Addis Ababa Sidewalk Design and Maintenance Guidelines

Addis Ababa Sidewalk Safety and Improvement Study

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Contents

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The Addis Ababa (AA) Sidewalk Safety and Improvement Study is undertaken as part of the Ethiopia Transport Systems Improvement Project (TRANSIP), under the general guidance of Ousmane Dione (Country Director for Ethiopia), Doina Petrescu (Operations Manager for Ethiopia), and Maria Marcela Silva (Practice Manager, Transport Global Practice) at the World Bank. The Global Road Safety Facility (GRSF) of the World Bank provided funds to support the study with funding from UK Aid.

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Abbreviations

AACRA	Addis Ababa City Roads Authority
GRSF	Global Road Safety Facility
ITDP	Institute for Transportation and Development Policy
LED	Light Emitting Diodes
LOS	Level of Service
LRT	Light Rail Transit
NACTO	National Association of City Transportation Officials
PRM	Person with Reduced Mobility
SWOT	Strengths, Weaknesses, Opportunities, Threats
TOD	Transport Oriented Development
UNESCO	United Nations Educational, Scientific and Cultural Organization
WB	World Bank
WHO	World Health Organization

Glossary

Accessibility	The relevant measures to ensure access for persons with disabilities, on an equal footing with others, to the physical environment, transport, information and communications, including information and communication technologies and systems, and other services and facilities open to the public or for public use, both in urban and rural areas. *Source: General Law for the Inclusion of Persons with Disabilities*
Sidewalks	Space for pedestrian movement and access, with the objective of improving connectivity and promoting active mobility. Additionally, they serve as a transition space between the city/public space and private establishments. *Source: National Association of City Transportation Officials*
Tactical Urbanism	Low-cost, temporary changes to the built environment, usually incities, intended to improve local neighborhoods and city gathering places. *Source: Bike Utah*
Public space	Area or place that is open and accessible to all people, regardless of gender, race, ethnicity, age or socio-economic level. These are public gathering spaces such as plazas, squares and parks. Connecting spaces, such as sidewalks and streets, are also public spaces. *Source: UNESCO*

Glossary

Traffic Calming	Use of physical design and other measures, including narrowed roads and vertical or horizontal deflections, with the intention of slowing down or reducing motor-vehicle traffic and speed to improve safety for pedestrians and cyclists is known Traffic Calming. *Source: NACTO*
Level of service	defined a range of values to standardly describe the impact of contextual situations of density on pedestrian flows. *Source: Fruin, 1971*
Walkability index	Walkability index is an indication of the built environment's suitability for walking on a street or in a neighborhood The walkability of any neighborhood will increase when pedestrians are provided with a safe, comfortable, and accessible infrastructure. *Source: Khaled Shaaban, 2019*
Permeable frontage	A permeable façade refers to the street frontages or edges that allow a visual or physical engagement between the street users and the ground floors of buildings Frequent openings and windows with few blank walls; narrow-frontage buildings that give vertical rhythm to the street edge; facade articulation; transparency that promotes eyes on the street; and uses spilling onto the street contribute to active frontages. *Source: NACTO*
Transport Oriented Development	TOD, or transit-oriented development, refers to integrated urban places designed to bring people, activities, buildings, and public spaces together, with easy walking and cycling connections between them and near-excellent transit service to the rest of the City. *Source: ITDP*

Introduction

"Lowly, unpurposeful and random as they may appear, sidewalk contacts are the small change from which a city's wealth of public life may grow."

- Jane Jacobs.

Walking is the mode of travel predominantly used in Addis Ababa as more than half of the total daily trips are made on foot. The warm weather in Addis Ababa makes the use of this healthy and green mode of transport possible. However, sidewalks are often narrow, uneven, obstructed, or non-existent, making them a nuisance and a safety risk for the most vulnerable road users: pedestrians. In 2018, 363 pedestrians lost their lives in Addis Ababa. Based on statistics from the Addis Ababa Road Safety Annual Report 2017-2018, this figure represented 76% of total fatalities per year caused by traffic accidents.

Currently, the City does not have enough research data regarding pedestrian sidewalk safety, which prevents the City from formulating and implementing effective solutions. So far, initiatives have focused on roads and intersections, and not on a systematic diagnosis of sidewalk safety.

For this reason, the World Bank has conducted the **ADDIS ABABA SIDEWALK SAFETY AND IMPROVEMENT STUDY,** in collaboration with Addis Ababa City stakeholders, to develop strategies and tools, and address pedestrian safety issues.

This project entailed a study in a selected area to identify the elements hindering sidewalk quality and user safety, as well as pedestrian infrastructure design, construction and operation. Recommendations are made to maximize accessibility and connectivity.

This study aims to be the first systematic approach in addressing sidewalk safety for pedestrians. It intends to raise awareness and build analytics on unsafe walking conditions, and connect pedestrians, sidewalks, urban design, and road safety with a comprehensive approach.

Throughout the study, the interrelationship between the development of quality pedestrian infrastructure and the improvement of other key elements for the City was proven:

- the need to increase vegetation, public recreational spaces, and green spaces.
- the need to mitigate and adapt to climate change, reducing the likelihood of flooding and facilitating movement in adverse weather conditions, such as rain, wind or heat; and finally,
- the importance of fostering gender equality in the use of public spaces and public transit.

These guidelines seek to promote the development of quality pedestrian infrastructure and environments, based on the condition's assessment and global best practices. The information and visual rendering shared provide recommendations and specifications for the policy makers to consider when developing the City's design and maintenance standards for urban roads, sidewalks, public spaces, and transit-oriented development, some of which will be carried out as part of the technical assistance program as part of the Transport Systems Improvement Program (TRANSIP).

This document consists of two parts: the first briefly describes the conclusions of the diagnosis of Addis Ababa sidewalks in the study area, and the second presents sidewalk design and maintenance guidelines to be considered and adopted by the City based on the diagnosis and global best practice.

1. Highlights of study findings

A diagnosis (based on innovative digital data collection and the urban inventory) has depicted the qualitative and quantitative characterization of current walkability conditions in the City, as well as the highlighting of other elements that impact user experience and perception.

Sidewalks in Addis Ababa: A summary of the diagnosis findings on sidewalk safety and walkability, as well as the gap analysis on which this guide is based are presented. Please refer to the report on the Addis Ababa Sidewalk Safety and Improvement Study, a separate deliverable of the study, for further information.

It is clear from the diagnosis that Addis Ababa requires pedestrian infrastructure design guidelines. These guidelines propose design solutions for each category identified during the diagnosis, including special designs for children in school surroundings and a sidewalk maintenance section. It is recommended that the city considers these issues during sidewalk design and guidelines implementation for the purpose of improving conditions for pedestrians.

2. Sidewalk Design and Maintenance Guidelines

These guidelines aim to establish technical procedures and design parameters to facilitate the development of high quality, safe, inclusive, and sustainable pedestrian infrastructure, and increase accessibility for all road users. These guidelines feed into the city's ongoing and planned studies related to sidewalks, including the Urban Corridor Design (ongoing), the Urban Road Design and Maintenance Manual (in its initiation phase), the Transit Oriented Development Study (upcoming), and others.

Sidewalks Geometric Design: This chapter defines elements essential to a well-designed sidewalk, i.e., the basic concepts of a sidewalk, and the geometric criteria recommended, including width, height, slope and material.

Universal accessibility: Refers to all the street elements which guarantee that a pedestrian can safely use a sidewalk, including pedestrian ramps, detectable surfaces, sound traffic lights, among others.

Safe walk to schools: When it comes to inclusive design, we traditionally think of people with reduced mobility and not of users with other disabilities and needs, such as students and children around schools and in residential areas.

Crossings and intersections: These are points in the urban road network where conflicts between different modes of transport are more likely to occur. Thus, making crossings safe for pedestrians is one of the priorities of sidewalk design.

Urban furniture: Sidewalks are spaces for all kinds of activities, not only for moving. They are also used for resting, seeking shelter from the weather, sightseeing, and eating, among many others. Streets must be properly equipped to provide spaces and furniture for all these activities.

Lighting: Well-lit spaces are critical to pedestrian safety, creating lively, inviting spaces at night and helping to prevent crime. Lighting design criteria should reflect pedestrian characteristics and improve visibility.

Maintenance of sidewalks and public spaces: Publics spaces require proper maintenance as they are prone to wear-and-tear due to intensive usage. Disciplined maintenance of public spaces, including the use of new technology, can improve effectiveness and reduce costs in the long run.

Roadmap to the implementation: Sidewalk and public space design requires constant revision by the city. Best practices include continuous monitoring and upgrading the pedestrian infrastructure.

Part 1.
Highlights of Study Findings

Sidewalks in Addis Ababa

Walking and public transport are the dominant forms of mobility in Addis Ababa, making up an estimated 85% of trips. Pedestrian trips account for 54% of the total, with an average length of 1.5 kilometers.

The share of pedestrian trips varies widely across the city. For example, in the Addis Ketema sub-city, walking accounts for 78% of trips, while in the Bole sub-city only 40% of trips are made on foot.

Even though pedestrians are the most important road actors in the city, street design in Addis Ababa has traditionally been car-oriented, causing alarming road safety issues and sidewalks being unsuitable for pedestrians.

The World Bank has conducted this sidewalk improvement study, in collaboration with Addis Ababa stakeholders, to address the problem. The challenges faced by pedestrians are analyzed based on a detailed analysis of the key points of the Addis Ababa's pedestrian network within the study area, resulting in a diagnosis of their current mobility situation.

By means of a gap analysis, the study turns these challenges into actions and measures that lead to improved pedestrian conditions, applicable to the rest of the city.

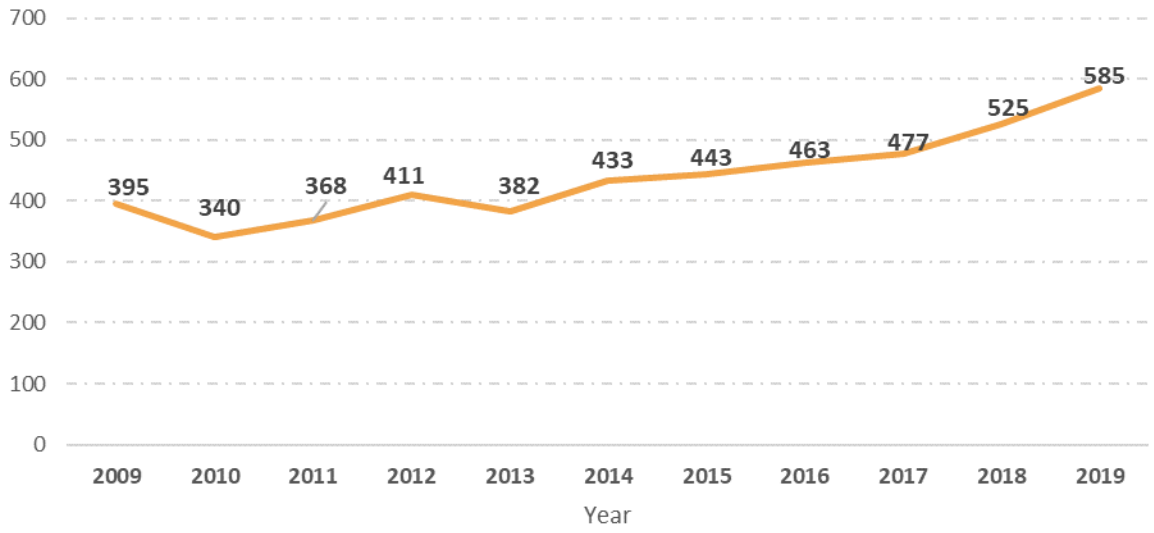
This chapter summarizes the most relevant conclusions obtained from the diagnosis of the current pedestrian infrastructure situation in the study area.

Addis Ababa's Challenges

Addis Ababa's road safety history is very peculiar and differs significantly from global trends, the African context, and even from Ethiopian reality. In the last ten years, the yearly death toll related to traffic accidents has risen by almost 50%, going from 395 in 2009 to 585 in 2019: an increase of almost 200 fatalities in 10 years as shown below.

The rise in motorization rates and the development of high-speed roads without pedestrian considerations could explain the increase of traffic accidents. Nowadays, more vehicles in Addis Ababa are circulating at higher speeds on roads designed to prioritize private mobility.

