assessed the relationship between poverty and cycling in Mali, Senegal, Ghana and Burkina Faso. These studies developed expertise that was applied to continuing NMT research in the Sub-Saharan region, and that has generated valuable data about the state of NMT from the1990s and onwards.


© Wikimedia commons / Walter Hochauer

Cycleway typologies

A cycleway is a facility that is provided primarily for bicycle travel. Different cycleway typologies exist. These include:

- Cycle path;
- Cycle lane;
- Shared road; and
- Green corridor.

The criteria for selecting appropriate cycleway typology depends on the existent road dimensions at its narrowest section and the required dimensions for bicycle and tricycle transit. The road dimensions should allow for comfortable, fluid circulation of different transport modes, as well as room for necessary manoeuvres for all users, including pedestrians and cyclists.

Variables to be considered here include: volume and traffic speed (defines the type of protection), previewed number of cyclists (defines the lane width), available space (defines the basic typology) and urban environment (defines any special characteristics). Other factors for consideration are: the existence of urban barriers, frequency of intersections, presence of buffer zones, number of lanes and available width for pedestrian facilities.

Box 12: South Africa Cycling Infrastructure

South Africa has taken the lead in bicycle infrastructure, successfully implementing facilities in several cities. In 2000, Cape Town constructed a network of 22km of bike paths in the Rondebosh/Newlands area. When the network was completed, there was a 30 per cent increase in the number of students who commuted by bicycle[*31]. As part of its National Greening 2010 Programme, the Department of Environmental Affairs (DEA), with the support of the German KfW Development Bank, planned to develop bicycle routes, parking facilities and rental stations in the cities of Cape Town, Durban, Johannesburg, Polokwane and Pretoria[*32].

Matrix of Cycleways

	Cycle path	Cycle lane	Shared road	Green corridor
Characteristic	Segregated way Physical divsion from motor vehicle	Lane along existing road with pavement markings. Same direction as vehicles	Different modes sharing safely the same road space	Dedicated off-road cycleway
Types	One way (unidirectional) Two way (bidirectional)	Unprotected Semi-protected	Public transport and bicycles Vehicles and bicycles Bicycles and pedestrians	Recreational Connecting route
Vehicle flux	>20,000 cars/day	<20,000 cars/day	<3,000 cars/day	none
Car speed	>50km/h	30-50km/h	<30km/h	none
Special Needs	Special attention to intersections	Measures to pacify traffic	Pacified traffic, signage to inform drivers	Special attention to maintenance

Based on: Cycling typologies. CITA (2008) Manual de Imagen Urbana del Municipio de Guadalajara

a) Cycle path

A cycle path or cycle track is a separated path for the exclusive use of cyclists, physically set apart from motorised vehicles through grade separation or a median island. In this typology, motor vehicle cross flow is minimised. The two main reasons for separating cyclists and vehicles through dedicated cycle paths are: the high speed of vehicles, and insufficient room and/or poor conditions for safe cycling on existing streets.

Cycle paths can be put in place on existing roads by reducing the number of lanes, reducing lane width or prohibiting parking on given streets. When additional right of way is available, cycle paths can be built between the carriageway and the sidewalk. Paths can be present on one or both sides of the street.

Share the Road Key Recommendation 7:

Where there are no dedicated pedestrian walkways, dedicated cycle paths will not be successful. In fact, in these cases, bicycle tracks will quite literally be taken over by pedestrians[*33]. Pedestrian facilities must be upgraded or provided at the same time as cycle infrastructure is installed.

Design

The cycling path width should be large enough to allow cyclists to overtake each other. Typically, this width is 3 metres, but 3.5 to 4 metres is preferable if the expected volume of bicycles and mixed NM vehicles is high (more than 150 cyclists per hour). This width will also allow for the circulation of freight tricycles, tricycle-wheelchairs, carts, bicycle-taxis, carriages and other type of non-motorised vehicles.

Cycle paths should be constructed on cities' most important urban corridors, and planned as part of a network with adjoining bike lanes, bike parking, and public transport nodes.

Application

- Roads where traffic flux is greater than 20,000 cars per day, or the driving speed is above 50km/h;
- Arterial roads and collector streets with heavy traffic;
- Where there is a high potential for vehicle intrusion into cycle lanes; and
- Where there are not too many major intersections (every 100-200m). Separated cycling paths reduce the cyclist visibility, which makes them vulnerable at intersections.

Benefits

- Segregated paths enhance the safety, comfort and mobility of non-motorised vehicles; users are protected from vehicles encroaching on their designated space.
- If planned in a continuous manner, travel time will be significantly reduced.
- Preferable on long stretches without intersections.

Considerations

- Separated cycle paths are maintained less frequently than bicycle lanes on carriageways.
- At difficult intersections, a cycle path should be incorporated into the carriageway to increase the bike rider's visibility when vehicles are turning.
- If sidewalks or other pedestrian facilities are narrow or non-existent, pedestrians will most likely walk on the cycle track.
- Separated cycle path construction cost is higher, and utilises more urban space.
- One-way cycle paths are not recommended due to the difficulty of getting users to comply.
- Turning restrictions for motorised vehicles and reduction of parking spaces may be required.

b) Cycle lane

A cycle lane is a portion of a carriageway that has been marked for the exclusive use of non-motorised users. The separation from motorised traffic can be visual (painted markings with a standard 100mm edge line or a buffer zone) or physical (through bollards or raised kerbs). Visual separation measures are usually not enough unless there is strong traffic enforcement and education. For this reason, physical separation of lanes is desirable, although it is not always possible.

Design

- On-road lanes indicated along existing roads, usually running in the same direction as motor vehicles.
- For streets where car speeds do not exceed 30km/h, the minimum lane width is 1.50m. If the volume of cyclists is above 1,500 per day or a large number of handcarts or larger NM vehicles are present, the minimum lane width should be 2.25m.
- A marked buffer zone of at least 0.50m should separate the cycle lane from motorised vehicles when car speeds are between 30km/h and 50km/h but volume is under 20,000 vehicles per day. In such a situation, desirable total lane width would be 2.00m.
- In rural areas where traffic volume is low, the development and maintenance of 1.20m paved road shoulders with a standard edge line can significantly improve safety and convenience for bicyclists and motorists. Its width should increase when approaching trading centres (1-2km) according to capacity.
- Vertical clearance from obstacles such as signals or trees should consist of a minimum of 2.50m, and preferably 3.00m.

Application

- Roads with car speeds below 50km/h and traffic flux under 20,000 cars per day, with no heavy vehicles.
- Secondary collector streets within residential areas.
- Rural areas with low traffic flow.
- Widened hard shoulders can be used as a cycle lane and progressively upgraded with protection measures in conflict-prone areas.

Widened hard shoulder can be used as a cycle lane for crossing a bridge © UNEP

Shared the Road Key Recommendation 8:

The road shoulder should be widened close to trading centres (1-2km) to meet higher pedestrian and cyclist demand. Around these areas, the shoulder should be designed to sufficiently separate stopping vehicles, bus stops, vendor areas, and circulation facilities[*34].

Benefits

- Easier to implement if protection elements are placed in required areas.
- Cycle lanes can be incrementally upgraded by adding protective elements such as raised concrete kerbs or bollards.
- Buffer zones increase comfort and make it possible to overtake.
- Preserves kerbside access.
- Increases cyclists' visibility, which is particularly important at intersections.

Considerations

- Difficult to enforce. Unprotected cycle lanes are not recommended for places where there is a high risk of encroachment by other motorised vehicles.
- Not recommended where the need for parking space will likely result in cars parking on the cycling lane, or where informal bus networks frequently use cycle lanes as drop-off areas.
- Motorised bicycles, as well as any other motorised vehicle, should be prohibited by law from accessing cycle lanes.
- Cycle lanes may require additional traffic calming measures, such as lane width reduction, speed humps, medians or kerb extensions at intersections.
- Road shoulder cycle lanes are prone to utilization by overtaking motorists especially on roads that are in poor condition, or for stopping close to commercial centres.

Box 13: Bicycle Share in Ouagadougou

Ouagadougou, in Burkina Faso, is known as the two-wheel African capital. It has one of the highest percentages of bicycle and motorbike use than any other Sub-Saharan African capital. In 1992, 10 per cent of all trips in the city were made by bicycle, 42 per cent via walking, and 39 per cent by motorbike. This tendency may be a response to the low public transport user share, which is only 3 per cent[*35]. Throughout the 1980s, dedicated cycling spaces were created along roads, and bicycle tracks were built along the city's five main arteries[*36].

Share the Road Key Recommendation 9:

To increase road safety, it is essential to separate cyclists from other vehicles when there is high volume, major speed differences, or a significant number of heavy vehicles. Cyclists can be separated from other traffic by a difference in grade or with strategically placed protective elements.

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c) Shared road

A shared road is a low-speed, sometimes kerbless roadway designed as a single surface for use by pedestrians, bicyclists and low-speed motor vehicles*[37]. On a shared road, drivers and cyclists share the same space in a way that is safe for all users. Shared roads are also known as "Zones 30" since vehicles using them should maintain a speed limit of 30km/h.

Shared traffic in Kigali, Rwanda © Wikimedia commons / Helge Fahrnberger

Design

- The main factors in guaranteeing cyclists' comfort and security are carriageway width and speed limits.
- Speed can be controlled through strong enforcement of speed limits and street design.
- Recommended lane widths are below 3.00m, or between 3.90m and 4.30m. When the lane is less than 3.00 metres wide, cars cannot overtake cyclists, unless they change lanes completely. Lane widths between 3.90 and 4.30 metres allow cars to safely overtake cyclists without changing lanes, and while maintaining a 1.00m distance from the cyclist.
- Special bike infrastructure is usually not necessary, but may require vertical and horizontal signage and traffic calming measures to ensure lower vehicle speed.

Application

- Shared roads are adequate for neighbourhood streets with low traffic volume, less than 3,000 vehicles per day.
- Cyclists must circulate in the same direction as motor vehicles.
- This modality is highly suitable for well-connected streets, for example, in urban grids, where heavy traffic can circulate in parallel streets.

Benefits

- Shared roads can become feeders to primary bike routes, or work as a parallel network to primary streets that lack designated cycle infrastructure.
- Shared roads benefit existing NMT users.
- The 30 km/h speed limit has multiple benefits to all users: it reduces noise and emission pollution, increases road safety and enhances neighbourhood life.
- Higher volumes of cyclists on the streets improve safety conditions for all cyclists.

