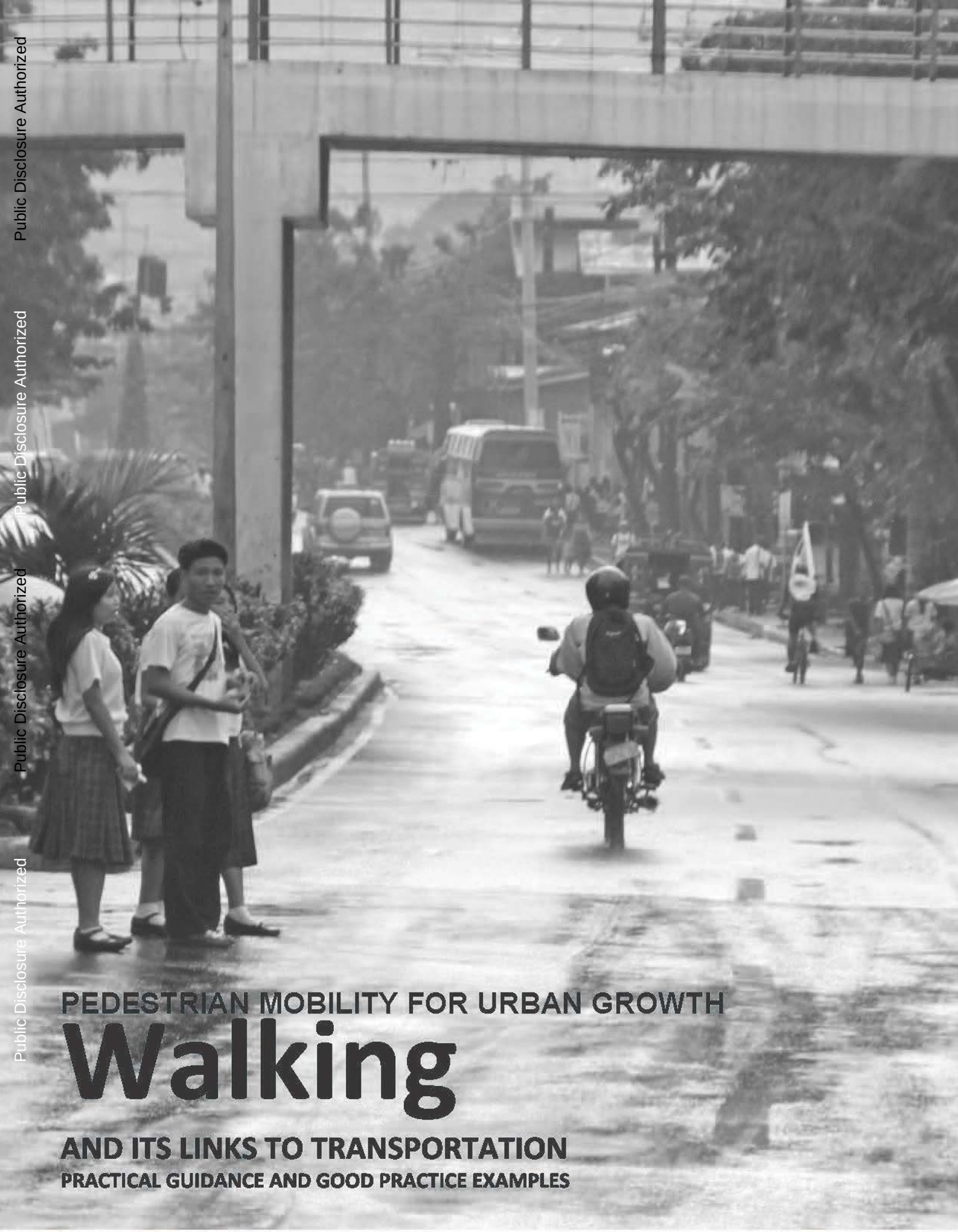

PEDESTRIAN MOBILITY FOR URBAN GROWTH

Walking

AND ITS LINKS TO TRANSPORTATION

PRACTICAL GUIDANCE AND GOOD PRACTICE EXAMPLES

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1. EXECUTIVE SUMMARY

This report draws on international best practice and pilot projects in Africa to provide guidance on the key elements that should be considered in the design and maintenance of high-quality walking environments.