Evolution of total road traffic deaths in Addis Ababa



Source: TRANSIP, Consultancy Services for Monitoring and Evaluations. First Bi-Annual Report, 2020

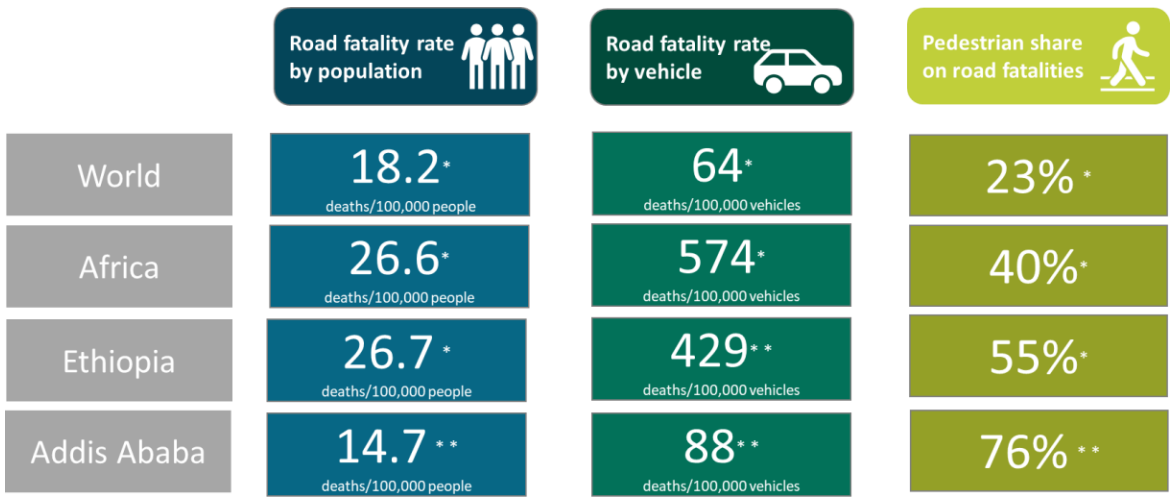
Despite the increase in road fatalities, the traffic death rate remains relatively low in the city (14.7 fatalities per 100,000 people), considering the world average (18.2 fatalities per 100,000 people), as well as the average for Africa, and the total rate for the country (nearly 27 fatalities per 100,000 people).

The road fatality rate for the city of Addis Ababa is lower than the one reported for Africa by the World Health Organization (WHO), which, considering the context, can be considered positive. The chart below shows the comparison of road fatality rates by population and by number of vehicles in the world, for the continent, for Ethiopia, and for Addis Ababa. It also shows the pedestrian share of total traffic fatalities.

The Addis Ababa road fatality rate by the number of vehicles is higher than the world average but lower than the continent and country rate. Therefore, it's clear there is vast room for improvement in road safety.

Moreover, it is important to mention that the pedestrian share of road fatalities in Addis Ababa is alarmingly higher compared to all averages, with 76 % of total traffic fatalities associated to pedestrians in the city. 60 % of pedestrian deaths occurred while crossing the street, which infers the significant deficiency of safecrossing points in the city, while 69 % of deaths are related to crashes between vehicles and pedestrians, reassuring the vulnerability of non-motorised modes in the city.

Rate comparison for road fatalities by population and number of vehicles, and pedestrian share of road fatalities.



*Source: *WHO **TRANSIP*

The problems in pedestrian mobility in Addis Ababa span across design, construction, maintenance, and risky behaviors from road users especially drivers and pedestrians. It is common in the city to find sites with inappropriate intersections, deficient crossings, discontinued sidewalks, poor accessibility options for vulnerable users and intentional barriers such as guard railing on main avenues.

In other instances, sidewalks lack proper maintenance, leading them to be invaded by vegetation, rocks or debris and resulting in damaged elements. Moreover, the lack of traffic enforcement causes the sidewalks to be often obstructed by street vendors, retailers, parked vehicles or freight operations.

For instance, these problems are observed along the LRT corridors represented in the figure below, where wide and newer sidewalks in the curbs receive high pedestrian flows. The effective width of the sidewalk is reduced by the invasion of informal vendors and parked vehicles, forcing pedestrians to walk along the road, mixed with vehicular traffic. Crossings for pedestrians are limited, thereby generating informal crossings.

Problems in sidewalks identified along LRT corridors

The study areas were selected based on the following criteria:

- proximity to the public transport system, especially LRT.
- proximity to schools and workplaces.
- potential to build transit-oriented developments (TOD).

This study aimed to identify potential mixed-use areas that were already acting as a TOD or that are set to become one in the near future. In this light, an area along the Line A corridor was identified as a study zone, especially east of the intersection with Line B, as it meets all the preconditions established. It also presents the possibility of defining a series of recommendations in an area under transformation and will soon become a TOD area in Addis Ababa. Additionally, this corridor is significant hotspot for pedestrian fatalities and warrants a sidewalk safety analysis.

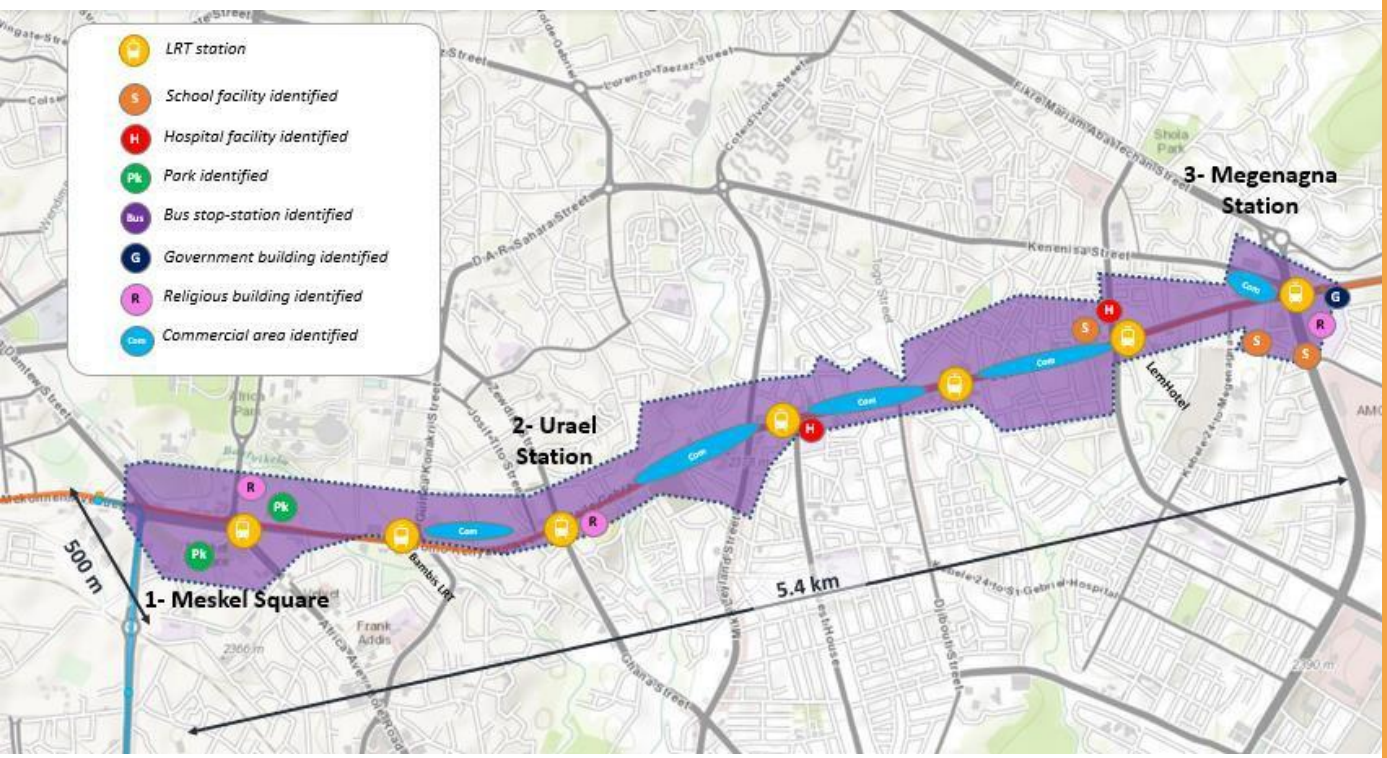
The study area, jointly determined by the World Bank and the Planning and Development Commission team, is a 5.4 km stretch along the LRT Line A corridorfrom Meskel Square to Megenagna Station.

The study area is illustrated in the image below. It consists of a section of the Line A and will be focused on three station areas to conduct thefieldwork. However, these three selected zones were not defined based on particular spots, but rather based on specific surrounding buildings which, given their characteristics, were important generators and attractors of pedestrian mobility.

Its purpose is to provide a better understanding of sidewalk conditions and analyses through site observation, user surveys, and design proposals.

Study area

Selected study area (shaded in purple) along Line A corridor



Meskel Square

The first study area was a one-kilometer-long corridor: it is an important transport hub where the two LRT lines converge. This area attracts many passengers who come in to work at offices and stores, and who alight and board the LRT system. There is also a school nearby. A project from the Addis Ababa City Government is currently improving the Meskel square area, creating a new underground parking, and improving the sidewalk width and walking area. However, the new walkway lacks universal access.

St. Urael Station

The second location is around St. Urael Station. This area generates high demand for walking because it is an important commercial and financial center, as well as the religious buildings nearby.

Megenagna Station

Finally, the area of Megenagna Station presents some features in terms of the presence of buildings and commercial spaces. Currently, an elementary school, as well as a few government buildings are located nearby.

The following are highlights from the sidewalk conditions assessment. For a detailed description, please refer to the final report on conditions assessment.

• Road safety indicators in Addis Ababa, compared to other similar cities, are not that concerning. However, pedestrians are the most vulnerable road users accounting for an alarming 76% of total road fatalities.

• More than 60% of the people surveyed reported walking almost every weekday for work or school trips. This means that the corridor has a vast potential to serve commuting trips with walking.

• In the study area, 39% of the network has sidewalks widths greater than 2.5m, while 29% are in the range between 1.5m and 2.5m, indicating that 68% of sidewalks have acceptable dimensions in this LRT segment. However, 26% of the network doesn't have any sidewalks, and those areas must be prioritized.

• Most of the network in the study area (79%) is associated with inadequate crossings. It is recommended to raise the number of crosswalks in the area to reduce travel distance for pedestrians and prevent jaywalking.

• Crossing accessibility is low (35%), as is the presence of safe crossing points in the network. An enhancement of pedestrian ramps on crossings should be considered.

• Street illumination calls for improvements as only 48% of the street network have appropriate street illumination. This is crucial for an enhanced sense of personal safety for pedestrian use, especially at the evening.

• Tactile pavement for visually impaired users is non-existent in 54% of the network, and 52% of the network does not have adequate street lighting.

Pedestrian improper crossings

Pedestrian traffic obstacles

Non-permeable facade

• The urban inventory reveals that sidewalks contain an adequate density of trees, especially in St. Urael and Meskel Squares. Replicating this shadowing design method in other segments of the network would be considered a best practice.

• Most fronts or ground activities are not permeable or accessible (55%), making walking unsafe or uncomfortable, especially at night.

• Users perceive that sidewalks are inaccessible (75%), unsafe in terms of infrastructure quality (66%), and unsafe in terms of exposure to traffic (63%). Similarly, they express their discontent regarding flash floods (62%) and the lack of continuity of sidewalks (46%).

• In the study area, 20% of the sidewalks are obstructed by obstacles. Most of the obstacles are trash, holes, or construction waste (63%). However, it is visible that street vendors (37%) occupy more of the street width than trash.

Roundabout in study area

Vision to actions

The improvement strategies proposed for this study should be aligned with the transport and mobility vision for the City, as defined in the Addis Ababa Transport Development Plan.