Considerations

- Lane widths between 2.80 and 3.90 metres are not recommended since automobiles will try to overtake cyclists without changing lanes and thus pushing cyclists onto the shoulder.
- Shared roads seem less safe to users than segregated cycling lanes or paths.
- Shared roads do not attract potential new users.

d) Green corridor

A green corridor or green route is a dedicated off-street cycleway free from other motorised traffic. Green corridors can be built along footpaths in peri-urban areas, and can be used to overcome urban or topographic barriers (crossing rivers, streams or other topographic obstacles), increasing the attractiveness and convenience of bicycle travel. They can also be designed for recreational purposes, along attractive scenery like parks, streams, lakes, seashores, etc.

Design

- Usually a bidirectional lane along a pedestrian walkway.
- Always include an adjacent pedestrian walkway, marked on the pavement by a different treatment or colour.
- The width of a bidirectional green corridor should vary between 2.60m and 4.00m depending on the volume of users.

Application

- To connect areas underserved by the road network.
- Green corridors, parks, along rights of way, and river basins.

Benefits

- Attracts potential new users to the NMT experience under safe riding conditions.
- Provides recreational activity.
- Protects the right of way and creates a barrier against urban expansion next to water bodies in green areas.

Considerations

- Being off-road, they necessitate higher maintenance.
- Areas along the corridor are prone to squatting, or promote the growth of informal areas.

Geometric design

Geometric design establishes the design characteristics and procedures that create safe bicycle infrastructure. Similar to road design, the geometric design of a cycle track will determine its features.

a) Design speed

Cycle path width is defined by speed, user volume, traffic type, and grade. The design speed chosen for a cycleway will determine the kerb radii and banking (super-elevation), as well as the length of crests, vertical curves and stopping sight distances. The appropriate design speed will make the ride more comfortable and safe.

In an urban environment the design speed of cycle infrastructure should be 30km/h, so that the cyclist can ride at an average speed of 20km/h. In peri-urban contexts, where the cyclist's trip is more continuous and travel speed is around 30km/h, the design speed should be 40km/h. On prolonged slopes (steeper than 4 per cent and longer than 150m), the design speed should increase to 50km/h so that cyclists going downhill are able to ride fast without safety risk.

The conditions and use of bicycles in Africa affects design speed. A situation analysis in Uganda found that most available bicycles in Uganda are of a roadster design that has changed little since the 1950s. They do not have gears, but do have rod brakes and crossbars, suitable for carrying water and other goods. Most bicycles lack basic safety equipment, such as adequate reflectors, bells and lights. A large number of bicycles have no front brake blocks with badly damaged and worn tyres. A surprising number have no pedals but just an axle[*38]. Cycling facilities in Africa should consider these conditions and adapt to the local users by increasing the stopping distance and using buffer zones on downhill tracks.

Design Speed (km/h)	Banking (%)	Minimum Radius (m)
20	2	10
	3	9
	4	9
	5	9
30	2	24
	3	23
	4	22
	5	21
40	2	47
	3	45
	4	43
	5	42
50	2	86
	3	82
	4	79
	5	76

Based on: California Department of Transportation (2006) Highway Design Manual

b) Kerb radius and banking

The minimum curve radius for a bicycle is determined by banking and design speed, and the coefficient of friction on the tyre surfaces. The table to the right provides guidance for calculating the minimum curve radii.

A banked path or super-elevation can help smooth turns. The degree of banking on a cycle track will vary from a minimum of 2 per cent (the minimum necessary for an adequate drainage) to a maximum of approximately 5 per cent. A straight 2 per cent cross slope is recommended on tangent intersections. At higher speeds horizontal curves must maintain a larger radius, while a steeper bank (max. 5 per cent) will make the turn easier, and reduce its radius.

c) Grade

The road grade, or slope, is measured by the vertical rise in relation to its horizontal length. Cyclists are very sensitive to topographic conditions; grades over 6 per cent require extra effort from the cyclist, making the trip less attractive. In hilly locations, cycling networks can be planned according to topography, giving priority to infrastructure development in flat areas within the city.

When bicycles are in poor condition, as is often the case in Africa, long downgrades can cause problems and uphill climbs require more physical effort. While the maximum recommended grade rate for bike paths is 6 per cent, sustained grades should be limited to 3 per cent. Steeper grades can be tolerated for short segments of up to 150m.

Maximum Grade	
Grade	Longitude
3-6%	up to 500m
6%	up to 240m
7%	up to 120m
8%	up to 90m
9%	up to 60m
10%	up to 30m
11-20%	up to 15m

When steep grades cannot be avoided, the design speed should be increased to 50km/h, allowing for smoother turns and more distance for cyclists to slow down and stop. For prolonged slopes of over 6 per cent, the design should also consider a widening zone of 0.60m so that the cyclist can manoeuvre more easily, or simply get off the bike and walk uphill. Grades for unpaved cycle paths (e.g. crushed stone) should remain lower due to the difficulty most cyclists will have mounting the slope.

Supportive elements such as bicycle angles or embedded ramps can help move a bicycle or a wheelbarrow along stairways. In such cases, the angle should maintain a minimum distance of 20cm from the wall or handrail to make enough room for pedals and handles.

Box 14: NMT Promotion and Share Increase

Bogota, capital of Colombia, has the most extensive network of cycle tracks in Latin America, with a total of 345km in 2010. Large-scale public awareness campaigns increased the popularity of cycling as a means of transport. By 2010, the percentage of the population using bicycles had increased to 4 per cent from 0.58 per cent in1998[*39]. In Nairobi, Kenya, 4 per cent of the population uses bicycles to go to work; in Ouagadougou, Burkina Faso, bicycles count for 10 per cent of user trips, while the rate in Dar es Salam, Tanzania is 3 per cent. A systematic increase in cycling infrastructure could potentially greatly increase bicycle use in African cities.

Intersections

At intersections, the risk of an accident is 3.6 times higher when a cyclist rides against traffic, and 5.3 times higher if he or she rides against traffic at a different grade[*40].

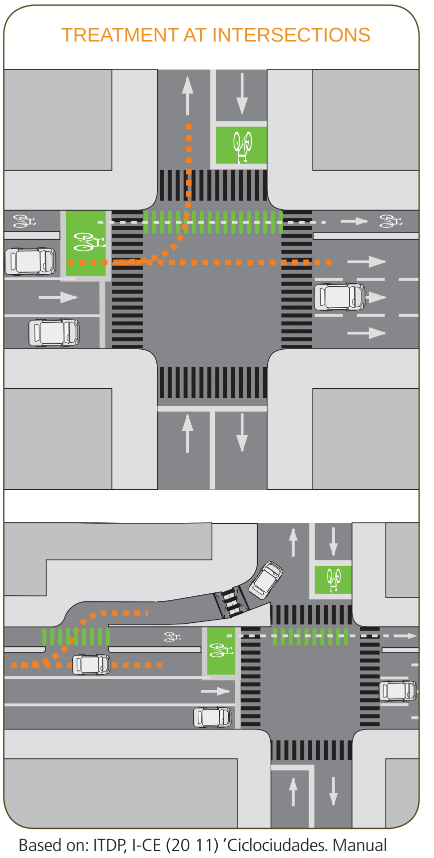
It is at intersections where the majority of interactions between different road users occur, and where the majority of conflicts and accidents happen. Therefore, intersections are a prime consideration in cycle path design and are crucial elements for creating high-performing NMT infrastructure. The type of intersection will determine the treatment to be used. In all cases, it is important to prevent drivers from encroaching on cyclists' trajectories. Road design should ensure that cyclists are visible to other road users, especially at junctions. Good visibility depends on the geometric design of the intersection and the predictability of movement of each user.

Bicycle path intersections and approaches should be on relatively flat grades and close to the vehicle lane, to ensure visibility. Adequate warning should be given to permit cyclists to stop before reaching the intersection, especially on downgrades. Basic design recommendations to reduce the risk of accidents at intersections and increase trip continuity include:

- Adjust intersections to reduce crossing distance. The shorter the crossing distance, the safer it is;
- Reduce speed on all sides; and
- Increase visibility so that cars can see cyclists.

At intersections with angles other than 90°, vehicles will lose sight of bicycles, increasing the risk of accidents. In such cases, it is important to reduce vehicle speed, which can be done by re-designing the junction or applying traffic calming measures.

On arterial roads, cycling infrastructure should usually consist of a segregated track. In cases where there is a high volume of vehicles on a continuous turn, it is advisable to incorporate both fluxes before the intersection to increase the visibility of the NMT user. When crossing an arterial street, the crossing should either occur at the pedestrian crossing, where motorists can be expected to stop, or at a location completely outside the intersection, to give cyclists an opportunity to see turning vehicles.



Based on: ITDP, I-CE (20 11) 'Ciclociudades. Manual integral de movilidad ciclista para ciudades mexicanas'.

Roundabout intersections

The safety of cyclists in roundabouts depends on their design. Roundabouts can have single or multi-lane approaches. Properly designed single-lane roundabouts improve safety, while roundabouts with multi-lane approaches create problems for cyclists as vehicles turn continuously without reducing speed. Under these conditions, the visibility of cyclists is poor.

The required conditions for a cyclist to be safely and comfortably integrated into motor traffic are narrow roads (one lane in each direction), slow speeds, and respect for traffic lights and right of way. If these conditions are not met, cyclists may not be able to share the road comfortably. For larger roundabouts, off-road cycling paths and crossings that follow the pedestrian flux are recommended. Though they may be less convenient and create longer trajectories, they improve the safety of cyclists[*41].

Protection elements

Protection elements such as bollards, raised kerbs, rails and vegetation barriers are meant to separate cyclists from high-speed motor vehicles. Their design is defined by the speed and volume of motorised traffic. Sometimes, a simple concrete block on the road shoulder may act as a separator preventing cars from invading pedestrian space, while in other cases intermittent steel bollards over a raised kerb are more effective. They are highly cost-effective measures to increase cyclist and pedestrian safety.

Individual protection elements, like bollards, can be placed along the cycleway at intermittent distances to separate areas, while continuous elements such as raised kerbs, rails, open drains, or vegetation walls provide continuous physical separation. If protection elements are higher than 150mm, a safety strip adjacent to the cycle lane may be needed. The width of the strip depends on the height of these elements, which can be calculated on the table:

Protection element	Height	Safety Strip
Raised kerb	0.05 - 0.15m	-
Bollards	0.60m	0.25m
Vegetation and urban furniture	0.90m	0.50m
Continuous rail or wall	1.00m	0.80m
Parked vehicles	-	1.00m

Bollards are very effective for separating pedestrian and cycling areas, however they should not become obstacles that hinder comfortable use of the facilities. When bollards are located perpendicular to the cycling lane to delimit vehicle entrances or crossings, the free space between them should be 1.50m and not less than 1.20m. A shorter distance will interfere with the circulation of handcarts, tricycles and loaded cycles, pushing them into the carriageway. It is also preferable to place an odd number of bollards (one or three) at entrances and intersections. Bollards should be more widely spaced at curves, and away from intersections.