Importance of walking environments. Walking provides basic mobility. It also provides crucial first- and last-mile connectivity to public transport besides bringing significant health and recreational benefits. Improving conditions for pedestrians reduces the demand for travel by motorized vehicles and hence diminishes multiple urban transport challenges, including congestion, pollution, road accidents, and personal security. Infrastructure and management interventions that improve the convenience, comfort, and safety of walking benefit existing users while encouraging more people to walk.

Defining the pedestrian environment. Understanding the features that constitute a high-quality pedestrian environment is an important prerequisite to efforts to improve conditions for walking. Three key elements, in particular, have an impact on the quality of the pedestrian environment and should be considered when designing pedestrian infrastructure and transport networks. These are:

- **Street design.** A well-designed urban street protects pedestrians from the negative impacts of motor vehicles. This can be achieved either through dedicated pedestrian sidewalks or a design that reduces vehicle speeds in case of a shared space. Sidewalks need to be unobstructed, continuous, shaded, and well-lit, and should include a number of elements positioned in a strategic manner. These elements include paving, landscape planting, street lighting, street furniture, public facilities, underground utility access points, and other sidewalk amenities. There are also features that make streets more accessible, including curb ramps, tactile paving, and accessible traffic signs.

- **Building design and land-use mix.** The built environment surrounding pedestrian routes must be conducive to walking. Streets with many kiosks, shops, and vendors oriented toward pedestrian spaces help create a feeling of safety, while producing a more active and vibrant atmosphere. Architectural design elements such as building setbacks, the ratio of building height to street width, and the articulation and permeability of building street wall (e.g., the number of doors and windows) have a major impact on the quality and safety of pedestrian spaces.

- **Street network.** There are many types of urban road networks. However, the key to good pedestrian mobility is a high ratio of intersection nodes to road links so that streets and pathways are well connected. Prioritized connectivity creates finer grained networks for walking, including pedestrian-only streets.

Factors that shape the pedestrian environment. Pedestrian environments are regulated at the national and local level. Multiple agencies are responsible for different aspects of the pedestrian environment. Differences in the coordination, institutional structures, and financing systems affect governments' abilities to design, construct, and maintain the pedestrian environment. An important focus of the report is on these challenges as well as the specific challenges related to the management of pedestrian spaces due to a lack of institutions empowered to make decisions on urban infrastructure. This report includes case studies of the institutional structures, financing practices, and regulations that have been adopted by cities and have been successful at achieving dramatic improvements in the design and

implementation of the pedestrian environment. Design and management interventions have a cross-cutting impact on multiple elements of the pedestrian environment. The key factors related to street design, building, land-use mix, and network design that affect the pedestrian environment must be planned and managed to ensure proper design and sustainable accessibility of the infrastructure (see Figure 1).

Figure 1: Planning and management factors affecting the pedestrian environment.

Intervention		**Pedestrian environment element addressed through the intervention**			
		 Streets	 Building design	 Land-use mix	 Street network
Planning, design, and finance	Mobility plans and strategies	●		●	●
	Street design standards	●			●
	Funding policies	●			●
	Motor vehicle laws	●			●
	Building control regulations	●	●	●	●
	Zoning rules	●	●	●	
	Road network plans	●	●	●	●
Management	Street cleaning and maintenance	●			
	Parking management	●	●		
	Vending management	●			
	Driving enforcement	●			●
	Criminal enforcement	●	●	●	●

Walking assessment tools. Planning, maintaining, and assessing pedestrian environments requires a good understanding of the mobility problems encountered in a city. Existing assessment methodologies were reviewed in order to facilitate rapid assessments of the walking environment. A composite tool was developed to assess the walking environment across an urban setting through field surveys and mapping. The smartphone-based survey relies on a compact set of indicators to generate a snapshot of the critical issues facing pedestrians. The World Bank piloted the survey tool across five African cities.