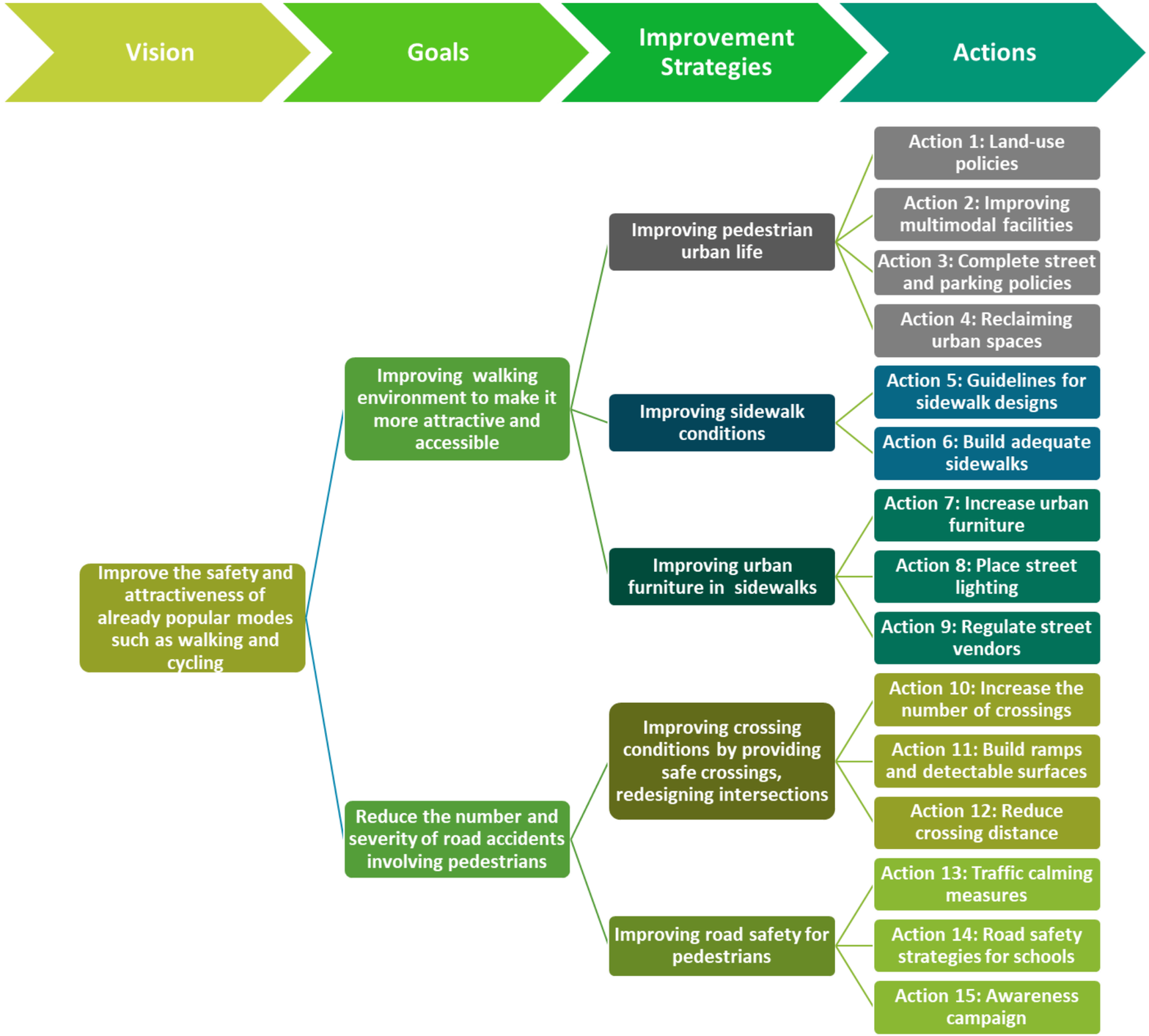
As part of this Vision, three main 2030 Goals are presented:

- Promote rapid and affordable mass transit, including light rail, bus rapid transit and local buses.
- Improve the safety and attractiveness of already popular modes such as walking and cycling.
- Contain the increase of private vehicles to minimize traffic congestion and pollution.

Under the overarching vision for 2030 guiding pedestrian mobility, this study focuses on the short-term strategies to move the city in that direction. Therefore, new goals for the short-term are set.

This guide is presented as one of the key strategies to improve sidewalks and public spaces in Addis Ababa.

The guide proposes measures and specifications for improvements, such as sidewalk geometry, universal accessibility, and crosswalks. Additionally, it embraces new elements in terms of design, construction and maintenance of sidewalks, children's needs, maintenance requirements, and a project implementation roadmap.



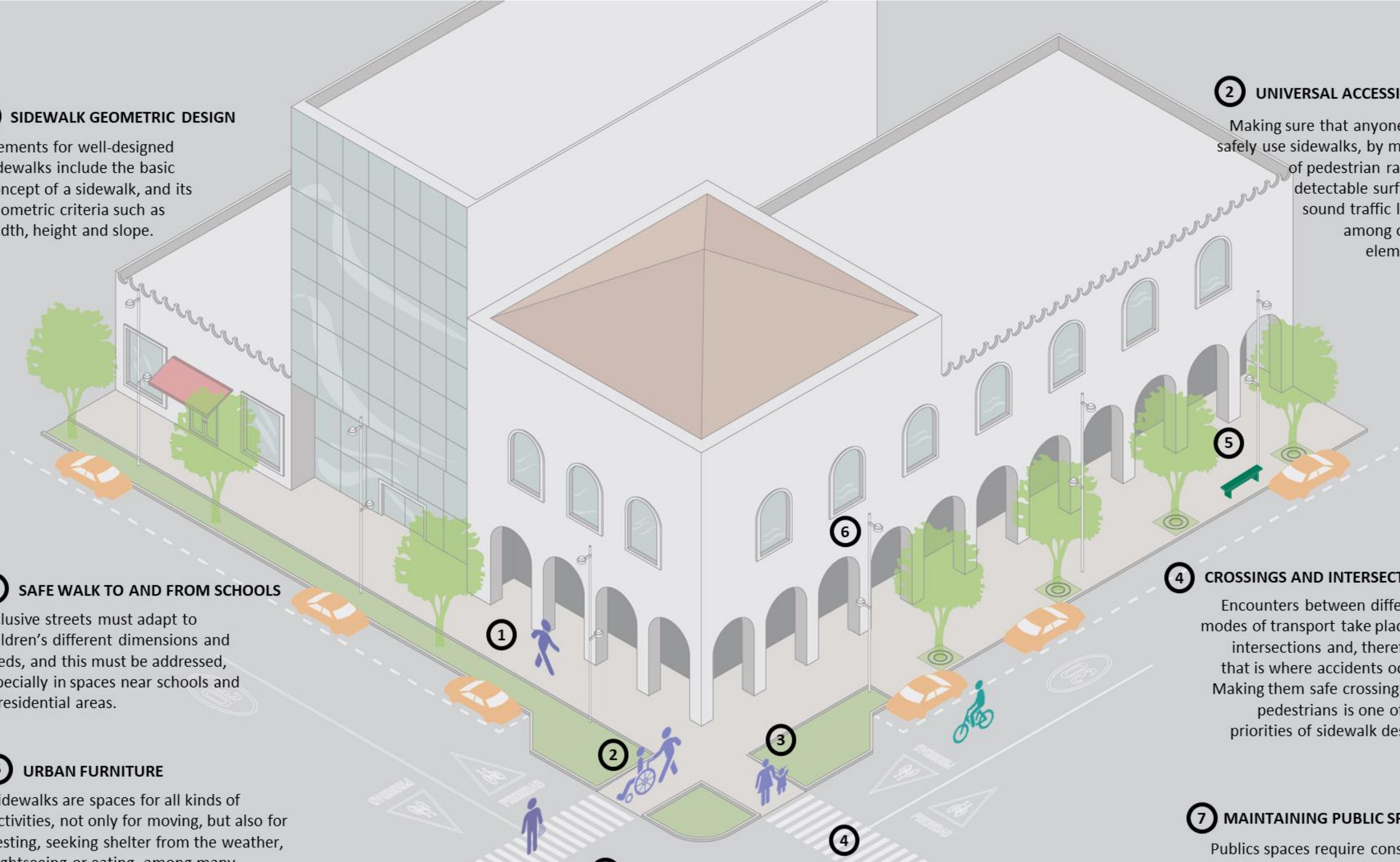
Part 2.
Sidewalk Design and Maintenance Guidelines

1 SIDEWALK GEOMETRIC DESIGN

Elements for well-designed sidewalks include the basic concept of a sidewalk, and its geometric criteria such as width, height and slope.

2 UNIVERSAL ACCESSIBILITY

Making sure that anyone can safely use sidewalks, by means of pedestrian ramps, detectable surfaces, sound traffic lights among other elements.



3 SAFE WALK TO AND FROM SCHOOLS

Inclusive streets must adapt to children's different dimensions and needs, and this must be addressed, especially in spaces near schools and in residential areas.

4 CROSSINGS AND INTERSECTIONS

Encounters between different modes of transport take place at intersections and, therefore, that is where accidents occur. Making them safe crossings for pedestrians is one of the priorities of sidewalk design.

5 URBAN FURNITURE

Sidewalks are spaces for all kinds of activities, not only for moving, but also for resting, seeking shelter from the weather, sightseeing or eating, among many others. Streets must be properly equipped to provide spaces and furniture for all of these activities.

6 LIGHTING

Well-lit spaces are critical for pedestrian safety, creating lively, inviting spaces at night, and allowing for crime prevention. Lighting design criteria should include pedestrian characteristics.

7 MAINTAINING PUBLIC SPACES

Publics spaces require constant maintenance to make things last longer, promote their correct use, reduce risks and improve appearances

1. Sidewalk Geometric Design

Tactile pavement

Sidewalks are a basic element of the public space in any city. It is the place dedicated to pedestrians, the most vulnerable street users, and their activities. Pedestrians must share public spaces with other modes of transport with higher speeds, such as motor vehicles or cyclists, meanwhile pedestrians are those who suffer more injuries in case of an accident. This requires the city to have the tools to design streets to protect the integrity of pedestrians and to prioritize sidewalks over other modes of transport.

This document describes the recommendations for designing, building and maintaining sidewalks taking into consideration the characteristics and needs of the city of Addis Ababa.

Well-designed sidewalks take the following elements into consideration:

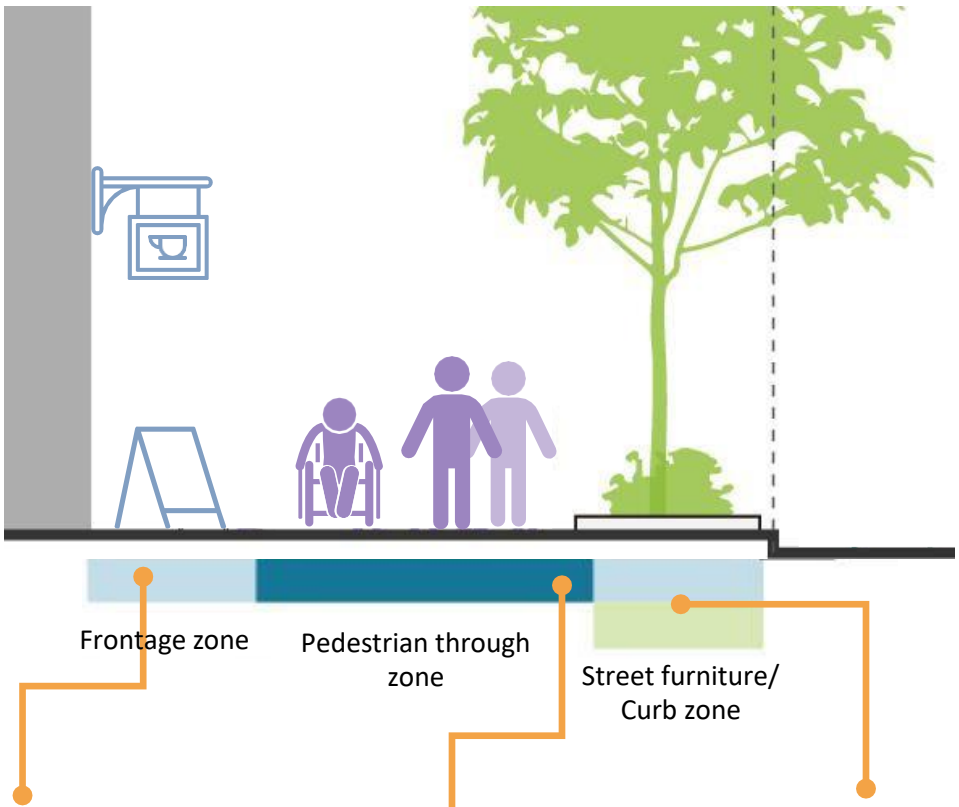
- have a clear path that meets accessibility and pedestrian volume needs.
- provide enough room for conversation to coexist with movement.
- be well-lit at night.
- have inviting building edges.
- have shaded places and furniture adequate for resting, observing and socializing.
- have wayfinding systems.

Sidewalk sections

Sidewalks tend to be seen as spaces assigned exclusively to pedestrian traffic, yet, it is a space with a wide variety of uses, including zones for placing urban furniture, places where the interaction between private and public space occurs, and areas for recreation and resting, as well as for eating and sightseeing.

The image below describes the minimum zones that a sidewalk must have in order to be functional.

Sidewalk zones



The frontage zone is the section of the sidewalk that functions as an extension of the building. It varies in width, the minimum length of it is 0.5m.

The clear path has at least 1.8–3.2m wide in residential settings and 2.5–4.5m wide in downtowns, school zones, or commercial areas with heavy pedestrian volumes. The continuous path for walking, free from obstructions, should have a minimum clear width of 3m.