The ideal height for bollards located between lanes is below 600mm to avoid interference with handlebars. If a fence or rail is used to protect the cycle lane against a lateral cliff or bridge crossing, the recommended height should be 1.40m, which will prevent the bicyclist from falling, but also ensuring his or her visibility.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Box 15: Bollard Maintenance

Like any other element of urban infrastructure, bollards and concrete kerbs require regular maintenance. Soon after they are installed, elements are often damaged when vehicles collide into them. It is important to consider bollard resistance and maintenance in NMT planning. Bollards should be well anchored by solid, high quality footings to resist light car impacts and ensure durability. Damaged bollards have a negative psychological effect, stimulating careless behaviour on the part of road users.

Despite the fact that they can be easily damaged, protection elements remain highly cost-effective if one considers how many potential accidents they prevent.

Experiences in Kenya and Tanzania showed that certain kerb designs were not respected by vehicle drivers, particularly minibuses and taxis*[42], who would often encroach NMT areas for parking and passenger drop-off spots. Raised kerbs should be high enough to prevent cars from crossing them, while open areas must allow wheelchair access.

Supportive infrastructure and bicycle parking

Supportive elements such as stair ramps, bicycle parking stations, and bike lending services can facilitate the continuity of NMT trips. Steel angles or concrete ramps adjacent to stairs can help cyclists carry/push their bikes up and down stairs when there is no place available for a proper ramp. Additional supportive infrastructure and facilities that promote this transport mode include benches and vegetation where cyclists can rest in shaded areas, showers and changing facilities at work.

Guarded bicycle parking is essential to making bicycle use more practical and to prevent the risk of theft. These parking areas must be present at major circulation points, particularly at bus stations to encourage inter-modality. Bicycle parking is also necessary at strategic locations such as public buildings, schools, universities, places of work and inter-connection hubs such as bus and taxi stations. They should be located in a safe place, and if necessary, kiosk owners or shop-keepers can take care of them for a small fee.

Bicycle parking can be designed as a short- or long-term facility. For the short term, a single U-shape anchored steel frame is the simplest option. Bicycle parking stations can be incorporated into the design of other street furniture.

Stair ramp angle © BKT | Mobiliario Urbano

U-Shape bicycle parking © BKT | Mobiliario Urbano

Small U-Shape bicycle parking © BKT | Mobiliario Urbano

Share the Road Key Recommendation 10:

Bollards and other NMT infrastructure involving pipes or metal fixtures should be well anchored and constructed in a vandal-proof way. As they are valuable in the informal market, they are prone to theft. Precast concrete curbs are easier to maintain and are vandal-proof.

Cycleway materials and surface

Bicycle riders are very sensitive to road surface. Cycleway pavement should have the same characteristics as road pavement; i.e. a smooth riding surface with skid resistant qualities. Many NMT users carry loads or use freight vehicles such as handcarts; surfaces should be able to accommodate these loads. For proper drainage, the bike path surface should have a cross slope of 2 per cent. Sloping in one direction will simplify drainage. The surface should be smooth and free of potholes with a uniform pavement edge. Potholes are particularly risky for cyclists as they may not be able to see their depth. Even a narrow gap between two concrete slabs can catch a bicycle wheel, making it potentially dangerous. Culvert bridges are necessary where cycle paths cross a drainage channel.

Pavements materials for cycleway should be acquired locally and be context appropriate in order to benefit the local economy. The minimum recommended pavement thickness is 50mm of asphalt or concrete. Other surface requirements include:

- Even paving;
- Good drainage;
- Inclusion of ramps; and
- Avoidance of obstacles.


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Signage

Signage is a collection of displayed verbal, symbolic, tactical and pictorial information*[43]. Adequate road signage enhances safety for both pedestrians and cyclists as it clarifies the rights and roles of each user in the transport network.

Signage can be divided into two categories, horizontal and vertical; horizontal signage is printed on the road surface, while vertical signage is placed on vertical sign panels. Both types should indicate how cyclists should behave, and announce their presence to other road users. Road signage has an important traffic education function. In terms of use, signage is classified as: normative, preventive and informative. A signage system must be coherent and integrated into the entire network.

Basic cycleway information must include: lane delimitation (100mm wide), standard crossing signs, and the announcement of its use as a cycleway. The information or direction on each signage element should be clear and suited to its particular function. The scale should be appropriate for whom it is intended; at a scale that is easily visible to pedestrians and cyclists. For vertical signage, the distance and viewpoint of the reader should be taken into consideration; motorist eye level is between 1070-1200mm high, while pedestrian eye level is around 1740mm from the ground. The typeface and characters must be appropriate for the reading distance and the viewer's speed.

Text Size	Max. Reading Distance
100mm	39m
80mm	30m
60mm	22m
40mm	15m
25mm	10m
13.5mm	6m
7.5mm	3m

Based on: Griesel, G. University of Pretoria, Design Guidelines

Matrix of cycling interventions

The following table shows a menu of proposed interventions:

Matrix of cycling interventions	Share the Road Pillars			Condition achieved		
	Environment	Safety	Accessibility	Speed Reduction	Space Allocation	Better use of land
Designation of cycling routes	x	x	x	x	x	x
Establishment of shared roads	x	x		x		x
Marking of cycle lane	x	x		x	x	
Construction of cycle path	x					
Adequation of green corridor	x					
Improving intersection crossing		x	x	x		
Signals and markings for cycleway		x	x			x
Placement of protection element		x			x	
Connection of missing route links						
Placement of bicycle parking	x		x		x	x
Provision of ramps at staircases		x	x		x	x
Provision of bike lending service	x		x		x	

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4 Modifications to the Road Space

Walkways occupy less space than roads and enable travel for many more people per square meter. Cities with large pedestrian areas are more attractive, safer and more pleasant to live in. Furthermore, inclusive street design improves the urban economy, as it gives more people access to productive opportunities and allows them to benefit from urban concentration.

In urban areas, space is not only a valuable resource, but also a public good. In many cities, streets are the largest, and sometimes the only, public space. However, the dominance of motor vehicles means that the majority of the population—non-motorised transport users—do not enjoy satisfactory use of urban space. Sharing the road amongst all users in an equitable fashion is a challenge that can be addressed through equitable re-distribution of road space.

A three metre-wide sidewalk has the capacity to accommodate 3200 pedestrians per hour. The space required for travel by a pedestrian is 0.80m^2, while a bicyclist needs 3.00m^2. The space required by a person travelling by car, bus, or articulated bus at 33 per cent of its capacity is 60m^2, 28m^2 and 12m^2 respectively[*44]. In other words, 100m^2 of urban space can be used by 1.66 persons travelling by car, 3.57 by bus, 8.33 by a half-full articulated bus; 33 cyclists, or 125 pedestrians.

The following section presents a menu of interventions to integrate NMT by retrofitting existing roads. There are two main retrofitting strategies for existing roads such as improving pedestrian facilities on the road while preserving the current carriageway, or modifying the carriageway in order to gain space for NMT by re-distributing lanes or other measures. How these improvements are implemented depends on the role of the street within the road hierarchy.

Box 16: iRap Star Rating

iRap, the International Road Assessment Programme, developed a road safety rating which ranges from 1 star for the least safe roads, to 5 stars for the most safe. The 4- and 5-star roads have safety features that are suitable for prevailing traffic, while 1- and 2-star roads have neither appropriate safety features nor dedicated facilities for bicyclists and pedestrians. Star ratings are based on road inspection data and design risk factors for car occupants, pedestrians and cyclists. Inspected road features include intersection design, road cross-section and markings, roadside hazards, footpaths and bicycle lanes.

iRap used the results of surveys in Kenya to create star-rated maps of the main inter-urban roads in the countryside and the most important roads in Nairobi. The star rating programme includes an investment project for cost-effective, network-wide countermeasures to improve road safety in Kenya[*45].

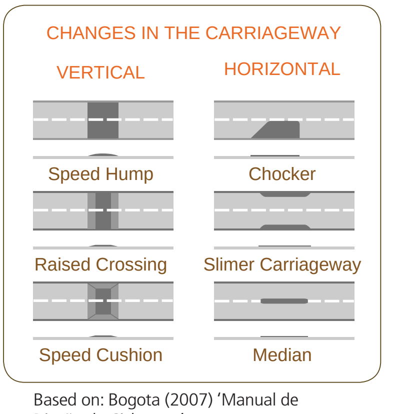
Traffic calming interventions

Traffic calming is a combination of measures aimed at altering driver behaviour, primarily by reducing speeds and improving pedestrian and cycling travel conditions. The basis for traffic calming is the fact that traffic speeds under 30km/h substantially reduce fatal or serious accidents and injuries.

Measures for calming traffic are implemented in streets with low car volume, creating safer crossings for pedestrians, as well as a bicycle and pedestrian-friendly environment. Once speeds have been reduced, cars and bicycles can more safely co-exist.

Interventions can affect the carriageway vertically, horizontally, or on its surface. Vertical measures include speed bumps, raised crossings, speed cushions and elimination of the kerb; horizontal modifications include the introduction of chokers, median islands, open side drains, kerb extensions, road delineation and lane narrowing. Finally, changes to the surface can consist of a rougher pavement, whose texture is uncomfortable for vehicles to roll over and causes them to reduce speed. Redesigning intersections can also reduce vehicle speed.

Most traffic calming measures are for low-volume streets and are not recommended for highways and arterial roads. These measures are best applied according to the following table:



Based on: Bogota (2007) 'Manual de Diseño de Ciclorutas'.

Matrix for the selection of traffic calming instruments					
Measure	Height	Max. Daily Vehicle Volume	Boulevard	Avenue	Local Street
Speed Hump	100 mm	7,500	x	x	x
Raised Crossing	150 mm	7,500	x	x	x
Speed Cushion	100 mm	4,000		x	x
Chocker (one lane)	150 mm	3,000			x
Slimer Carriageway	150 mm	20,00		x	x
Median Island	150 mm	20,000			x

Adapted from: Abu Dhabi Street Design Manual

Horizontal measures

a) Road delineation

A road without markings is incomplete. Clear signs and road delineation are essential so that road users know what they are expected to do and traffic laws are effectively enforced. Appropriate road delineation can increase safety for all users, particularly when no sidewalk is provided and pedestrians walk on the road shoulder. Road markings are a low-cost measure that is highly cost-effective in reducing accidents.

b) Lane narrowing and redistribution

Lane narrowing is a simple way to gain space for pedestrian facilities. Re-distributing this space also makes it possible to incorporate other traffic calming measures. The principle is that narrower lanes (three metre-wide) encourage slower speeds. The objectives are to slow traffic and increase safe pedestrian space. Road narrowing can economize enough space to create a shoulder buffer zone for pedestrians and cyclists, a wider sidewalk, or a bicycle lane.