African city case studies. African cities are growing faster than cities on any other continent. African cities held just 32 million people in 1950 but are projected to include nearly 1.3 billion people by 2050.[1] With populations growing at such an enormous rate, it is often difficult for infrastructure to keep pace with urban growth. Rising automobile traffic on the continent has posed a great challenge. Increasingly, African cities struggle to handle the volume of motor vehicle traffic on their roadways. African urban dwellers spend much of their time stuck in traffic and away from their work and families. In order to

accommodate growing populations and greater demands for mobility, African cities must develop alternative means of transport. Public transport systems and pedestrian facilities must be improved so that African cities may continue to grow without suffering the consequences of runaway growth in private vehicle traffic.

In Africa, between 40 and 60 percent of all trips are done entirely by foot, with trips undertaken primarily by public transport also involving significant walking distances (Image 1). It is estimated that sidewalks are missing from around 65 percent of the road network, forcing pedestrians and motor vehicles to share the same space.[2] What little pedestrian space exists is often blocked by parked vehicles, encroached upon by shop premises or eroded by street vendors. An increased provision of sidewalks in African cities can expand access to resource-efficient travel, prevent road traffic crashes, and increase the use of public transport.

Knowledge in this area is needed to convince national governments and local authorities of existing challenges as well as opportunities for improvement. To address these issues, the World Bank launched Pedestrian Mobility for Urban Growth, a project that aims to develop strategic plans for pedestrian improvements in Abidjan, Cote d'Ivoire; Kampala, Uganda; Dar es Salaam, Tanzania; Gaborone, Botswana; and Yaoundé, Cameroon. In these cities, the transport environment for pedestrians and non-motorized transport can be unsafe, declining or non-existent. Examples from these cities illustrate common challenges faced as well as lessons learned from the process of developing pedestrian mobility action plans.

Image 1: Walking is a critical form of low-cost mobility in African cities.

Pedestrians in Nairobi, Kenya (left), and Dar es Salaam, Tanzania (right).

Source: ITDP Photo

KEY RECOMMENDATIONS

The following actions are needed to improve the pedestrian environment:

- **Implementation of demonstration projects.** High-visibility pedestrian mobility demonstration projects build political support for more extensive improvements.
- **Adoption of standards and design review processes.** To help address the shortcomings of existing highway-oriented design manuals, cities need to adopt urban street design guidelines, along with processes for design review audits to ensure that projects comply with the new guidelines.
- **Institutional structures.** Cities need to create empowered working groups as a way to share data, conduct peer reviews of road designs, and synchronize the implementation of road projects. Regular meetings can serve as a forum for discussions about ongoing projects and pedestrian mobility issues.
- **Street management.** Even after good pedestrian facilities are built, poor management of on-street parking and vending can compromise the usability of these spaces. These challenges need to be addressed through a combination of physical enforcement measures such as bollards and better management and enforcement systems.
- **Financing.** In order to enhance funding support for pedestrian improvements, cities should look at innovative sources of revenue, including collection of on-street parking fees and leasing of outdoor advertising rights.
- **Reform of building control regulations.** To address the role of the private realm in shaping the pedestrian environment, building control regulations need to be reformed to encourage active façades in place of compound walls and establish mechanisms for breaking up large blocks during the redevelopment process.
- **Preparation and implementation of pedestrian network plans.** At the city level, governments need to identify street networks that ensure connectivity and walkability as areas develop.
- **Capacity building.** Personnel involved in the street design projects need basic training in street design principles and design standards. Governments can partner with local academic institutions to develop certification programs. Finally, there is a need for academic institutions to reform university curricula to provide better training to the next generation of street designers.

OUTLINE OF THE REPORT

1. **The link between walking, green growth, and sustainable development.** Well-designed streets and street networks that prioritize walking are crucial to achieving many of the global Sustainable Development Goals (SDGs). The provision of high-quality walking facilities can advance Vision Zero, pro-poor, gender-equity, low-carbon, sustainability, and climate-resilience goals. Investment in walking spaces can be justified as a way to reduce road fatalities, contribute to more equitable communities, enhance economic prosperity, improve public health, and contribute to climate change mitigation and adaptation strategies.