This zone acts as a buffer between pedestrians and cycle lanes, parked cars, and moving vehicles. It provides space for amenities such as benches, lighting, cycle parking, kiosks, etc.

Sidewalk Geometry

Minimum width

Minimum width is recommended in places where there is significant pedestrian flow: a pedestrianstrip of 3m should be considered so that at least two people in wheelchairs can travel side by side. If designing for low pedestrian flows, it should be based on the wider movements of persons travelling by wheelchair or with a service dog, for which a 1.8m clearance for maneuvering is required.

The conceptualization of a new road project or street improvement must preserve a minimum sidewalk width that is proportionate to the category of the road in the network. It is recommended that the sidewalk width not be less than 4.0m if located on principal or sub-arterial streets, and no less than 3.2m on collector and local streets.

Sidewalk width (m)	Pedestrian through zone width (m)	Street furniture/ Curb zone Width (m)	Frontage zone width (m)
2.50	1.80	0.60	-
2.50 – 4.50	1.80 – 3.20	0.60 – 1.00	0.50
4.50 – 10.00	2.40 – 4.50	1.00 – 3.00	Variable

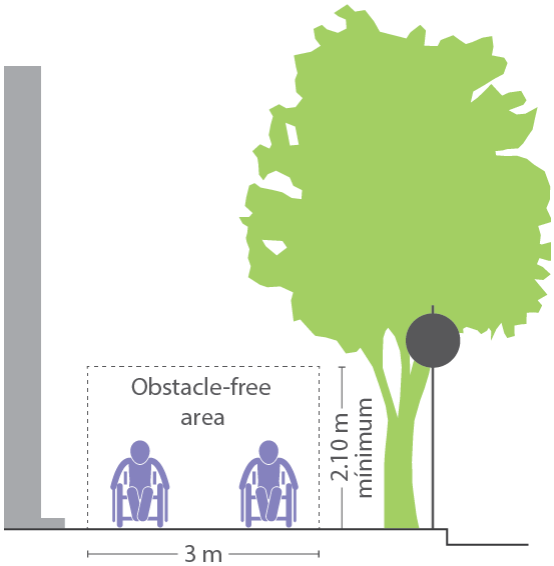
Minimum height

Requirements for pedestrians' and other users' comfort and safety include minimum clear heights.

Components	Clear height (m)
Minimum clear height	2.10
Ceiling in underpasses	3.00
Signs on sidewalks	2.10
Signs on bicycle lanes	2.30
Tree branches	3.00
Balconies, sidewalk roofs	2.60

In general, it is recommended that sidewalks have a height of 14 cm measured from the roadway level; however, this may vary depending on the accesses in nearby properties and should be studied on a case-by-case basis.

Minimum sidewalk dimensions



Materials

The materials used should allow for movement, both for wheelchair users, as well as people using crutches or canes, in dry and wet surface conditions.

- The surface finish of the circulation zone should be fully continuous, firm, flat, and slip resistant.
- Unstable materials, such as sand or gravel, are not considered accessible and should not be used in a pedestrian walkway.
- Construction materials affect the aesthetics, use, durability, and sustainability of urban streets and pedestrian infrastructure.
- Apply different pavement structure and surface materials to central areas where pedestrian activity is considerable, and outer zones where pedestrian movement is minimum.

Materials shall include:

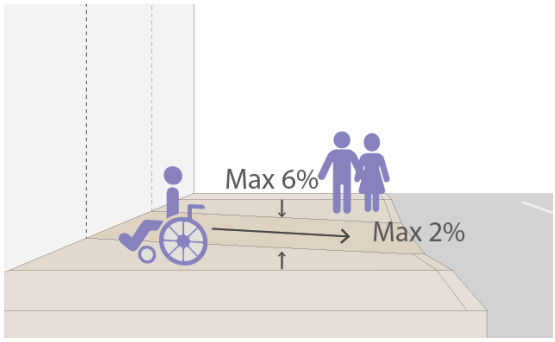
- Concrete tiles
- Cement tiles
- Mixed terrazzo, concrete and cement tiles
- Dressed, semi-dressed and cobble stones
- Roughly dressed granite cobble stones (in high standard city centers).

Example of sidewalk material

Slopes

Cross slopes usually run from the frontage strip to the vehicular stream. This allows for gradual runoff of rainwater into the drainage system, sometimes passing through planters, which prevents runoff going into buildings and puddles forming on sidewalks. It is recommended that all longitudinal sidewalk strips be at the same level and that they be constructed with a slope of between 1% and 2%. To maintain continuity, a slope of 6% or less should connect the sidewalk to the cross slope.

Maximum sidewalk slope



Vehicular ramps

The implementation of vehicular ramps is of great importance as this is where vehicles interact with pedestrian infrastructure: careful considerations must be made regarding pedestrian flow. A longitudinal slope can be understood as a "ramp of great length", in which its slope percentage must be as small as possible: always less than 6%. Some elements to take into account are:

- Sidewalk continuity must be guaranteed in terms of level and width, so that, at the property access points, pedestrian circulation is enhanced.
- Access ramps should be restricted to street furniture/curb zones, so that they do not encroach on the circulation zone and always maintain the same level.
- Access ramps should be as short as possible so as to avoid interrupting pedestrian traffic as much as possible.

2. Universal Accessibility

Cities are places for people who use streets for walking and resting, sitting, playing, and waiting. This requires making people the highest priority in street design, with careful consideration for the most vulnerable users: young and senior citizens, as well as persons with physical constrains or disabilities.

Street design should always prioritize infrastructure safety for pedestrians and measure its success from the pedestrian's perspective. A walkable and safe city offers its citizens independence and equity.

Accessible infrastructure

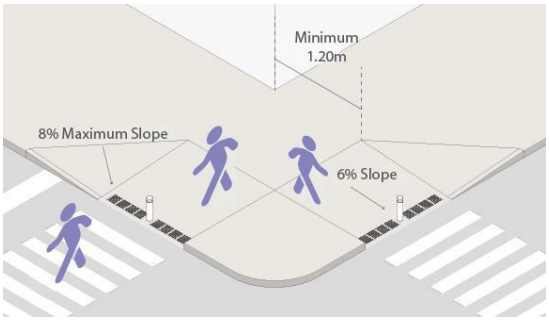
Pedestrian ramps

Pedestrian ramps are inclined planes that help overcome the difference in level between the sidewalk and the roadbed by providing continuity in the surface with a gentle slope (maximum 6%). To guarantee accessibility, pedestrian ramps should be installed at every pedestrian crossing and level change. These ramps are critical for people in wheelchairs as well as those pushing strollers, carts, or heavy luggage.

Non-slip material should be used and there must be a maximum slope of 1:12 (8%)—ideally 1:16 (6%). The ramp width should be as wide as the clear path: at least 1.8m wide, though 2.4m is recommended.

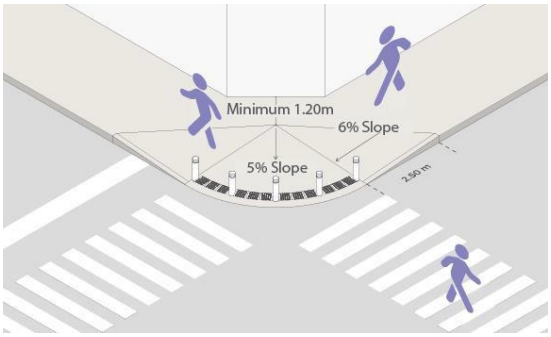
A level landing of with a minimum length of 1.8 m accommodates the maneuvering of a wheelchair.

Perpendicular curb ramp



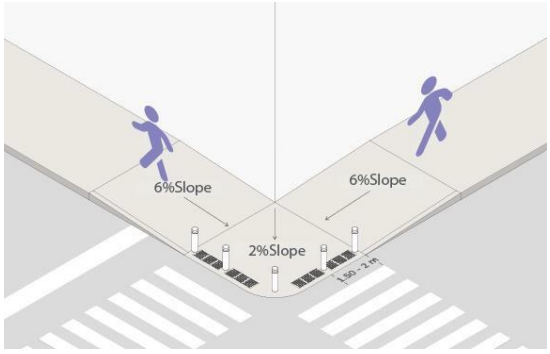
- They should be aligned perpendicular to the pedestrian crossing.
- Complementary works for storm drainage must be considered.
- Pedestrian protection elements, such as bollards, should be placed at the edge of this type of ramp, facing the vehicle lane.
- Their distribution should include a free passage area of between 1.5m and 2.0m between these elements.

Blended transition ramp



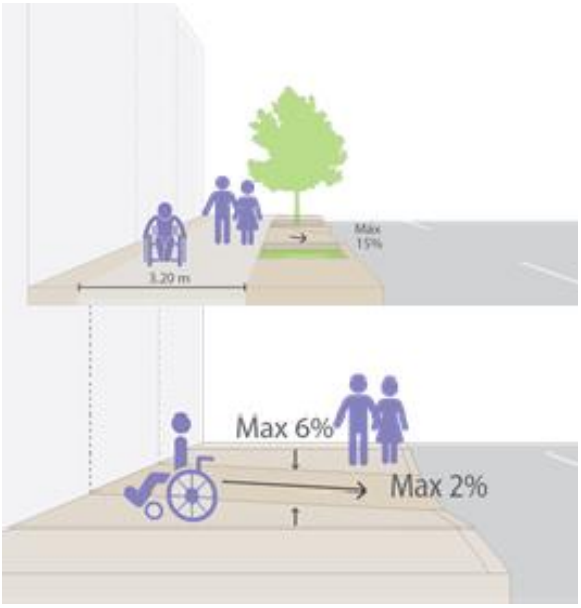
- The central straight ramp should have a maximum slope of 5% and the triangular side ramps, one of 6%.
- Complementary works for storm drainage must be considered.
- The width of the center ramp surface must coincide with the crosswalk marking.
- The trim must be of a contrasting color compared to the vehicular lane.
- Pedestrian protection elements, such as bollards, should be placed over the tactile warning strip. Their distribution should include free passage areas of 1.50m and 2.00m between these elements.

Parallel Curb Ramps



- Straight side ramps will have a maximum slope of 6% and will be rectangular in shape.
- The approach area shall have a maximum slope of 2% towards the vehicular lane.
- Complementary works for storm drainage must be considered.
- The width of the center ramp surface must coincide with the crosswalk marking.
- The trim must be of a contrasting color compared to the vehicular lane.
- Pedestrian protection elements, such as bollards, should be placed over the tactile warning strip. Their distribution should include free passage areas of 1.50m and 2.00m between these elements.

Pedestrian Ramps



- Vehicular entrances and ramped accesses should be designed to avoid obstructing free traffic on the sidewalk.
- The vehicular ramp must be straight, and its width must not be greater than the width of the street furniture strip of the sidewalk.
- The vehicular ramp must have a maximum slope of 15%.
- For sidewalks with a width of less than 2.0m, the access solution must have a zone at the vehicular lane level and two straight ramps of 6%, perpendicular to pedestrian circulation.

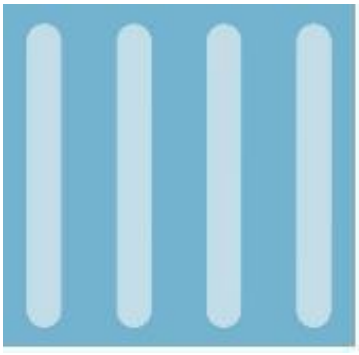
Detectable Surfaces

Provide tactile paving or detectable warning strips at curb ramps and other transition points between pedestrians, vehicles, or shared areas.

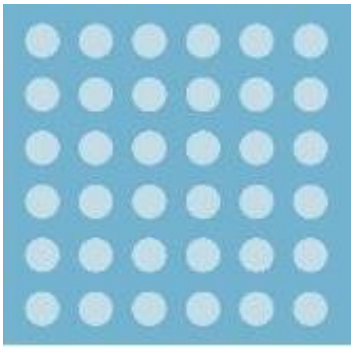
Detectable surfaces should have a distinctive texture, used universally, intended to alert people they are approaching a conflict zone.

A tactile route should:

- be complemented with tactile- visual signals and ramps.
- be located on the safest routes for the visually impaired and in the area with least pedestrian flow.
- be marked to connect public service areas.
- be marked on sidewalks to lead to the tactile warning strip before the crosswalk, when and wherever required.
- include signaling for route interruptions due to grates, sewers, construction, etc.