An easy, low-cost method of narrowing lanes is simply to paint lines on the street. Median islands and kerb extensions can also create narrower streets, allowing for centre turn lanes, bicycle lanes and parking places. Lanes are re-distributed according to how much available space there is on the carriageway. The table below shows an example of lane redistribution:

Examples for the redistribution of lanes in the carriageway				
Carriageway width (m)	Cycle path width (m)	Vehicle lane 1 width (m)	Vehicle lane 2 width (m)	Counter-flow vehicle lane (m)
7.30	1.30	2.50		3.50
7.50	1.5	2.50		3.50
8.00	1.50	2.50		4.00
8.50	1.50	3.00		4.00
9.00	1.50	3.00		4.50 (1.50 + 3.00)
10.00 (1 lane)	1.50	3.50		5.00 (1.50 + 3.50)
10.00 (2 lanes)	1.50	2.50	2.50	3.50
10.50	1.50	2.50	2.50	4.00
11.00	1.50	2.50	2.50	4.50 (1.50 + 3.00)
11.50	1.50	2.75	2.75	4.50 (1.50 + 3.00)
12.00	1.50	3.00	3.00	4.50 (1.50 + 3.00)
15.00	1.50	3.00	3.00	3.00 + 3.00 + 1.50
* Widths of carriageway without considering the median				

Based on: Transport for London (2005), and ITDP, I-CE (20 11).

Share the Road Key Recommendation 11:

Savings from narrowing vehicle lanes can pay for pedestrian and cycling facilities.

Box 17: Narrow Lanes and Safer Driving in Tanzania

A three wide carriageway lane was tested in Morogoro, Tanzania. The road re-design included a 0.50m shoulder and open drains as delimitation elements. Bicycles and pedestrians were given separate tracks on one side of the road, past the drain. Raised zebra crossings at regular intervals (300–400m) assured low traffic speed. When tested, the road model reduced the number of pedestrians on the carriageway and the conflicts between motor vehicles and cyclists. The narrow carriageway encouraged motorists to slow down and drive safely, and prompted cyclists to stay off the road and use the cycle track. The cost saving from the narrower carriageway was large enough to pay for the separate bicycle and walkway facilities[*46].

c) Open side drain

Similar to narrowing lanes, placing open side drains between carriageways and walkways can be effective for reducing vehicle speeds. In this case, side drains act as a buffer zone between the two fluxes, protecting pedestrians. Footbridges must be put in place at regular intervals, particularly at crossings. Other measures like speed humps or table-top crossings at regular intervals must also be in place to ensure that car speed remains low.

d) Kerb extensions or chocker

The kerb line or sidewalk can be extended out into the parking lane, reducing the effective street width. Kerb extensions significantly improve pedestrian crossing by reducing the crossing distance, visually and physically narrowing the roadway, improving the visibility between pedestrians and motorists, reducing the kerb radius and lowering vehicles' turning speed.

Kerb extensions can be placed at corners or at mid-block points. When placed at an intersection, they prevent motorists from parking on or too close to a crosswalk, or from blocking a ramp. They also provide additional space for kerb ramps where existing space is limited. Mid-block extensions provide an opportunity to enhance mid-block crossings. Through the additional space, kerb extensions can provide an opportunity to place street furniture or vegetation, providing they do not block the visibility of pedestrians. They should only be used where there is a parking lane, while putting attention to the kerb radius so that vehicles can turn. Special consideration must also be taken to ensure that bicycle lanes are not obstructed.

Kerb extension at corner © UNEP

Planter used as a chocker to reduce speed © Regina Orvañanos

Box 18: Regulating and Removing Parking Spaces

The re-distribution of road space to introduce a bike lane may result in the removal of some parking spaces. For the remaining spaces, parking can be made more efficient through the installation of parking metres. These discourage long-term parking and encourage the rotation of private vehicles. Parking spaces that require motorists to pay are an important source of revenue for local governments. Share the Road recommends that part of the revenues be used to improve public transport or NMT facilities. The city of Westminster in London, designates 40 per cent of parking revenue for public transport and infrastructure, and 28 per cent for improvement and street maintenance[*47].

Vertical measures

a) Speed humps

Speed humps, or bumps, are parabolic raised elements placed in the carriageway to slow traffic. Traditionally, they are made of asphalt or concrete; modern speed humps can be made from rubber and incorporate recycled materials. They are the most widely used traffic calming measure. Despite their efficiency, speed humps have certain disadvantages. They are difficult to construct correctly and easily become distorted; they cause noise when cars break abruptly; they have a negative impact on storm water runoff, and they can damage road surfaces. On collector or arterial roads, other traffic calming measures such as raised crossings or lane narrowing are preferable.

Adequate storm water drainage is essential where speed humps and raised crossing are constructed, or they will rapidly deteriorate. No water should be able to accumulate on the pavement in front or behind the hump, or on the road shoulder next to it. If water does accumulate, the road base will weaken and the pavement will be damaged.

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b) Raised crossings

Raised zebra crossings, also known as table-top crossings, are highly cost-effective interventions. They offer three-fold traffic-calming benefits by substantially improve safety for pedestrians (safer crossings), two-wheelers (safer driving on the carriageway), and motor vehicles (fewer collisions). They also have a positive influence on traffic by reducing large speed differences between vehicles. For high-volume pedestrian crossings, the raised zebra crossing should be 5 to 6m wide, well connected to walkways, bus bays and footpaths, and clearly visible.

The vehicle speed reduction achieved by a raised zebra crossing depends on its slope and height (10 to 12cm will be enough for a straight slope). The desired speed reduction can be obtained by carefully selecting the slope of the concrete sloping block. The designed slope will result in an estimated speed reduction as follows*[48]:

Slope	Resulting speed
1:8	10-15 km/h
1:10	20-25 km/h
1:12	30-40 km/h

Box 19: Speed Humps vs. Raised Zebra Crossings

Although asphalt humps with standard zebra crossing markings have a cheaper initial construction cost, over time, the raised zebra crossings perform significantly better than the humps, as they are structurally stable. Asphalt concrete humps deform gradually and thus become less effective. The impact of raised zebra crossings is sustained over its lifetime. Even after people get used to them, the crossings continue to reduce traffic accidents*[49].

c) Speed cushion

A speed cushion is similar to a raised zebra crossing, although it does not cover the full width of the road. It is located at the centre of each lane and affects only one side of vehicles. They achieve most of the benefits of a raised crossing but let storm drainage flow freely, and cycling easy at the original street grade. A disadvantage is that speed cushions do not facilitate pedestrian crossings.

Share the Road Key Recommendation 12:

Avoid creating complex solutions. In the African context, the most elementary, cost-effective and robust interventions are usually the most successful ones.

© Emma-Liisa Hannula

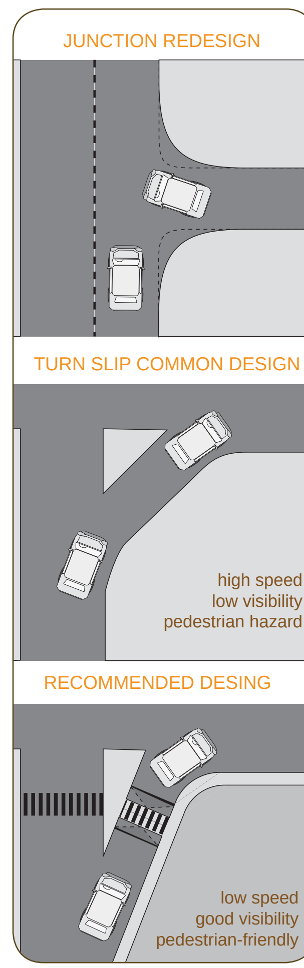
d) Kerbless streets

Kerbless streets are a modality where the carriageway is at-grade with the pedestrian walkway. This intervention can be used for commercial streets with high-intensity pedestrian use and low vehicle volume. The motorised lane must remain narrow and concrete or metal bollards should be used to keep cars off the sidewalk and pedestrians off the street. The use of different paver block or variation in their colours can be useful. Buffer zones must be created for urban furniture and other facilities. Kerbless streets help in draining water to the side of the road. However, attention should be paid to the street profile to make sure pedestrians avoid the storm water drainage path.

Intersection measures

a) Junction redesign

Intersections with angles other than 90° encourage increased speed on approach, and reduce the visibility of pedestrians and cyclists. The geometric re-design of junctions has proven to benefit pedestrian safety by reducing speed. The re-design should include a rectangular angle at the junction, and a smaller kerb radius.



b) Turns slip, corner island and kerb radius

Intersections are difficult places for pedestrians, because cars often turn without reducing speed. Strategic design of corner islands, lane width, turn slips, and kerb radii can reduce high-speed turns. Smaller kerb radii force cars to decrease speed, making crossing at intersections safer for pedestrians. Kerb radii should be calculated according to road typology, using the table below:

Slip lanes usually allow vehicles to turn at a higher speed. When slip lanes are narrowed, the sensation makes drivers reduce speed. Corner islands give pedestrians a place to stop. Introducing raised zebra crossings at slip lanes onto a corner island makes it easier and safer for pedestrians to cross.

Kerb radii	Use
1.50m	Roads lees than 30m ROW
3.00m	Most intersections
4.50m	Roads with truck traffic

Establishment of the road hierarchy

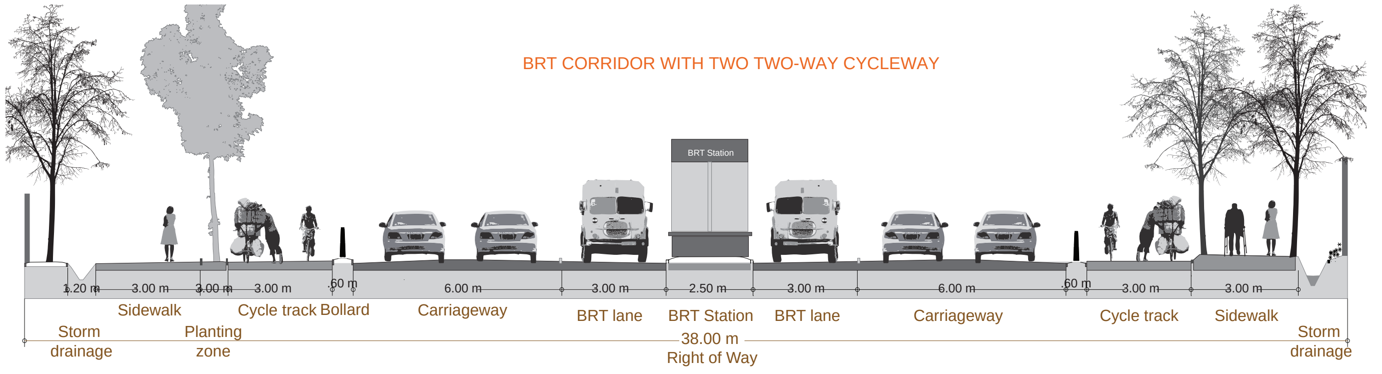
A hierarchical road network is essential to maximise road safety, residential amenity and legibility. Each class of road in the network serves a distinct set of functions and is designed accordingly. The road network for residential developments should have clear legibility. It is related to the intended land use and urban density; its definition helps identify the entire network as a unified system and prepare the adequate interventions. Roads can be classified hierarchically into the following categories, according to the road typology, different interventions can be applied.