2. **Designing good walking environments.** Despite its importance, the pedestrian environment is often neglected in urban transport planning. Streets are often designed with little or no dedicated space for pedestrians. Crossings, refuge islands, and other critical safety features are neglected leaving pedestrians to compete for space with fast-moving motor vehicles. Where sidewalks exist, they are encroached upon or blocked. This section presents design standards for the key physical elements that have an effect on the quality of the pedestrian environment—street design, network design, and building design. To illustrate the needs of and the challenges facing pedestrians, this report includes case studies where good practice solutions have been found.

3. **Supportive institutional, policy, and financial frameworks.** The underlying factors behind poor pedestrian environments include a lack of appropriate design standards and poor capacity to design, implement, and manage high-quality pedestrian facilities. Effective management of the pedestrian environment involves a range of agencies, including transport ministries, housing ministries, road building agencies, traffic police, municipal governments, utility providers, and public transport agencies. Various dedicated funding sources that cities have utilized to construct and maintain pedestrian infrastructure are discussed.

4. **Proposed walking assessment tool.** Assessments of the pedestrian environment can help reveal infrastructure gaps and inform the identification of priorities for infrastructure improvements and regulatory changes. Effective walking and street usability can be assessed through various measures, including sidewalk width, presence of shade, presence of obstructions, presence of lighting, block size, block density, and degree of mixed use. This report reviews existing approaches to assess walkability. Based on a multi-criteria assessment that takes into account the pedestrian needs, the ease of measurement, and other factors, the report proposes a methodology for evaluating walkability.

5. **Pilot projects: Developing good practice for better walking environments in five African cities.** This report includes findings from an assessment of the walking environments in five African cities. Cities in Africa present particular challenges as pedestrian environments are often non-existent or poorly maintained and cities lack good practice in developing safe street environments. Accessibility and safety of the pedestrian environment is often hindered by poor planning and low investment. This report describes solutions identified through stakeholder consultations in five African cities. Since many challenges to a better pedestrian environment require interdisciplinary solutions, it is essential that these agencies develop a common vision and an integrated action plan to improve conditions for pedestrians. In addition, action plans need to consider local political dynamics. In many cases this means achieving quick wins to demonstrate the benefits of pedestrian facilities through rapid, discrete interventions in order to build buy-in for more widespread change.

2. Walking and its link to green growth and sustainable development

Well-designed pedestrian infrastructure is critical to the sustainable development of cities around the world. The impacts and benefits of walking facilities can help advance a variety of development goals, including Vision Zero, pro-poor, gender-equity, low-carbon, sustainability, and climate-resilience goals. The provision of walking spaces can be justified for safety, equity, economic, public health, and environmental reasons.

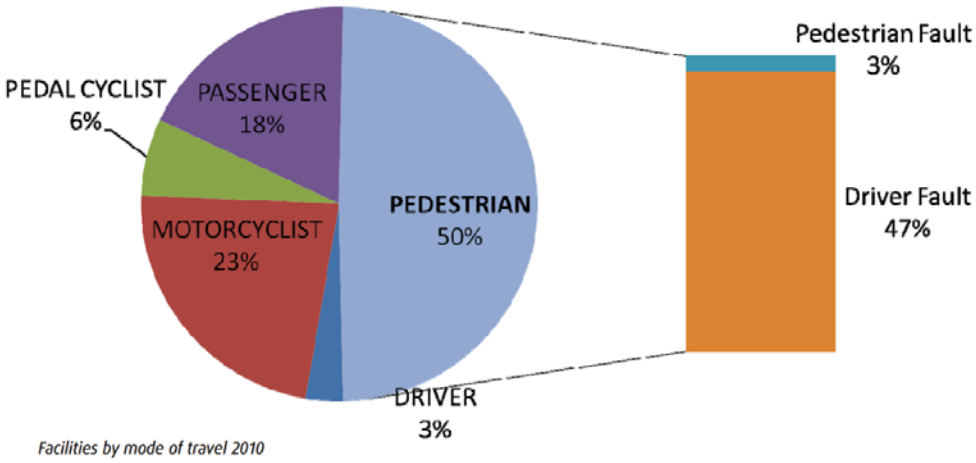
Road safety

Pedestrian infrastructure design is critical to efforts to reduce the global burden of deaths and injuries from road traffic accidents. An estimated 1.25 million people are killed in traffic crashes annually and injuries from traffic crashes are currently the ninth leading cause of death globally.[3] Road safety is a global challenge and a concern in emerging economies. Of the 68 countries reporting an increase in road fatalities since 2010, 84 percent are low- and middle-income countries. Road fatalities are an acute problem in Africa. The World Health Organization (WHO) found that the residents of Africa suffered the highest road traffic fatality rate in the world: 26.6 road fatalities per 100,000 population compared with Europe's global low rate of 9.3 per 100,000.[4]