Block indicates "go"

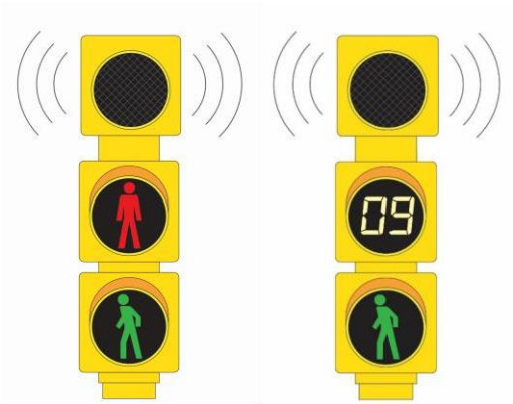


Block indicates "stop"

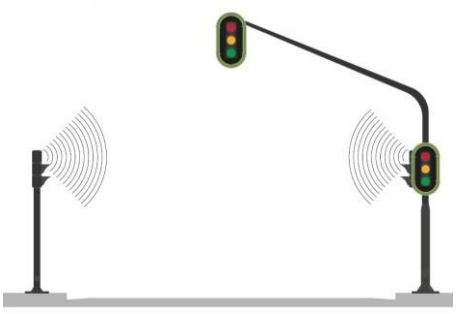
Audible traffic lights

Audible traffic lights emit audible signals to guide visually impaired pedestrians when crossing an intersection. They must comply with at least the following elements:

- **Location:** the device should be placed facing the pedestrian signal and be aligned with the opposite sidewalk above, the crosswalk. The minimum distance between two emitting sources should be 3.0m.
- **Phase:** the minimum duration of the green phase should be sufficient for disabled persons and persons with limited mobility to cross, considering speeds of 0.3 to 0.5 m/s for people with reduced mobility.
- **Audible signal tone:** must be an intermittent, soft chime with consistent frequency, with one tone for the green phase interval and three tones for clearance or eviction. The volume must be adjustable for day and night. The sound must be directed in a line parallel to the pedestrian traffic signallight.
- **Step request button**. It's color should be contrasting and contain an arrow in high relief indicating the direction of the crosswalk. The corresponding information sign must also be placed to indicate the user they must press it to be granted passage.



Traffic lights with audible signals



Gender

According to World Bank Handbook for Gender-Inclusive Urban Planning and Design, women have different mobility needs and behaviors, therefore, their dynamics must be supported.

Women are more likely to walk or use transit, and to have limited mobility, for example due to carrying children. Inclusive strategies for women should be taken into account to promote sustainable mobility for this population group.

Some strategies to improve the quality of women's mobility include:

- actively include the voices of women, girls, and sexual and gender minorities.
- meet the needs of women of all ages and abilities.
- monitor and evaluate participative planning and design.

3. Safe walk to and from Schools

Sidewalk design must consider all potential users, regardless of age and size. Unfortunately, nowadays, most streets do not address the specific needs of children. To include children in sidewalk design, it is necessary to adapt dimension spaces and furniture to their size and consider their preferences and habits.

Designing streets for children requires unique strategies and decisions to create child and caregiver-friendly spaces that allow their active use. These spaces must provide the necessary safety for different ages, for users to be comfortable, and give an educational approach for children. Recommendations aim at promoting good levels of walkability for children and special attention is paid to places often frequented by children.

Children and caregivers using pedestrian infrastructure

Safety conditions

Streets at different levels must guarantee the safety of all users, including children and their caregivers. Streets and sidewalks must, at least, have adequate and safe walking and cycling infrastructure. Connectivity should also be ensured with safe corridors with pertinent signaling, lighting, water, and waste management.

Define standards to improve safety, accessibility, and mobility: appropriate measures, characteristics, and strategies must be defined for each situation, taking into account parameters that guarantee the safety and comfort of children and caregivers:

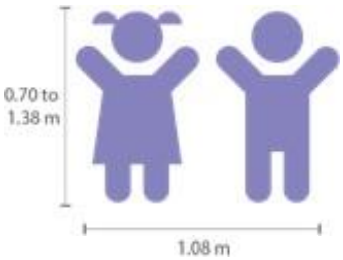
- Shortened pedestrian crossings;
- Raised pedestrian crossings with installed bollards along the sidewalk.

Ensure inclusion of pedestrians of all ages through usable, continuous, safe and accessible sidewalks: sidewalk safety must address the needs of minors, their caregivers, as well as additional elements such as cars that demand additional driving space.

Infrastructure degradation

Reduce traffic accidents involving children by implementing strategy to set speed limits: reduce speed limits and match them to design speeds of 30 km/h.

- Create 30 km/h zones near schools and playgrounds.
- Reduce traffic speed by minimizing the number of general-traffic lanes.
- Install speed bumps .



Comfortable conditions

User interaction within pedestrian infrastructure

Lack of infrastructure

Children and caregivers should be encouraged to spend more time on the streets through interventions that foster more trips in active mobility modes and make school trips more pleasant.

Streets should include adequate spaces for children to move around easily and comfortably, wide enough for them to be accompanied by adults.

Children require moments of pause and rest. Streets, therefore, need to include spaces specifically designed for quick activities, taking breaks or playing a short game.

Adequate spaces for enjoyment must be present along routes. For this reason, spaces for leisure and lingering act as destinations and invite children and their caregivers to spend more time in them.

Streets should incorporate additional elements such as vegetation, games and educational features.

Educational spaces

It is critical that children's spaces foster learning and inspiration. Children are greatly influenced by their environment, especially in their earlier years.Therefore, inspirational and educational streets are important as they contain spaces for learning, development and play, and offer opportunities for developing of the imagination.

Streets should also be designed to foster social interactions. Extending the street experience to adjacent spaces which make streets more active and interactive. For this purpose, there are different mechanisms that bring more activity to the streets and foster children's presence:

- Adding playful and interactive elements, such as a chalkboard and water features to incorporate play into everyday life.
- Painting crosswalks, widening sidewalks, and adding pedestrian ramps.
- Using ground-surface paving patterns along sidewalk clear paths, furniture zones, or active building edges.
- Using landscape elements such as planters and tree pits gives children a chance to engage with nature.

Streets as playgrounds

4. Crossings and Intersections

Safe and numerous pedestrian crossings foster a walkable environment. Pedestrians are especially sensitive to minor shifts in grade and geometry, detours, sidewalk materials, and lighting quality. Thus, pedestrian crossing design can shape pedestrian behavior, while guiding people towards the safest possible route.

The objectives of redesigning an intersection are twofold: to arrange the trajectories of the various road users, and to reduce vehicle speeds. Organizing the users' movements creates for more predictable circulation paths. The trajectory of those who move must be the one that responds to the pedestrian desire line, that is, the most direct natural route of passage that connects pedestrians to their destination. This is crucial, as it is the only way to ensure that crossing pedestrians will use the new design as intended. It is also recommended that the crossing be perpendicular to the sidewalk.

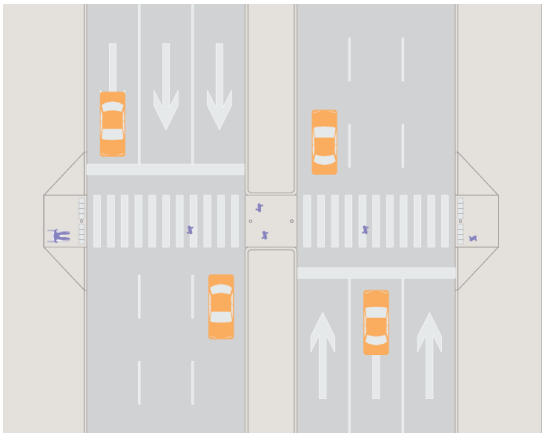
Location

Crosswalks are not only found at intersections. Best practices include the placement of mid-block crosswalks, especially in areas with important travel attraction points, such as bus stops, mass transit stations, parks, plazas, monuments, or even public building entrances.

Crosswalks should follow pedestrian desire lines, connect points of origin and destination with the shortest possible route, and be comfortable and attractive.

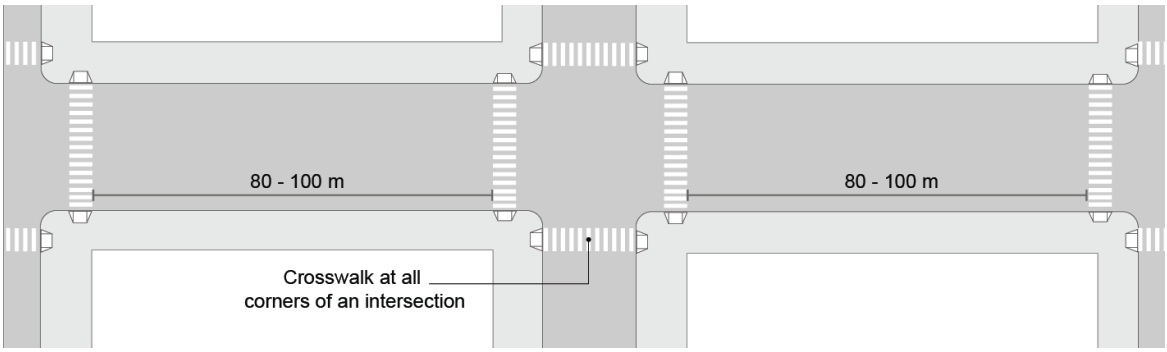
In addition, crosswalks should be placed every 80-100m, since crossing distances greater than 200m can encourage crossing at inappropriate places, putting pedestrians at risk. The same happens with traffic light timing: long waits encourage pedestrians to risk crossing the street even if they do not have the right of way.

Signalling of crossings



Along those lines, it is recommended to keep crosswalks as close as possible to the corners of intersections, as they increase visibility and make pedestrian paths direct.

Crossings location



Safety measures

Intersections and crosswalks are key points in mobility infrastructure. These are where the interactions between different road users occur and, therefore, are where traffic accidents are most frequent.

Some of the most relevant elements to generate safercrosswalks are:

- **Marks and signalization:** visible crosswalk marks and traffic lights with enough time to allow people to cross safely.
- **Length**: reducing conflict points by reducing the distance pedestrians must walk.
- **Visibility**: increasing visibility for all road users.
- **Traffic calming:** reducing motor vehicle speeds reduces the likelihood and impact of accidents.
- **Crossing level**: providing a continuous level for pedestrians is a tool to prioritize pedestrians over vehicles.

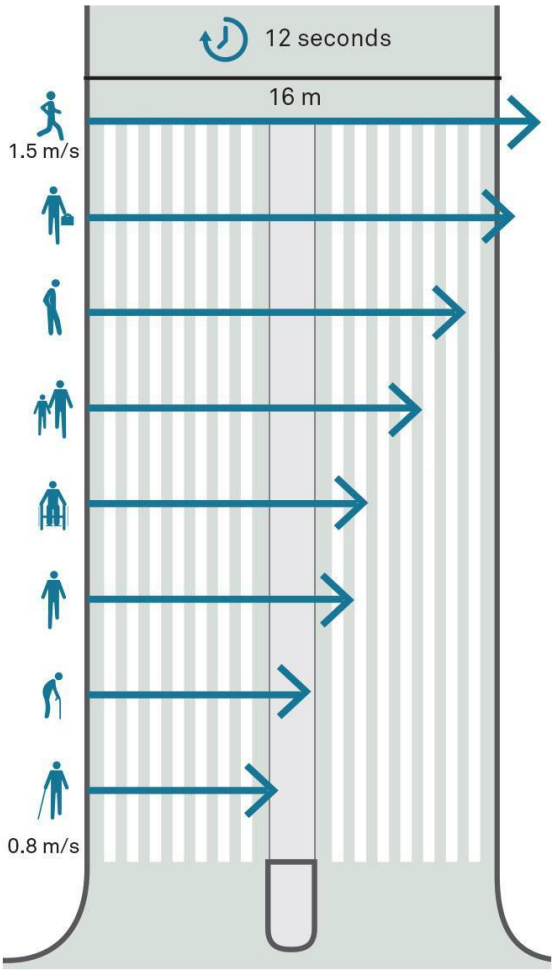
Marks and signalization

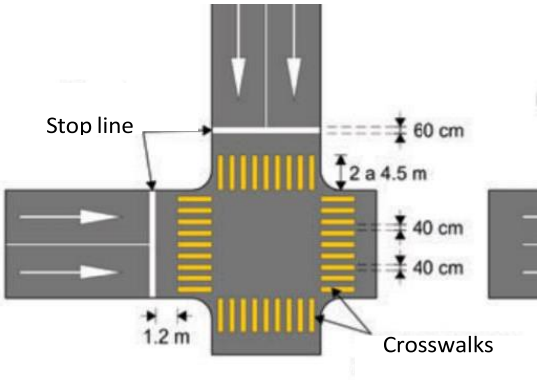
All crosswalks, regardless of material used or distance, must be adequately marked. Signaling increases visibility for all road users and provides the tools to make correct and timely decisions on how to behave. Crosswalks should be as wide as the adjacent footpath, and never narrower than 3m.