Box 20: Thikka Highway, Nairobi

In Nairobi, the construction of an urban highway with vehicle speeds up to 120km/h has worsened road safety conditions for pedestrians, cyclists and public transport users. Pedestrian bridges are being built during the final stage of construction. Meanwhile, in just four months of partial operation (Jan-April 2012), more than seventy people have died on the highway, which equals two fatalities every 24 hours*[50]. Urban highways have a huge effect on pedestrian accessibility, and neighbourhood connectivity.

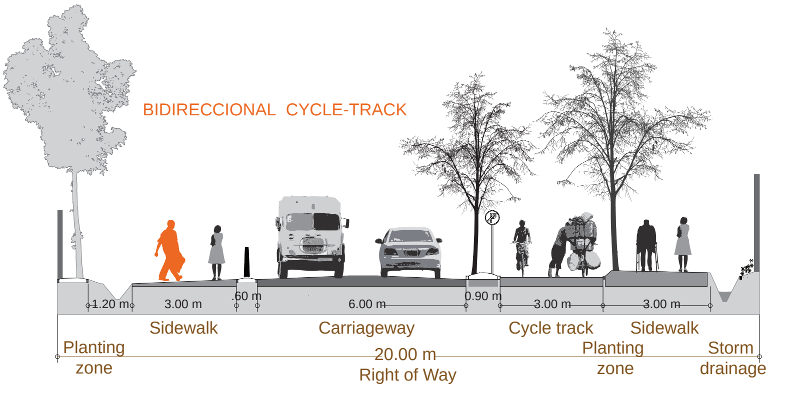
National or regional highways

Highways are a single-purpose logistical artery with state controlled rules and requirements. Their recommended minimum right-of-way (ROW) is 90m and not less than 60m. They should be avoided within urban environments, as they create barriers and fragment the city.



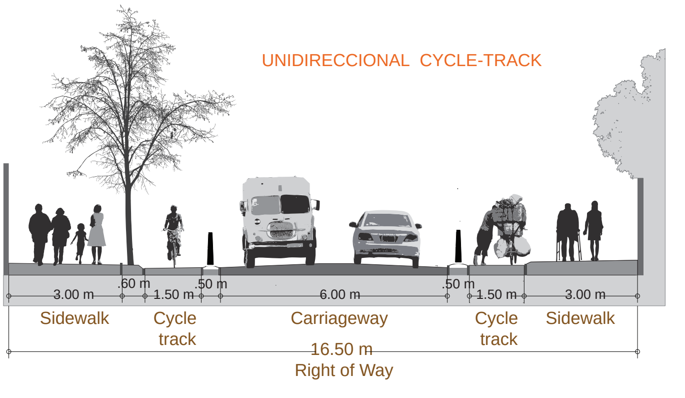
Arterial roads and Boulevard

Arterial roads and boulevards are primary roads with heavy, steady volumes of traffic, ROW between 60-80m for existing roads, and 80m for new roads. Arterial roads must include public mass transit. Other primary roads with heavy volumes of traffic should maintain a recommended ROW of 45-60m for existing roads and 60m for new roads.



Collector Streets

Primary collector streets connect arterial roads and inter-residential collector streets, and their ROW varies between 30 and 40m. Secondary collector streets gather traffic from local streets within one residential area and have a ROW between 18-24m.



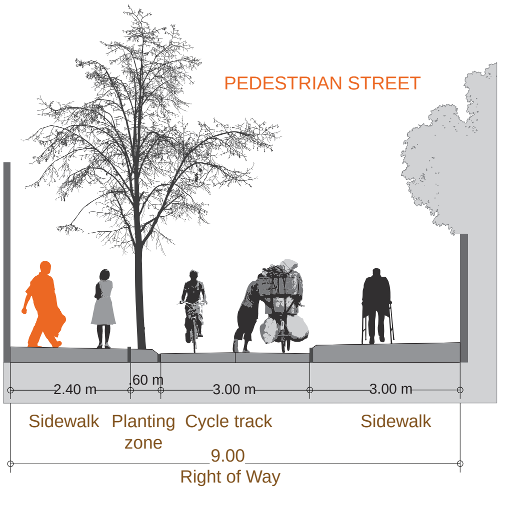
Local streets

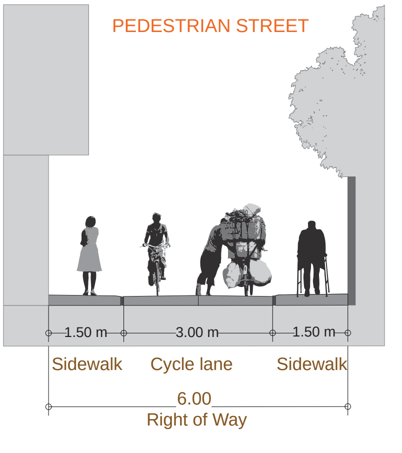
Local streets are intended for neighbourhood use only; through traffic should be discouraged. They have slow activity, low volume of traffic and low speed. Their ROW is between 12-20m. With traffic calming measures that ensure speeds of less than30km/h, local streets can become pedestrian-friendly.

Pedestrian-only streets

Traditional pedestrian streets restrain traffic access due to their narrow dimensions. They are usually 6m wide or less. Dominated by pedestrian and non-motorised flows, they are traditionally present in medina quarters and slum areas.

Pedestrian streets can also be found in areas with a high volume of commercial activity. In central business districts around the world, pedestrian zones have been very profitable for commerce.





Box 21: Pedestrianisation Projects

Pedestrianisation programmes have had broad acceptance and have been relatively easy to implement. Nairobi has created a few pedestrian-only areas, such as Mama Ngina Street in the Central Business District. By turning a two-way road into a one-way, it became possible to expand sidewalk width. The project included slip lanes with smaller kerb radii to reduce the speed of turning vehicles, as well as protection elements along the road. This successful intervention was partially paid for and fully supported by local commerce. Projects like this help reduce vehicle speed and improve the urban environment, which in turn intensifies commercial activity.

Measures to reduce cost of interventions

Stand-alone walkway and cycleway projects cost more than the same work performed as part of a larger project. Walkways and cycleways can be attached to projects such as road re-seals, water or sewer lines replacement, and placing utilities underground. Combining projects into bigger packages reduces costs per unit and eases implementation*[51].

Taking into account long-term benefits can create a strong argument in favour of interventions. Countermeasures for improving road conditions can be highly cost-effective. For example, the iRap plan for Kenya, a threshold Benefit-Cost ratio of 10 was used, meaning that each countermeasure recommended generated a benefit of at least 10 times its cost*[52].

Countermeasure type (urban)	BCR (Benefit Cost Ratio)
Shoulder widening	52
Pedestrian Crossing	17
Roadside safety barrier	17
Delineation	20
Regulate roadside commercial activity	61
Parking improvements	51
Intersection-roundabout	22

Adapted from iRap (2009) Kenya Results

Share the Road Key Recommendation13:

Implement a package of interventions that is large enough to be very visible and to have a tangible impact.

Matrix of traffic calming interventions

The following table shows a menu of proposed interventions:

Matrix of Traffic Calming Interventions	Share the Road Pillars			Condition achieved		
	Environment	Safety	Accessibility	Speed Reduction	Space Allocation	Better use of land
Road delineation		x		x	x	
Lane narrowing		x		x	x	x
Open side drain	x			x		
Kerb extension	x		x	x	x	x
Speed hump		x		x		
Raised zebra crossing		x	x	x		
Speed cushion		x	x	x		
Kerbless street			x	x		x
Junction redesign-kerb radius		x	x	x		x
Narrow turn slip		x		x	x	
Corner and median island		x	x	x	x	

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5 NMT and Intermodal Interface

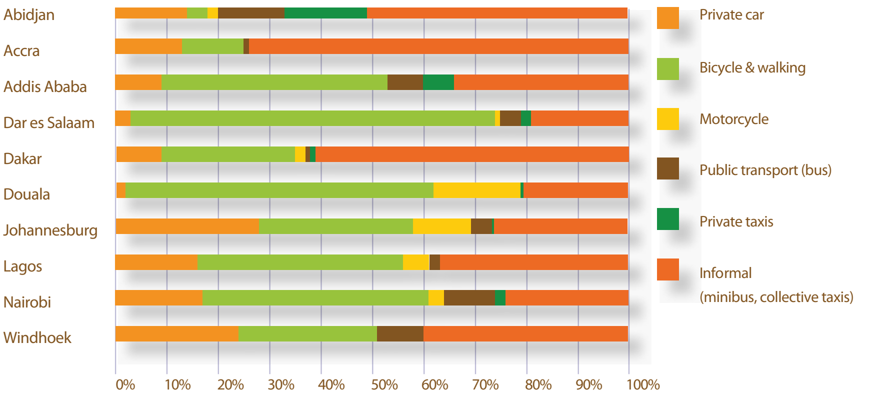
Improving public transport systems is a priority for African cities. Several cities have or are in the process of establishing Bus Rapid Transit (BRT) projects that restructure their public transport system. Although no single transport mode can solve all of a city's traffic problems, integrating available options can significantly improve urban mobility.

Intermodal travel is the use of two or more different modes of transport within a single trip. The term refers to how different modes are connected and how those links are facilitated. Effectively integrated travel modes can play a prominent role in improving mobility at a city-wide level.

One of the central elements of an effective BRT system is intermodal integration.

To enhance the quality of existing transport modes (formal and informal, motorised and non-motorised), it is essential to improve the connection between public transport and other modes such as walking, cycling, handcarts, and bicycle-taxi service (such as boda-bodas and rickshaws). The links between these modes are usually made by foot. Pedestrian traffic between mass transit stations is usually intense and requires extra space. Around main transport stations, pedestrian and cycling areas should be a priority, and sidewalks should be widened as necessary to accommodate a large volume of pedestrians.

Transport modal share of the cities



Based on: International Association of Public Transport (2010) 'Major Trends and case studies'

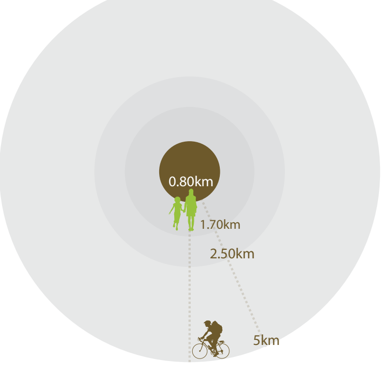
Box 22: Transport Household Expenditure

The average annual transportation spending per household for the lower income segment, or Bottom of the Pyramid (BOP), varies widely within and between regions. The average spending in Africa ranges from $25 a year in Burundi to $157 in Nigeria, $333 in South Africa, and $517 in Gabon. In Asia the range is from $101 a year in Nepal to $136 in India and $601 in Thailand. In contrast, in Latin America, BOP transportation spending is distinctly higher than in Africa and Asia. The range extends from $181 a year in Peru to $331 in Jamaica, $613 in Brazil, and $809 in Mexico (Measurements are expressed in 2002 purchasing power parity dollars)*[53].

Higher transport expenditures result in larger amounts of captive NMT users; people that do not necessarily wish to walk or cycle, but do not have any other choice. By improving intermodal travel and making non-motorised travel more attractive, more people will choose NMT for a portion of their trips, reducing their travel expenditures.

Increasing catchment areas

Every public transport trip starts and ends with walking. Ensuring that transport stations are easily accessible through non-motorised modes is crucial. To measure the number of potential users of a transport station, measure the number of inhabitants in the station's catchment area within a 15, 30 and 45 minute walking or cycling trip. Identify the most direct and obstacle-free route for the NMT trip.



Catchment Area of transit stops within walking and cycling distances of 10, 20 and 30 minutes

Average Speed	Distance in 10min	Distance in 20min	Catchment Area (within 20min)
5 kh/h	0.80km	1.70km	8.70km^2
15 km/h	2.50km	5 km	78.50km^2

If walking conditions are improved around public transport stations, people can walk longer distances in a shorter amount of time, therefore increasing the catchment areas. Improved walking conditions make it possible for people to walk farther during their 15, 30 or 45 minute trip. When pedestrians are willing to walk longer and farther, the public transport catchment area increases, as well as the number of potential public transport users.

Pedestrian consideration in transit stations

Public transport stations can vary in size according to the volume of passengers they serve, from a simple bus stop, to an intermodal BRT or a rail station. Despite their size, the following considerations must be kept in mind for pedestrians:

- Allow simple, direct and universal access;
- Provide a comfortable place for pedestrians, and buses to stop without compromising safety; and
- Do not break the continuity of sidewalks or non-motorised modes of transport.

a) Bus shelters

Bus shelters should have the following basic characteristics:

- Transparent sides for better visibility;
- Access in and out of the shelter at two points;
- Include seating facilities, a litter bin, and display surface;
- Keep a 1.00m setback from the kerb line, including the roof overhang; and
- Provide sufficient lighting.

Share the Road Key Recommendation 14:

Connecting sidewalks and cycling paths to bus stations and other motorised transport nodes expands transport options. It not only makes travel more efficient, but also increases public transport ridership.

Bus shelters should preferably be placed between the sidewalk and the street, or between the sidewalk and adjacent property, so that waiting passengers do not obstruct the flow of pedestrians along the sidewalk. Benches and other street furniture should be placed outside walking paths to keep the walkway accessible.

b) Bus bays

Long bus bays should be able to accommodate 3 to 4 minibuses. They should have a three-metre-wide pavement, and paved pedestrian waiting areas that are separated from the bay by high curbs. The construction of raised zebra crossings at the bus bay locations force buses to slow down at the bus bays, providing safe crossing for passengers before or after their trips. Separating the carriageway from the shoulder near bus bays discourages random stopping.

Properly designed bus bays have positive impacts. They offer economically attractive areas for kiosks and street trading. Incorporating proper space for street vendors and small shops in their design can increase their value as a public amenity, creating a source of revenue for the local government.

A study in Morogoro, Tanzania showed that bus bays with raised zebra crossings were more often used by minibuses: 70 per cent of minibuses stopped at bus bays with raised zebra crossings, compared to 30 per cent at standard bus bays. Since the raised crossing forced them to slow down, most minibuses used the bus bay to let passengers on and off[*54].

c) Bus Rapid Transit stations

BRT stations have standardised designs to ensure efficiency and encourage high user volume. Each station must include platform-level boarding for universal access, tactile signage for visually-impaired users, climate protection, sliding doors, and be integrated into pedestrian walkways, bicycle paths and other public transport. Many of the BRT station requirements, particularly those promoting universal accessibility, can be applied to other public transport stations. Measures improving accessibility can also be applied within a 2km range surrounding the station to ensure a better catchment area.

Lagos, Nigeria and Johannesburg, South Africa have introduced BRT corridors, which have significantly improved the efficiency of public transport. Cities like Dar es Salaam, Addis Ababa, Kampala and Nairobi are also considering BRT projects in the core city.

Interior of a BRT station, Guadalajara, Mexico © Colectivo Ecologista Jalisco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WARNING

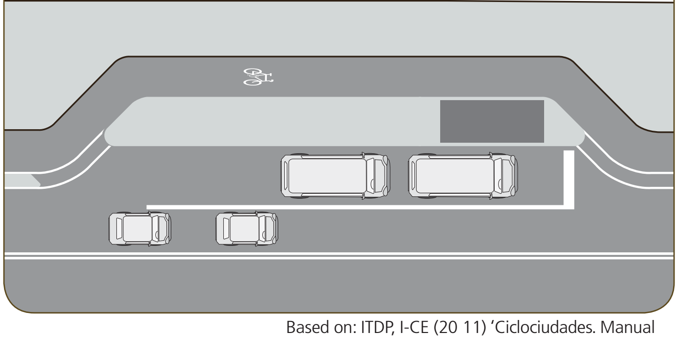
d) Cycleways and BRT corridors

Cycling should be integrated into BRT systems as part of an integral transport plan. Cycleways can interact with BRT corridors in two modes; as feeders along the corridor, and as part of the road section. Both methods present advantages.

BRT corridors are usually built along arterial roads or boulevards with a standard right of way ranging between a minimum of 23m and 30m. Such corridors are planned within busy urban areas and give priority to public transport and NMT. The use of cycle-ways as part of the section increases its attractiveness, making it a more inclusive urban corridor.

Cycleways can partially replace other transport modes as feeder systems. Used as feeders for public transport, bicycle paths can have a catchment distance of 7-10km. Provision of adequate and safe bicycle parking facilities can increase intermodal travel. However, a BRT system may not be accessible to the urban poor due to the cost of fares, and a cycle-way system designed only for intermodal transfer may result in a transport system that promotes social exclusion.

BUS BAY AND CYCLE TRACK INTEGRATION



Based on: ITDP, I-CE (20 11) 'Ciclociudades. Manual integral de movilidad ciclista para ciudades mexicanas'.

Share the Road Key Recommendation 15:

Bicycle use should not replace public transport, but should be integrated into an intermodal transport policy.

Integrating NMT into other modes of transport

Non-motorised transport can complement the transport system within urban and peri-urban areas. In Africa, cycling offers both direct and indirect economic benefits for the user and the country. The bicycle is often a work tool, and promoting bicycle use can generate benefits for the economy as a whole. Cycling has two important functions; it generates income and provides service for individuals.

After 60kms of cycleways were included in a network in Tamale, Ghana, cycling accounted for 65 per cent of trips. The network was fully integrated into other transport modes, including long-distance travel modes like taxis and lorries*[55].

Box 23: Economic Potential of Promoting Bicycle Use

Organisations like "Cycling out of Poverty" promote the use of bicycles for income generation, particularly for women. Through a system of micro-credits, farmers, traders, bicycle taxis, waste collectors, water vendors, and others can improve their well-being and their livelihoods. Bicycles can simplify daily chores for women, like carrying water or going to the market, thus saving time that can be used to generate income or improve quality of life. In Uganda and Kenya, among other countries, wheelchair tricycles are used mainly along the border to transport goods, providing a source of income for disabled men and women.

Bicycle use increases productivity, as it reduces the travel time –compared to walking trips: and cuts the travel costs as compared to using public transport. A case study from South Africa shows low-income earners spending 25% of income on public transport to and from work. After the initial purchase cost of a bicycle, the household cost of transport was reduced to 5% of income after three months*[56]. Another study made in Uganda found that boda-boda drivers had a higher income than agricultural workers in the same city*[57].

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a) Bicycle taxis and rickshaws

Bicycle taxis carry passengers and/or goods, particularly in smaller cities and peri-urban areas. They are often found at minibus stops where they often complement journeys, serving areas that are not served by public or informal transport. Provision of a shaded area will help promote their services. Similarly, in many Asian cities, rickshaws are widely available as a transport option.

> Different modes of transport should not interfere with each other, but rather complement each other as elements of a unified city-wide system.

b) Handcarts

Handcarts provide an accessible means of transporting goods for personal or occupational use. They have an average speed of 3-5km/h and can carry loads of up to 400kg[*58]. Handcarts are in great demand because they are cheap and commonly available. Many women who are licensed street vendors and shopkeepers depend on handcarts to ferry heavy and bulky goods. Their service for carrying goods can be a fraction of the cost of motorised pickups, which are rarely available[*59]. In East African cities, a vast portion of the population utilize handcarts. Facilities for handcarts, such as parking places, should be considered in NMT planning, particularly on routes between markets and transport stations. Regulations that determine which roads should be accessible to handcarts, and measures to improve their safety should also be factored into transport planning.

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Box 24: Handcarts in Nairobi

In Nairobi, handcarts are used by 10.8 per cent of NMT users[*60]. A survey showed that 65 per cent of the city's handcarts served the main central markets, 24 per cent were used around bus terminals, and the remaining 12 per cent circulated on the streets[*61]. Handcarts are licensed by Nairobi City Council for a fee that entitles them to use the roads. However, handcart operators are not provided with facilities such as parking spaces, or any special rights of way[*62].

© Christ The King Catholic Church, Kibera

6 Social Infrastructure

As in many public space projects, NMT facilities can potentially increase social integration if the population's needs and concerns are taken into account during the planning process. Building inclusive pedestrian and cycling infrastructure that promotes a more equitable use of public goods can reinforce social values, maximising the social benefits of existing urban investments.

Social infrastructure is the basic foundation needed for the operation of a society. Principles such as traffic education, law enforcement, participation, gender inclusion and capacity building are elements of social infrastructure that help make public facilities more functional and increase their value to society. These principles are key factors in the success or failure of transport planning, even when projects are technically sound.