Zebra markings are preferred for Addis Ababa as they are the most recognized by road users.

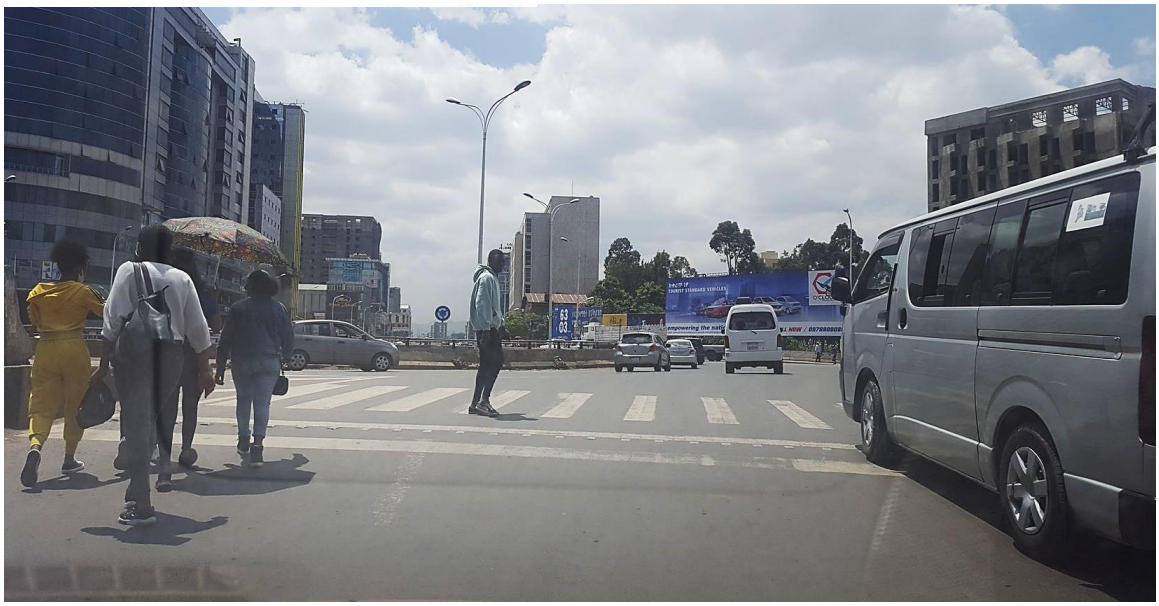
Traffic lights at intersections also have a major impact on pedestrian safety. Traffic signal cycles should provide pedestrians sufficient time, considering different walking speeds, to traverse the crossings from one safe point to another.

Distance travelled by different users in 12 seconds





Pedestrian Crossing



Length

At an intersection, reducing the distance through the intersection limits the points of conflict with vehicles, decreasing the likelihood of accidents. Traffic calming elements should be supplemented by appropriate road markings and signage. There are several design elements that can help reduce pedestrian travel distance, the most used are outlined below:

Curb Extensions: visually and physically narrow the roadway, creating safer and shorter crossings for pedestrians while increasing visibility and space available for street furniture, benches, plants, and street trees.

Curb Extension Example

Medians: are barriers in the middle of the street that act as islands and separate traffic flow. They minimize intersection size and crossings by creating a 2-step crossing for pedestrians. Medians should be provided on all streets atpedestrian crossings.

Median Example

Diagonal Crossing: are multimodal intersections on arterial streets which minimize crossing distances and pedestrian exposure by stopping all vehicular traffic and allowing pedestrians to cross in every direction.

Diagonal Crossing Example

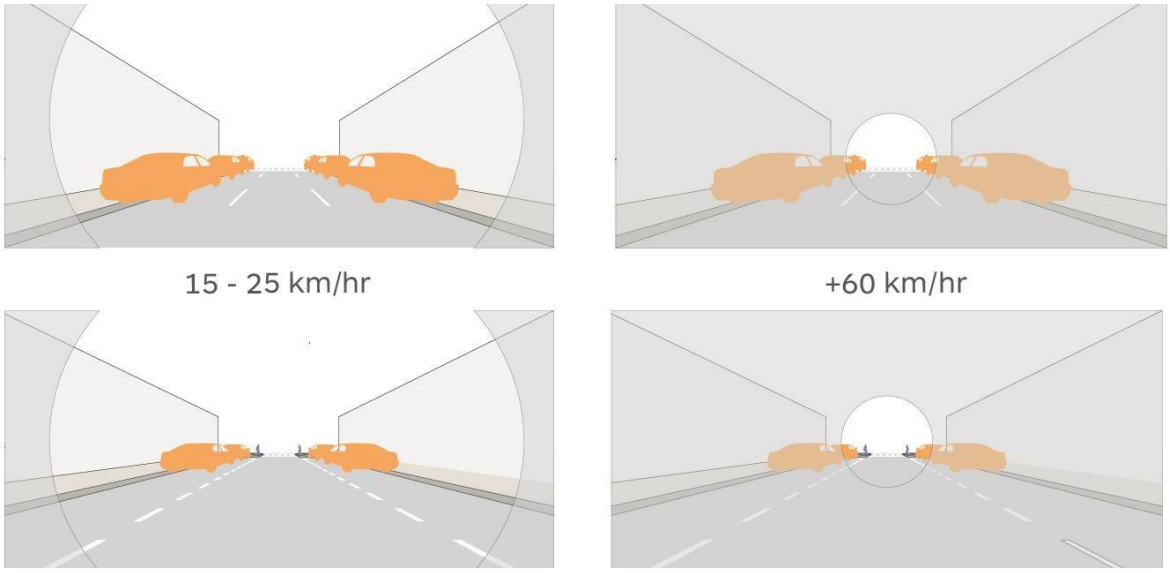
Visibility

To facilitate decision making and reduce the likelihood of accidents, visibility is key for road users.

Increasing visibility encourages pedestrians to walk at the roadway level. Vegetation should be frequently trimmed to prevent it from obstructing the field of vision, and there must be lighting to ensure that drivers are able to see pedestrians at night.

Speed also plays a fundamental role: the higher the speed, the more reduced the driver's cone of vision and the longer their reaction time. Traffic calming measures are, therefore, closely related to this criterion.

Driver visibility according to vehicle speed



Crossing levels

It must be highlighted that pedestrians are more vulnerable than any other road user. They move by making a physical effort (walking or running), and, potentially, carrying some kind of load. Therefore, pedestrians should take the most direct and least strenuous routes.

If possible, pedestrian crossings should be at a grade. The building of overpasses and underpasses is strongly discouraged in urban areas: for example, footbridges should be avoided because they are inconvenient, inaccessible, and unsafe.

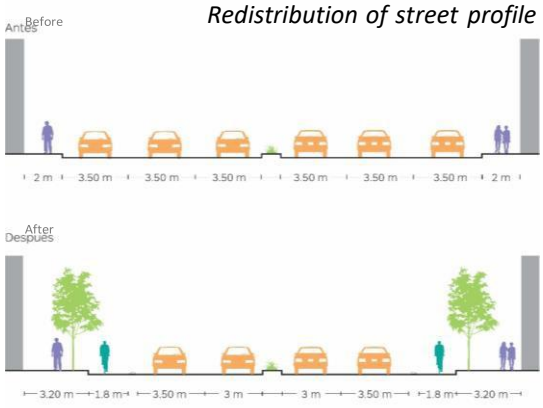
They increase pedestrians' efforts and distance travelled, increasing the probability of jaywalking at unmarked points. Furthermore, overpasses require additional maintenance, both in terms of infrastructure and cleaning. The lack of maintenance makes these places unattractive and unsafe for pedestrians.

Traffic calming

The speed of motor vehicles is the common factor to all elements used while aiming to improve safety levels for road users. The most dangerous accidents involve vehicles moving at high speeds. The measures of signaling and reduction of pedestrian travel distance help bring down vehicle speeds by preventing the driver from assuming they have priority passage on the road. These measures can be complemented with design measures that force the driver to slow down upon approaching an intersection. Some of the most commonly used are:

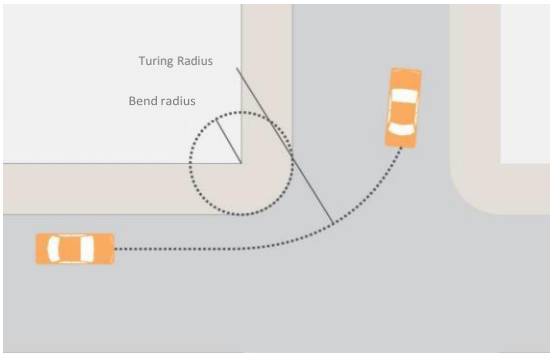
Lane narrowing: Narrowing lanes and reducing the total number of lanes on arterial streets restricts the space available to vehicles, and encourages drivers to go slower. The recovered space can be reclaimed to increase the width of sidewalks or provide separate areas for other users, such as widening sidewalks, creating a bicycle lane, or allocating an exclusive lane for transit.

Redistribution of street profile



Turning Radii

Reducing turning radii: In terms of speed, one influencing design feature is the turning radius, which is the distance from a central point to a point on the semicircular path that vehicles make when changing direction (see Illustration). The wider the turning radius, the higher the possible speed, the narrower the turning radius, the lower the speed.



Raised pedestrian crossings example

Speed bumps or raised pedestrian crossings: Geometric elements can help enforce speed limits in places where enforcement is more difficult. At intersections, raised pedestrian crossings are the most recommended. They prevent pedestrians from making changes to travel paths, and promote more direct and accessible itineraries. However, these measures are more suitable for local roads.

5. Urban Furniture

Sidewalks have different longitudinal components that allow us to locate different elements that fulfil a specific function when referring to walkability and connectivity for users. Within these spaces, furniture and vegetation strips stand out: these correspond to the area destined to accommodate urban furniture and vegetation (street lighting poles, vertical signs, traffic control, among others).

- **Green area:** used as an area of soil without pavement for trees and plants to live in, and for the purpose of rainwater absorption.
- **Furniture area:** used for furniture- related activities, such as public transportation stops, public telephones, benches, or garbage bins.
- **Infrastructure areas:** intended for the placement of poles for lighting, electricity, telephone, and internet cables, vertical signals, among others.

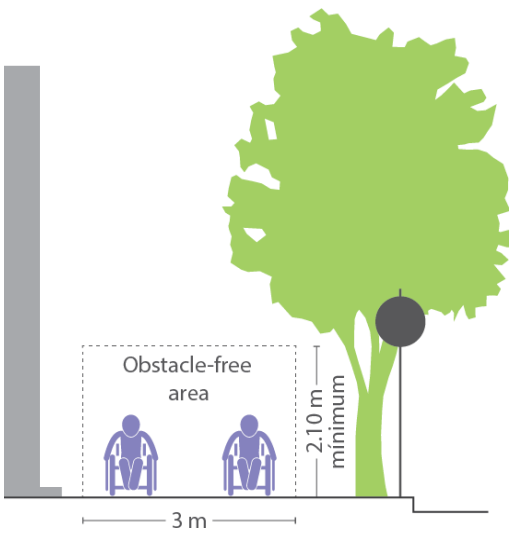
Furniture zone and different elements

Vegetation

Street vegetation contributes to the aesthetic quality and bioclimatic comfort of spaces, mainly consisting of trees, shrubs, and planters. The plant palette will include plants and trees selected from the approved vegetation catalog, and has the ability to absorb and filter water so that it can be returned to aquifers free of pollutants. The Ministry of Urban Development and Infrastructure Street design manual has proposed a fine grained, dense, small and medium leaved deciduous tree, based on the geographic location and topography of the city. Vegetation choices should prioritize the role to be played so that more people can enjoy a space. It is recommended to use species from the region to favors their long-term existence and maintenance.

- Provide a shaded and comfortable space, mitigating the heat, which is relevant for promoting mobility on foot or by bicycle.
- Offer efficient drainage systems that use the absorption capacity of soils.
- Provide vegetation, soil, and natural processes that captureand infiltrate, or evaporate water, before it enters the pipe system.
- Mitigate the impact of motorized traffic (for example, noise).
- Reduce noise. Trees and vegetation have been found to reduce urban noise by 3 to 5 decibels.
- Reduce stress and aggression: urban trees and vegetation help reduce stress levels and aggressive behavior in cities, and have been linked to crime reduction.
- Improve air quality and increase comfort.