A medium- to long-term investment, social infrastructure can positively affect how a city evolves, and serve as a model that can be replicated in other cities. Successful social infrastructure works hand in hand with on-the-ground infrastructure. The recommendations in this chapter are not directly related to infrastructure design but have a profound effect on its development.

Traffic education and enforcement

Effective traffic code enforcement and traffic education are two sides of the same coin. Teaching drivers, pedestrians and cyclists how to interact with the road infrastructure brings safety and order into the urban space. When traffic codes are understood and enforced, road users can anticipate the behaviour of others, preventing accidents. A more orderly use of road infrastructure leads to fewer accidents and less congestion, which in turn, saves substantial amounts of money.

Many people using road facilities are not aware of the most basic elements of the traffic code. For this reason, it is vital to invest in a long-term traffic education campaign. Traffic education programmes can provide instruction on how to use new infrastructure like cycleways efficiently and safely. In many countries, traffic education is part of the curricula for elementary education. However, if codes are not enforced and children do not see adults following the rules in their daily lives, school programmes may not be effective. Traffic education is a long process that must be accompanied by actual enforcement; when applied together they can transform road behaviour within a relatively short time frame.

Public participation

When traffic regulations are not enforced, other road users may encroach on pedestrian and cyclist space. However, encroachment may also signal a lack of consideration of certain users needs. Stakeholder participation during infrastructure project planning is a key element of success. Considering the needs of neighbours, shopkeepers, street vendors, taxi drivers, and other frequent users will not only bring new ideas and activities into the programme, but will also positively impact public perceptions of the project.

Informal businesses frequently encroach on cycle paths. Experiences in cities like Ouagadougou and Nairobi show that designating space for street vendors, taxi, motorcycle taxi drivers and handcarts can help ensure that cycle path space is respected.

Share the Road Key Recommendation 16:

Regular stakeholder consultations increase a project’s chances of success. Stakeholder participation helps identify user needs and minimises implementation problems later on.

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Box 25: Encroachment on Cycling Facilities

In Eldoret, Kenya, bicycle tracks were built along an urban corridor. After implementation, the municipality was unable to convince shopkeepers to keep the space in front of their shops free for use as a walkway. As a result, pedestrians used the new “bicycle” track. Almost all cyclists continued to use the carriageway, since the track was full of pedestrians. Even if the path was not fully used by cyclists, the upgrading and construction of footpaths separated from the carriageway was considered one of the city’s more successful NMT interventions*[63].

Gender inclusion

Every transport project must take gender perspectives into account. Women and men travel in different ways and their transport choices are motivated by different factors. In Africa, most means of transport, including bicycles, are owned and operated by men, leaving women less mobility options. In certain regions, bicycles are widely used by women, while in others, cultural traditions keep women from taking advantage of the many productive opportunities cycling can offer. Similarly, vehicles design- of bicycles or buses- may complicate use. Both men and women should have equal access to any transport mode.

At night, certain areas are dangerous for walking or have dark transit stops, which increase the risk of gender violence and reduces the mobility of women. Transport planning and promotion campaigns should address women's mobility needs in a culturally appropriate manner.

© Marlene Gamez

Promotional campaigns

Promotional campaigns that address the physical, economic and cultural obstacles to walking and cycling are crucial to increasing NMT use. They can be organised by local authorities, by civil society, or through the cooperation of both. There are several organisations in Africa already engaged in promoting bicycle use. Many of them are working on making it easier for the local population to purchase a bicycle, and are setting up workshops where people can create, adapt and maintain non-motorised vehicles. NMT promotional campaigns can follow various strategies:

- To increase the supply, access and affordability of bicycles;
- To organise awareness campaigns and recreational activities addressing cultural taboos, such as the view that cycling is bad for women, or is a transport mode only used by the poor;
- To organise mass cycling trips where people can feel safer travelling in a group;
- To facilitate travel by providing information on safer and more convenient cycling routes.

Socio-cultural taboos that create barriers to bicycle use can be addressed through promotional campaigns. A study in Ouagadougou and Bamako found that despite the general acknowledgment that bicycles offer a good way to get from one place to another, they have a bad image: bicycles are associated with poverty and rural life. The perception of cycling needs to changed in Africa so that it becomes fashionable and attractive. Mountain bikes, for example, have a positive image, particularly among young people. They are considered to be recreational vehicles that are elegant, comfortable and modern, and therefore a sign of social status. A wider choice of bikes on the market can help combat the poor image associated with the traditional African bicycle[*64].

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Box 26: Image and Gender Choice

Cultural values can have a strong influence on the choice of transport mode. A 2002 study showed that while in Ouagadougou 33 per cent of bicycle riders were women, in Bamako, women cyclists were almost inexistent. In Bamako only 50 per cent of women knew how to ride a bike, as opposed to 95 per cent of the men. Women that had never learned how to ride had a more negative view of the bicycle[*65].

Share the Road Key Recommendation 17:

Any promotion campaign focusing only on the cost of bicycle use risks being counter-productive, by reinforcing the image of poverty linked to this mode of transport*[66].

Advocacy groups

Advocacy groups play an important role in promoting and changing the mind-set of users and decision-makers. Groups dedicated to promoting the benefits of NMT have emerged in several African countries.

In November 2001, organisations lobbying for bicycle use gathered in Jinja, Uganda for the first Pan African Bicycle Conference. The objective was to discuss the changing role of the bicycle in the 21st century. The Pan African Bicycle Network (PABIN) was created to facilitate information sharing among different groups working to put bicycle use on the African development agenda*[67]. One of the outcomes of the conference was the Jinja Declaration*[68] which proposed that "given the importance of personal mobility for economic and social development, and that affordable mobility is critical to sound economic and social development in Africa," African governments and other stakeholders must:

- Recognise NMT as the most efficient and effective mode of local transport;
- Establish planning and design guidelines and standards for NMT;
- Promote development of policies and practices that protect the rights of non motorised travellers;
- Formulate policies that support the development of bicycle enterprises;
- Facilitate intermodal trip generation and assignment; and
- Create awareness programmes highlighting the importance of NMT and its role in society, among others.

Box 27: Ghost Bikes

Ghost Bikes is an international advocacy movement to raise awareness about bicycle safety. The movement memorializes cyclists killed or injured on the road by placing a white bicycle with a small plaque near the site where the accident took place. The white bikes serve as a reminder and a plea for cyclists' right to safe travel. They have also helped identify dangerous routes and improve road conditions for vulnerable users. The movement started in St. Louis, Missouri, in the USA and has been replicated in 180 cities around the world*[69].

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Capacity building

If properly designed, NMT infrastructure projects can increase the capacity of public institutions, academia and civil society organisations. NMT projects can train engineers and builders, who will in turn apply principles such as universal accessibility to other public projects and facilities. The processes can sensitise others about the needs of vulnerable road users, enhancing urban life and promoting social inclusion.

Studies and evaluations make it possible to learn about the outcomes and impacts of existing pilot projects. Best planned at the beginning of a project, they may consist of user surveys or other information gathering processes. Surveys can be qualitative or quantitative, such as traffic counts segregated by user (including pedestrians and cyclists), age and gender. It is important to use indicators that measure policy objectives such as:

- Environmental: reduced CO^2 emissions per trip, per population;
- Accessibility: increased locations within transport catchment areas, number of inhabitants in catchment areas; and
- Safety: reduced number of accidents and fatalities.

Box 28: Citizen's Advocacy for Infrastructure

In Guadalajara, Mexico, a group of students and cyclists got together and painted cycle lanes on roads that led to universities. Following the official master plan for NMT and using funds they had collected, they painted 13km of lanes in three mornings. The action backed up their demand for better NMT infrastructure, demonstrating that will is more important than large investments when it comes to improving NMT conditions. The cycle lanes were officially recognized by the city authorities, and the experience has been replicated in other cities around the country.

© Felipe Reyes

UN Avenue Share the Road experience

The first Share the Road NMT pilot project in East Africa, UN Avenue offers valuable lessons for future initiatives. In 2011, NMT facilities were added to the avenue in order to improve pedestrian and cyclist safety. Cycleways and sidewalks were installed, along with raised zebra crossings for pedestrians and a left-turn slip lane for cars.

Once the project was completed, Share the Road conducted a survey along the avenue to see what users thought of the improved road and if they were benefiting from the new facilities. Overall, users perceive an improvement in road safety, security and convenience.

Separating pedestrians and cyclists from vehicles through NMT infrastructure has reduced the severity and number of accidents. However, improved driving conditions have actually increased vehicle speed as well as their number. Traffic calming measures, such as raised zebra crossings and refugee median islands, improved crossing conditions. But in sections where vehicles continue to circulate at high speeds, the painted-only pedestrian crossings have little effect on traffic.

Despite changes in the bike pathway to facilitate NMT, after six months of operation, the number of cyclist has remained steady on the road section. Surveys show that most cyclists use the avenue as an access route, while pedestrians generally start or finish their trip in the neighbourhood. Cycling trips tend to be longer than the intervention area. In order to increase the number of bicyclists, the origin and destination of cyclists should be identified and further improvements added along those routes within a 10km radius.

There are virtually no women cyclists along the route. Any promotional campaign should include a gender perspective.

Many cyclists continue riding through the carriageway, despite the addition of improved dedicated bike paths. The two main reasons for this are obstacles that prevent continuous use of the cycleway, and lack of adequate road markings. In direct relation to this, awareness raising is a key aspect of supporting effective behavioural change; and in the context of UN Avenue this output has not yet been undertaken. Behaviour change slowly, and a survey would be more useful once users had time to adapt, at least a year after project completion.

Survey responses also revealed that pedestrians and cyclists using this particular NMT facility had very different priorities for improvements to the facilities; pedestrians prioritised ease of access, including time issues associated with this; whereas cyclists found that improved safety conditions were the single biggest benefit of the infrastructure rehabilitation.

However, post-project analysis indicates that UN Avenue users lack awareness of NMT issues, not only regarding road safety, but also environment and accessibility—key elements of the Share the Road programme. The Share the Road Programme is planning to enhance focus on awareness raising and enhanced civil society integration into the process.

Enhanced coordination between different stakeholders may have reduced duplication of effort, and consequently reduced the costs and time frame required for project completion. Whilst physical infrastructure rehabilitation measures were minutely planned and closely overseen, social issues such as alterations to road utility for commercial reasons, such as taxi ranks and informal traders, were not integrated from the outset.

Capacity has been enhanced among staff at the Kenyan Urban Roads Authority (KURA). Future projects in other parts of the city can profit from their experience with technical, economic and social issues. Detailed final costs of the projects will be evaluated and used as a reference when planning future projects.

Box 29: Walking Time Savings

Results from Share the Road's UN Avenue project show increases in the average speed of pedestrian and cycling trips as road conditions improved. Better walking conditions (from an inadequate or non-existent walkway to a flat, unobstructed walking surface) resulted in a savings of 4 minutes per pedestrian kilometre. This corresponds to an increase in average walking speed from 3.5 to 4.5km/h. Improved cycling conditions (the addition of a separate cycling lane) resulted in a savings of 2 minutes per riding kilometre, corresponding to an increase in the average riding speed from 10km/h to 15km/h.

Conclusions

UNEP's Share the Road programme merges environmental, accessibility and road safety agendas with promoting NMT infrastructure and investments. Simultaneously, the programme helps develop policies and practices that are favourable to NMT. A new accessibility paradigm that centres on moving people, rather than vehicles, will help promote social and environmental justice by improving standard of living and quality of life. The impact of road infrastructure should take into account all road users, regardless of their means of mobility.

There are three conditions for non-motorised infrastructure: vehicle speeds that promote the coexistence of several modes of transport; provision of sufficient urban space for pedestrian, cyclists and other vulnerable road users; and promotion of urban land use that reduces travel distances and makes public transport more efficient. These guidelines are a preliminary exploration of the possibilities for improved transport infrastructure in fast-growing African cities. New, inclusive road infrastructure should lessen environmental impacts and facilitate accessibility, while diminishing road fatalities and injuries.

We recommend that interventions for improving NMT infrastructure be tested on the ground and that their impacts on road safety, accessibility and environment be evaluated, so that other African cities can benefit from the lessons learned. We hope that the menu of interventions proposed in this document can inspire and stimulate decision-makers and urban planners, and help make walking and cycling a priority throughout the continent.

In the spirit of improving knowledge and increasing capacity regarding NMT facilities in the African context, we encourage urban planners and other readers to share their feedback, case studies and lessons learned from their experiences in the region.

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Annex 1: Organisations promoting NMT in Africa

Several organizations and NGOs work in sub-Saharan Africa to promote cycling and pedestrian infrastructure. The majority of these focus on making bicycles accessible on the local market, and advocating for NMT safety and infrastructure. Below is a list of organisations that are active in Africa.

International organisations:

- Cycling out of Poverty: NGO based in the Netherlands, supports projects in Kenya, Uganda, Rwanda, Burkina Faso, Togo and Ghana. www.cyclingoutofpoverty.com
- I-CE (Interface for Cycling Expertise). Dutch-based NGO. Its Bicycle Partnership programme is active in Botswana, Ghana, Kenya, Uganda and South Africa. www.bikepartners.nl
- ITDP (Institute for Transportation & Development Policy) Based in New York, with regional offices in Tanzania and South Africa. www.itdp.org
- GIZ (German International Cooperation Agency) offers international expertise, policy advice, training and capacity building through the SUTP (Sustainable Urban Transport Project). www.sutp.org
- Goudappel Africa: a land use, traffic and transport consultancy registered and based in Uganda. www.goudappelafrica.com

African-based cycling organisations:

- African Bicycle Network. www.africanbicyclenetwork.org
- Pan African Bicycle Information Network. www.ibike.org/pabin/index.htm
- BEN (Bicycle Empowerment Network). Offices in South Africa, Botswana and Namibia. www.benbikes.org.za
- BSPW (Bicycle Sponsorship Project & Workshop), Jinja, Uganda. www.bspw.org
- CCE (Centre for Cycling Expertise) NGO based in Ghana. www.centrecycling.org
- FABIO (First African Bicycle Information Organization). Based in Uganda. www.fabio.or.ug
- QHUBEKA. Based in South Africa. www.qhubeka.org
- UWABA Tanzania. Cycling Community in Dar es Salaam, Tanzania. www.uwaba.or.tz/index-en.htm
- Pedal Power Association of South Africa: www.pedalpower.org.za

African community-based organisations with cycling promotion programs:

- La Nouvelle vie, Rwanda.
- AVO (Association d'Aide aux Veuves et Orphelines) Burkina Faso.
- HAU (Hope Alive Uganda) a community based organisation in Kisozi, Uganda. www.hopealiveuganda.org/
- NHASD (New Horizon Association for Social Development) Egypt. www.nhasd.org/

Glossary

Albedo: the proportion of incident light or radiation that is reflected by a surface.

Boda-Boda: Originally, a bicycle taxi used across the Kenyan-Ugandan border to transport people and goods, later became a generic term for bicycle taxis in both countries. Most recently, it also refers to motorcycle taxis.

Bollards: Any of a series of short posts set at intervals to delimit an area (as a traffic island) or to exclude vehicles.

Buffer Zone/ Safety Strip: A safety gap between a cycle track and a carriageway.

Capacity: The maximum number of vehicles that can pass over a given section of a lane or roadway in one direction during a given time period.

Carriageway: The part of a road used by vehicular traffic.

Crosswalk: the portion of a roadway usually indicated with lines, signage and sometimes traffic lights to indicate that pedestrians have priority.

Cycle Facilities: Infrastructure that is cycle-specific, such as cycle lanes paths and parking.

Cycle Network: An integrated network of both on- and off-road routes to make trips easier and safer for cyclists between various origins and destinations.

Cycle Lane: A portion of a roadway that has been designated for preferential bicycle use by striping, signing and/ or pavement markings, separated from adjacent travel lanes for motor vehicles.

Cycle Path/ Track: A path designated for preferential or exclusive bicycle use that is physically segregated from the carriageway.

Cycleway: a generic term that refers to both physically segregated facilities for cyclists and visually segregated facilities and routes marked as suitable for cycling.

Footpath: an informal travel path for pedestrians created by repeated use and usually separated from the roadway.

Intermodal: A term that refers to connectivity between modes as a means of facilitating linked trips.

Intermodal Facilities: Transportation facilities that provide for seamless links between travel modes.

Intermodal Trip: A trip that encompasses different modes of transport: walking, cycling, motorised public transport, or private vehicle.

Kerb/ Curb: A raised edge between a road carriageway and a footway. Often around 150mm.

Modal Split: usually expressed as a percentage that refers to the distribution of the different transport modes, usually at peak periods on work days, and refers to the number of trips made by single or multiple passenger private vehicles: bus, rail, bicycle and pedestrian modes.

Mode: Any means of moving people or goods: aviation, bicycle, highway, para-transit, pedestrian, pipeline, rail, water.

Parallel Route: Roadways suitable for cycle travel or off-road cycleways within a reasonable distance and along the same general corridor.

Paratransit: Transportation services that are either non-formal or provided customised, by-demand transport services through an unfixed route (e.g. for senior citizens of disabled people).

Planting Zone: a contiguous area within a right-of-way, along a kerb, cycleway or sidewalk used to provide landscape features, separation of uses and to improve comfort, attractiveness and the environment.

Peri-urban: The urban area on the periphery of a city.

Protections: Fixed urban elements whose purpose is to protect bicycle and pedestrian areas from encroachment by motorised vehicles, without affecting the ability to access them.

Right-of-Way (ROW): The width available for the construction and operation of transport facilities.

Sidewalk: A walkway separated from the roadway with a kerb or other protective barrier and constructed of a durable, hard and smooth surface, designed for preferential or exclusive use by pedestrians.

Street Furniture: fittings and fixtures on streets, such as benches, lamp posts, street signs and other structures. Street furniture can also include bike racks, planters and other elements to improve the quality of public spaces.

Streetscape: The appearance or view of a street.

Shoulder, Paved: The paved area between the motor-vehicle lane and the edge of pavement.

Traffic Calming: A combination of measures aimed at altering driver behaviour, primarily by reducing speeds and improving conditions for pedestrians and cyclists. Traffic calming is based on the fact that traffic speeds under 30km/h substantially reduce fatal or serious accidents and injuries.

Trip: A journey, from start to finish.

Walkability: the degree to which an area is easy to walk.

Walkway: A pedestrian facility, whether in the public right-of-way or on private property, which is provided for the benefit and use of the public.

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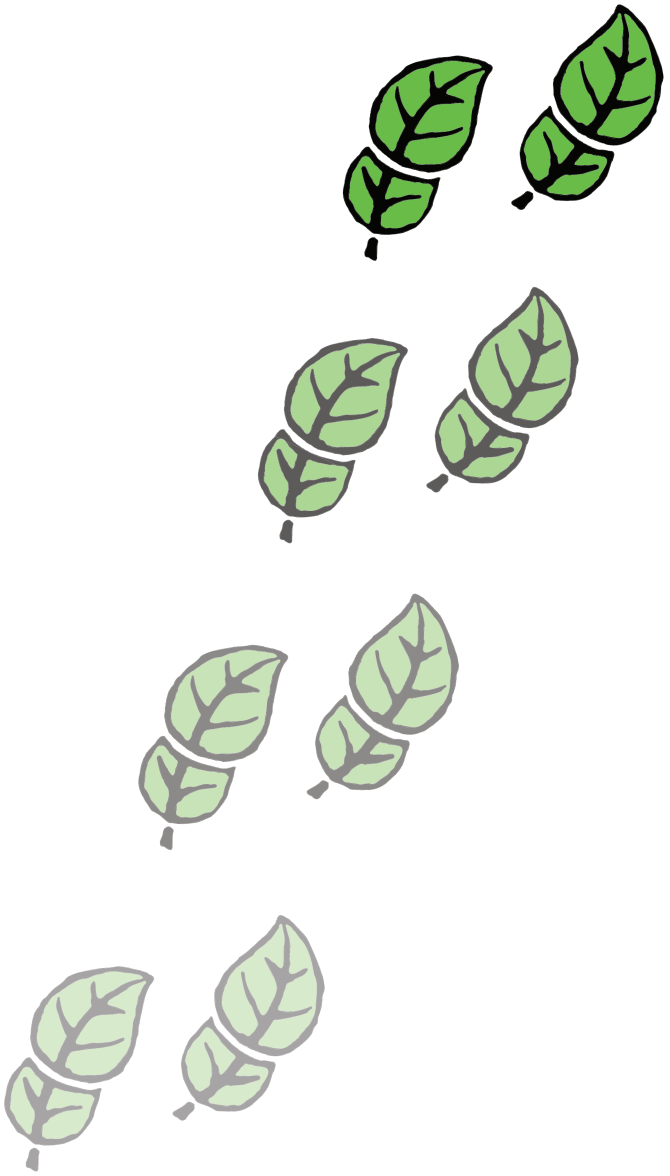

For more information please contact:

United Nations Environment Programme
Division of Technology, Industry and Economics
Energy Branch
Transport Unit

P.O. Box 30552, Nairobi, Kenya
Tel: (+254 20) 7624184
Fax: (+254 20) 7625264

Email: nmt.roads@unep.org
www.unep.org/transport/sharetheroad