Obstacle-free area requirements

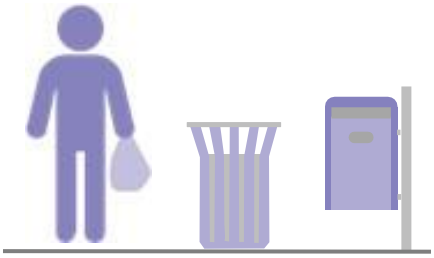


Utility furniture

Garbage bins:

They are used to store the waste produced in public spaces to ensure clean streets and prevent pollution. They must, therefore, be visible and located at accessible spots in public spaces.

Garbage bins examples



Phonebooths:

Public telephones should be located next to pedestrian circulation areas (ideally, near rest areas and public transport stops).

Phonebooths

Vending machines:

Street vending provides essential goods and services to a wide range of population groups. If appropriately designed, vending should be a part of the streetscape, without interfering with other elements.

Vending machine

Water:

The availability of drinking water for all users increases comfort in public spaces.

Drinking fountain example

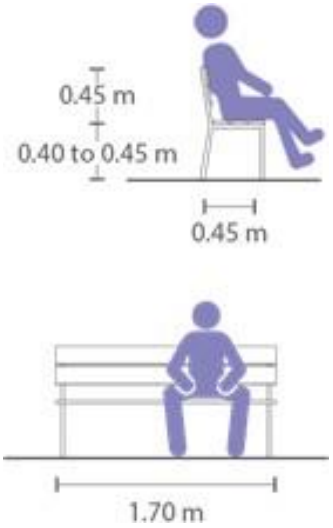
Leisure furniture

Benches:

The main function of benches is to provide a resting space for road users, but they can also represent decorative elements and increase the visual quality of public spaces.

They should be included according to pedestrian flow, potential users, available space, and should be placed so as not to create pedestrian barriers on streets where permeability is required.

Benches dimensions



Playgrounds:

Playgrounds where children can walk, exercise, and enjoy public spaces should be built near schools. This makes it easier for them to move around.

Playing areas

Multimodal furniture

Bicycle parking spaces:

Bicycle parking promotes active transportation and facilitates multimodal transit. It should be located near access points to different destinations; And demand, area needs, multimodal transit points, and avoiding obstruction of user paths are all elements that must be considered.

Bicycle area

Bus stops:

Bus stops provide waiting areas and shelter users from the weather. For implementation, the number of routes that operate, the dimensions of public transport vehicles, and the site's climatic conditions must be considered. The area for boarding the vehicle with a wheelchair must also be taken into account.

Bus stop area

Weather protection

Weather is a factor that affects pedestrians directly. Considering that weather conditions may become more adverse due to climate change, it is becoming increasingly important to adapt streets to provide shelter from rain and sun. The placement of awnings and canopies on facades wherever it is possible is a strategy that not only reduces weather exposure, but also helps give character to the streets. It is recommended that a uniform image be promoted by making these elements factors that can make streets eye-catching.

The sun's movement over any given street, shade points and schedules, must all be considered when establishing strategies for the location of main sidewalks, location of bicycle lanes, and vegetation to generate natural shade barriers.

In streets with large pedestrian spaces that do not have sufficient shade, the placement of free-standing shade structures is recommended, following the examples from other cities where these elements have been successfully used to make streets more attractive.

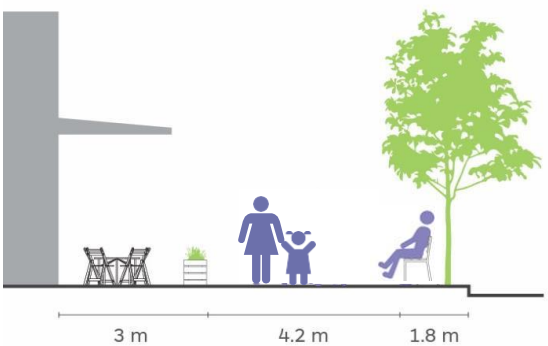
Elements protecting from weather conditions

Shops and street vendors

Commerce is an integral part of any city, and streets must be designed to accommodate commercial activity. Many people use the streets to sell and market products. The interaction between the people who participate in these activities plays a determining role in creating vibrant and dynamic streets. The presence of vendors in the streets can have very positive effects on the habitability of urban spaces, if the situation is properly managed and they are adequately placed. However uncontrolled vendors can disrupt essential urban mobility activities.

To benefit from street vendors, relevant spaces must be designated to accommodate commercial activity, and balance is an important component for users at any location. In short, commercial uses foster vitality and activity, support local economies, and make streets more livable and attractive.

Outdoor commercial space



Shopping places in Addis Ababa

However, certain considerations must be kept in mind:

- The location of vendors and their accommodation must be based on the local context.
- Furniture zones along the sidewalk must be defined.
- Design structures should be consistent and can be fixed or mobile.
- Clear regulations must be set and management of vendors carried out.
- Maintenance must be planned, including regular cleaning and waste and water management.
- Standards must be determined that allow for healthy and safe activities.

These recommendations should be taken into account so that commercial activities may complement the daily activities that take place in the streets.

Some examples of possible incorporation of street commerce are:

- Extension of commercial use on sidewalks.
- Location of vendors on sidewalks.

Street vendors should not be permitted to obstruct the spaces intended for pedestrian movement or reduce the minimum area provided for pedestrian traffic. Vendor spaces and frontage expansions must be controlled by strict measures regulating the spaces destined for traffic and those for commercial establishments and their related activities. In addition, there must be adequate correlation between street vending area definition and active mobility infrastructure to ensure continuity and accessibility.

Signage and wayfinding

When walking down a street, people must make a series of decisions in terms of their movements that entail identifying specific urban landmarks and visualizing the signs that will allow them to understand where they are. The strategies to design wayfinding programs are called wayfinding strategies.

Signage for pedestrians should be consistent, with clear visual language that can be universally understood. It should provide information that will allow users to switch mobility modes and navigate local street networks. Signage and wayfinding should be scaled at eye level and be visible for adults, children, and people using wheelchairs.

Wayfinding systems are intended to guide city travelers. It has been proven that effective information increases walkability in cities; and therefore, citizens should be provided with as much information as possible during their journey based on the following principles:

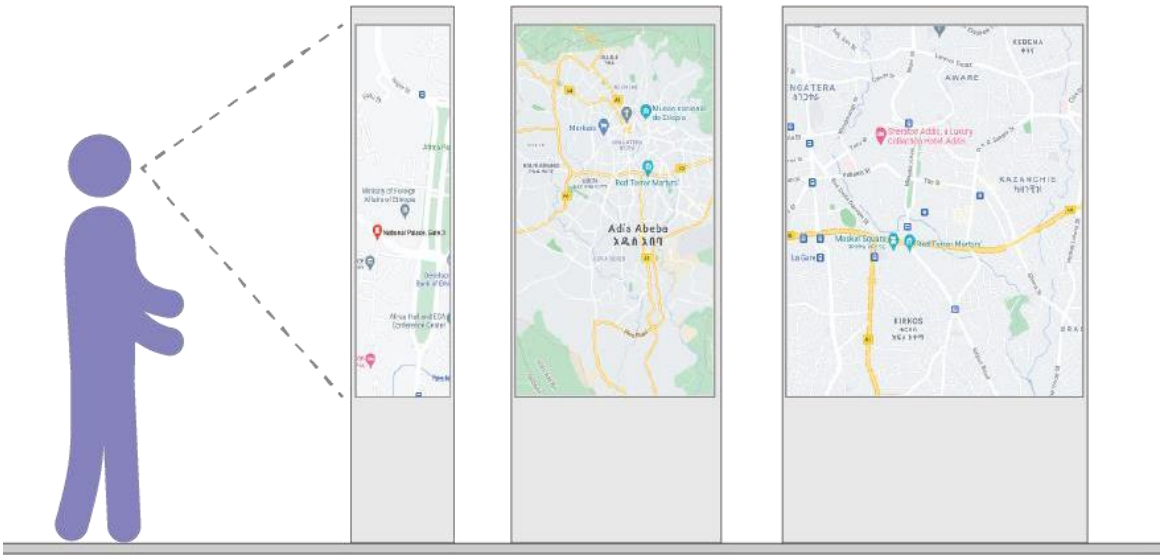
Generally, information is displayed with an accessible design that recommends placement between 0.90m and 1.80m above the floor level to allow for visualization by persons in wheelchairs, as well as persons who might be standing.

Information signs should contain at least:

- location map with information for a 5, 10, and 15 minute walking radius
- the names of surrounding streets
- the most important tourist attractions
- a list of specific services that can be found in surrounding streets
- restaurants and entertainment venues
- maps of public transport routes
- information regarding accessible routes.

These should be located at strategic points where pedestrians, and especially tourists, walk by and at locations with high visitor flows, such as tourist attractions, temples, transport stations, parks or markets, among others.

Wayfinding example



Green Infrastructure

The concept of green infrastructure represents an alternative to the traditional or "gray" stormwater management infrastructure (sewage system, pipes and canals). The development of infrastructure that allows the capture, collection and filtration of water through vegetated spaces is promoted.

This type of infrastructure has many advantages, particularly, that it fosters the creation of green spaces, water conservation for irrigation purposes, and flood risk mitigation based on a reduction of the stormwater load on the sewage system.

Seeking to adapt to climate change, and recognizing the importance of creating resilient cities, the development of sustainable stormwater management systems through green infrastructure is being promoted in cities worldwide.

Design considerations for green infrastructure should be based on site conditions like water level, soil permeability, and urban drainage. These parameters will determine the possible landscaping designs or sustainable urban drainage systems. Bioswales, rain gardens, and permeable pavements are among the most commonly used systems.

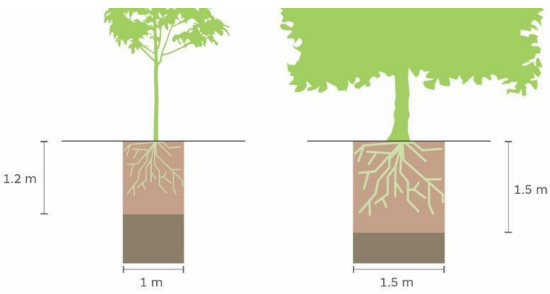
All designs and elements selected to compose green infrastructure must be tied to the site's climate conditions, the precipitation level, and the amount of filtered water, because they influence the acceptable behavior of the drainage systems and vegetation of the pedestrian infrastructure.

Also, species chosen are equally important given that they must adapt easily to the environment in which they are planted. Species selection is also based on the quality of the space created, as it is necessary that they easily adapt tothe climatic conditions and provide benefits to pedestrians.

Vegetation design

Possible climate variation

Design based on vegetation conditions



6. Lighting

Well-lit spaces are critical to pedestrian safety because they become lively spaces that are inviting at night and help prevent crimes. Pedestrian-scaled lighting should be installed along all streets, ensuring appropriate light levels and spacing to prevent dark spots between light sources. Brightness levels should be greater along commercial streets, and softer inresidential areas. Poles and fixtures should never obstruct walking paths.

Lighting implementation in public spaces is crucial for strengthening the sense of security, inhibiting criminal behavior, and increasing the aesthetics and prestige of a site. For traffic movements, lighting plays a crucial role, especially in areas of conflict such as crossings, highway exits, and intersections.

Poor lighting significantly reduces sight distance and visual clarity for all users, even when there are no obstructions in the line of sight. Energy inefficiency can cause high operating costs, and poor use and low maintenance are among the factors that most impact the cost of street lighting.

The installation and good maintenance of streetlights can be a timely solution to the safety problem of road users. Some objectives of public lighting are:

- to discern other road users and their circulation areas, especially in areas where vehicular and pedestrian flows intersect.
- to stress public road obstacles and variations in geometry.
- to foster safety in public spaces, as well as allow for nighttime activities.

Lighting zones must include pedestrian traffic areas, in addition to vehicular traffic areas. Lighting at intersections can reveal those intersections to approaching vehicles, stress the presence of obstacles, signage, directions, and make vehicle and pedestrian movements clearer.

Lighting from light poles and fixtures should aim directly onto the street to minimize glare, as well as light pollution that could negatively impact residential areas at night.

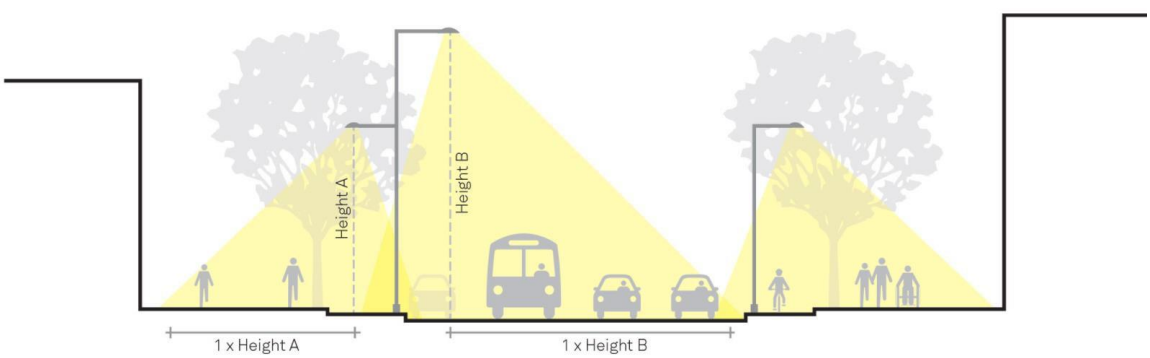
Shielded and cut-off fixtures with energy-efficient light bulbs are more cost-effective as they use less energy by directing the light toward the ground, reducing light pollution.

A consistent approach to color temperature should be applied throughout the lighting plan, although different color temperatures can be used to signify other users or types of travel. For example, 3000 Kelvin (K) is often used for pedestrian paths, and 5000K for vehicular paths.

Low-energy solutions such as Light Emitting Diodes (LED) minimize energy consumption and light pollution. LEDs have a long lifespan of 50,000–70,000 hours when not operated at high temperatures.

Alternative power sources such as solar panels or battery-operated lighting can be used in areas where power is not always easily accessible, such as informal developments.

Lighting design example



The spacing between light poles is typically 2.5–3 times the height of the fixture. A single row of light poles might be sufficient for a narrow street, while wider streets will require multiple rows.

7. Sidewalk and Public Space Maintenance

Maintenance plays a key role in having suitable and safe infrastructure and can be a real challenge in cities with adverse or varying weather.

The authorities in charge of infrastructure design and construction are not usually the ones responsible for maintenance. First, the authorities in charge with maintaining public spaces are usually local authorities, which may have difficulties in terms of budget, staff, tools and equipment, and the necessary knowledge to provide maintenance services for best conditions.

Secondly, based on experience, proper materials are key to the longevity of sidewalks. Therefore, designers are encouraged to base their material type and quality decisions on infrastructure maintenance, which must be suitable for the intended use in terms of traffic intensity, weather, and other specific conditions. For instance, using light color pavement can make a street look dirty, even with constant cleaning; and massive public transport entrances must be made with extremely durable materials on the stairs and pavements to resist heavy foot traffic.

Importance of public space maintenance

Public space maintenance is often forgotten or given less importance than design and construction. However, it is crucial to the enjoyment of the public space. Arguments for highlighting the maintenance's importance are described below:

It provides durability

Urban and public spaces should be available for the entire life span of the materials used.

It promotes correct usage

Poor maintenance can affect the intended usage as well as the lifespan of the design. For instance, a dirty bench or a broken swing cannot be used.

It reduces risk of accidents

A space that lacks maintenance can be dangerous and inaccessible. For instance, uneven pavement surfaces can cause people to fall. It also affects transit users, particularly people with reduced mobility or baby carriages.

It can reduce the cost of expensive repair when it's done regularly

Maintenance has a cost and involves the allocation of human and budgetary resources. Budgeting for routine repairs can also prevent deterioration from becoming more significant and generating higher costs.

It improves appearances

Lack of maintenance projects a bad image and generates negative opinions, making the location being considered unsafe.

Maintenance plan

Moreover, it is recommended that a measurable maintenance plan be developed, based on periodical inspections to determine sidewalk conditions and prioritize actions to be carried out regarding the network.

A maintenance plan should include:

- **Definition of roles and responsibilities:** Clear responsibilities for tracking, inspecting, and maintaining public spaces are essential within and across departments and agencies. The city needs to define clear roles and protocols for the care and monitoring of assets during the design process, as well as enter into agreements or memorandums with clear responsibilities and identified partners, and define the routine and corrective maintenance protocols.
- **Definition of Level-of-Service Standards**: The city can set policy standards for an acceptable level of service for infrastructure maintenance These performance standards must be clear and easily communicated
- **Tracking and managing assets with a mobile application:** an accurate and current database of geographic information system (GIS) assets is a powerful tool for maintaining a high level of system performance. The city can develop a feedback mechanism involving monitoring, maintenance, and design staff.
- **Type of maintenance**: There are different types of maintenance that must be complemented based on the types of needs that might arise: preventive, recurring, corrective, and emergency.

Preventive maintenance:

Refers to the conservation processes of buildings and their exterior spaces and furnishings. It is carried out through a systematic inspection program, minor repairs and checking of physical infrastructure. For example, overhaul and rust-proof painting of the metal parts in playground equipment.

Recurrent maintenance:

Refers to all processes of routine cleaning and sanitation that should be regularly checked. For example, lifting of garbage bins and cleaning of drains.

Corrective maintenance:

Refers to repairs due to deficiencies, breaks or failures in the construction components and systems. For example, the repair of cracked pavement.

Emergency maintenance:

Refers to action taken in case of risk situations. It involves immediate repairs, removal, or fencing off of elements to prevent use. For example, replacement of safety railings, fencing off of a tree at risk of keeling, fencing off or removal of games in poor conditions.

Maintenance of sidewalks and public spaces must include but are not to be limited to:

Cleaning services:

- Mechanical and manual sweeping of sidewalks and plazas, including shoulders, curbs, and green areas
- Litter removal
- Schedule trash collection and sorting
- Mechanical and manual water jet cleaning
- Façade and surface cleaning
- Graffiti removal
- Cleaning of fountains, lakes, and ponds

  Clean-up after natural weather events (such as storms or heavy rainfalls)

Gardening and landscape services:

- Tree pruning
- Edge trimming
- Planting and replacing plants and trees.
- Fertilization
- Weed control and pesticide use
- Lawn replacement
- Manual or automated irrigation.

Maintenance of public space elements:

- Repairing and replacing sidewalks and pavements
- Repairing and replacing urban furniture elements (see Chapter 4), playground elements, signage and wayfinding elements, ornamental fountains, street lighting fixtures, bus stops, and manhole covers
- Repairing and replacing gardening elements such as irrigation or pumping systems, plants, trees, and lawns
- Painting and repainting.

Improvements of maintenance services

New international trends are looking to reduce emissions and optimize the resources invested in maintenance: the following are some that could be applied in Addis Ababa for sidewalk and public space maintenance.

Using a data analysis tool to track and manage maintenance performances through developing an online platform (website and cell phone application). The platform would allow citizens to take pictures, report conditions, file maintenance requests, and report incidents and issues. This tool can facilitate needs identification, decrease response time, and provide information to take preventive measures. For instance, the posting of "no littering" signs or increased police control in certain areas.

Using recycled or non-drinking water to pressure wash streets can reduce water consumption, as well as calculating water needs for each area, correctly installing and programming efficient irrigation systems, and selecting regional plants adapted to the local weather conditions.

Using cleaning products with a low environmental impact not only reduces the amount of chemicals depleted in the water from product dilution and cleaning operations, but also reduces packaging and water waste.

Placing smart waste trash bins that are solar-powered, with waste compaction capacity, and equipped with sensors to monitor and report on fill levels and collection activity. The goal is to optimize solid waste collection operation.

Building green infrastructure means planting vegetation and trees to allow water to go through natural filtration and evaporation processes before it enters the pipeline system or is recovered for irrigation purposes. The system's objective is to manage stormwater better, helping reduce runoff, water waste and decreasing the risk of flooding. It can also promote the creation of more green areas and, more specifically, the planting of more trees, benefitting mobility and public space quality.

Using recycled and more durable materials. Reducing maintenance costs by increasing the durability and resistance of materials used for urban furniture, and reusing materials, particularly plastics and wood.

Introducing Light Emitting Diodes (LED) in Street Lighting to minimize energy consumption and light pollution. LEDs are attractive mainly due to their long lifespan of 50,000–70,000 hours, their reduced energy consumption, and little need of maintenance.

8.
Implementation Roadmap

Design methodology

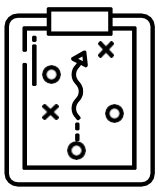
For sidewalk improvement, the following phases must be implemented:

Concept

Identify pedestrians' and street users' needs and requirements to roughly formulate the project. From this level of definition forward, solid technical basis and coordination between transportation, mobility and urban development and sustainability (economically, socially and environmentally viable) should be the project guidelines.

Diagnosis

Once the problem has been identified and technically justified, a situation analysis before implementing the project is necessary to understand the accurate functioning of the infrastructure in question, and to define the issues and challenges of the project. At this stage, the project's scope should be defined, existing information should be collected, and, when required, surveys should be conducted to provide a detailed description of the functioning of the study area. The diagnosis could be summarized in a SWOT analysis to serve as a starting point for determining the required design. The SWOT analysis can help identify strengths, weaknesses, opportunities, and threats, and provide answers on how the strengths and opportunities help address weaknesses and threats.



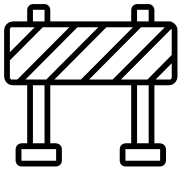
Planning

The goal is to conceptually define an optimal solution for modifying, renovating, or building a street. The proposed solution must address the issues identified in the diagnosis, and comply with the design criteria for sustainability and mobility. The recommendation is to present several alternatives and perform a multi-criteria analysis to make the optimal choice.

Design

The design stage involves the grounding of the concept in a blueprint for its construction. At this stage, it is crucial to incorporate all factors, types of users, and key elements outlined in this guide. It should be an iterative exercise assessed by technical experts with inputs and opinions by the citizens who will be the end users of the design.

Implementation



Construction sites should always follow quality and security control measures, and guarantee construction zone safety and accessibility for pedestrians for the entire duration of construction.

New trends in urban development propose the possibility of a temporary implementation at first, with removable materials (cones, paint, planters) that allow the city and the public to review and modify the design based on the observations made of users' behavior in the field, preventing more expensiveand long-term modifications. This exercise is called tactical urbanism.

Maintenance

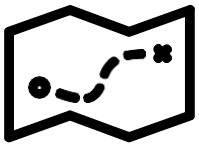
It is important to consider that both public spaces and sidewalks require maintenance and, therefore, from the design stage, the necessary resources (in terms of staff and budget) should be allocated so that the infrastructure is kept in optimal conditions throughout its design life.

Evaluation and monitoring

Finally, after construction, it is crucial to measure the intervention's impact. Measurement should be carried out based on previously defined indicators, the progression of which should be compared with the goals established in the planning phase.

Location

Authorities usually face the dilemma of choosing when and where to implement the measures proposed for these to be as beneficial, and with as little investment as possible. To guarantee the success of a project, the measures must generate tangible benefits for the majority of citizens, and this can only be done by conducting mobility, socioeconomic, and urban studies prior to construction.



Continuity

It is also important to consider that any action undertaken cannot be an isolated one, or one lacking a comprehensive perspective of the physical space. This perspective is necessary to develop continuous routes and street sections, ensuring that space improvement measures are carried out with continuity until a comprehensive network of accessible and walkable space is created. Improvements must also have continuity over time, ensuring that actions are generated progressively and constantly.

Stakeholders' Engagement

In order to foster citizens' acceptance, the affected users must be included and consulted in the defining of the problem and its possible solutions from the design stage. Likewise, creating awareness campaigns on the importance of respecting speed limits and prioritizing pedestrians is crucial for the public becoming more responsible and reaping the most benefits.

Considering the different stakeholders involved in implementing strategies and improvements regarding the city's pedestrian infrastructure, the roles of each entity should be identified. The responsibilities that each actor may acquire are shown below:

Addis Ababa City Administration Transport Bureau (AACATB)

- Provide political leadership and general oversight of strategy implementation.

Transport Programs Management Office (TPMO)

Addis Ababa Traffic Management Agency (TMA)

Transport Authority

Addis Ababa City Roads Authority (AACRA)

- Design and implement high-quality walking and cycling infrastructure.

Construction Bureau

- Develop pedestrian friendly construction guidelines.

Traffic Police

- Control and manage traffic operations
- Enforce parking regulation

Plan Commission

- Develop pedestrian friendly planning regulations.

Code Enforcement Office

- Manage street vending.
- Prevent encroachments on pedestrian infrastructure.

Road Safety Council

- Coordinate with stakeholders on road safety initiatives related to the walking and cycling environment.

Tactical Urbanism

An approach to neighborhood building and activation using short-term, low-cost, and scalable interventions in policies to obtain long-term changes in cities. (Mike Lydon and Anthony Garcia)

Temporary intervention

The measures are first carried out temporarily with movable restrictions such as cones and fences.

Creation of temporary spaces

Subsequently, non-definitive measures are taken, such as painting the streets and placing furniture and planters to define the space.

Final implementation

Finally, once the users accept the changes, the definitive modifications can be made to the infrastructure.

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Addis Ababa City Government Plan and Development Commission

IDOM