Pedestrians and youth are particularly vulnerable road users. Pedestrian deaths account for 22 percent of all fatalities globally.[5] Africa sees the highest fraction of pedestrian deaths: fully 39 percent of total traffic deaths on the continent.[6] In Kampala, for instance, pedestrians account for half of all road fatalities (see Figure 2). Indeed, the places where people walk out of necessity are the most susceptible to extremely high rates of injury and death due to poor walking conditions. Globally, children and young adults are involved in a disproportionately high number of traffic fatalities. Road crashes are the leading cause of death among people aged 15 to 29 worldwide, and the second leading cause among children aged 5 to 14.[7]

In addition to the loss of lives, and its toll on families and communities, there is a significant economic cost of road crashes. It is estimated that road crashes cost low- and middle-income countries approximately 3 percent of their gross domestic product (GDP).[8] This is the case in South Africa which lost 3.4 percent of its GDP in 2015 to road traffic crashes, including 11,144 fatal crashes.[9] In Kampala, pedestrians account for half of all traffic fatalities, and in most pedestrian crashes the motor vehicle driver was at fault (see Figure 2).

Figure 2: Fatalities by mode of travel and Who's at Fault in case of Pedestrian fatalities in Kampala, 2010.



Source: Kampala Capital City Authority et al. 2013. *Smart Moving Kampala: Design of NMT-zone in Namirembe Road and Luwum Street*.

Sustainable Development Goal (SDG) 3 aims to reduce the number of global traffic deaths by half by 2020. The provision of high-quality pedestrian environments can contribute to achieving that goal in several ways:

- Reducing the total vehicle kilometers travelled in a city reduces pedestrians' exposure to motor vehicles. As a result, places that have reduced car trips by prioritizing walking, bicycling, and public transport tend to experience fewer road fatalities.[10]

- Better walking infrastructure has been clearly associated with improved pedestrian safety.[11,12] Streets and intersections can be redesigned to make pedestrians more visible and predictable to drivers. Pedestrian refuge islands, curb extensions, walk signal priority, and other urban street design elements can be effective safety measures.

- Traffic calming interventions such as narrowed lanes and raised crosswalks can slow vehicle speeds, thereby increasing pedestrian safety. The faster a vehicle is traveling, the less time the driver has to react and stop before a collision.[13]

- The design of the street network can also contribute to improving road safety. Short blocks limit vehicle acceleration between intersections, lowering speeds and improving road safety for all users. Analysis of the impact of street network design on road safety outcomes in cities in California concluded that the highest risk of fatal or severe traffic crashes corresponds to very low intersection density, and that safety improves with an increase in intersection density.[14]

New York City has experienced a 29 percent reduction in people killed or severely injured on its streets since 2001 in large part because of the city's new approaches to street design.[15] An assessment of the road safety impact of many of New York's innovative street projects, which have, among other things, prioritized pedestrians, bicyclists, and public transport riders, revealed reductions in personal injury

crashes ranging from 12 to 88 percent. For instance, the redesign of the intersection of Park Avenue and E 33rd Street in Manhattan reduced injuries from road crashes by 88 percent compared to prior years, while design changes in Times Square, including a new pedestrianized plaza, lowered injury crashes by 27 percent.[16] The quality of the walking environment determines the safety of walking and the number of people injured and killed while walking.

Social equity

Investments in pedestrian facilities benefit all urban residents. Well-designed pedestrian facilities serve all people, including the most vulnerable groups—the poor, women, and people with disabilities—who are seldom given importance in the planning and design phase of road infrastructure. Some of these vulnerable populations experience compounding disadvantages. For instance, women and the poor are more likely to have a disability. Given that most trips in many cities take place by foot, providing universally accessible connections improves equity for many residents. That most public transport trips begin and end with walking means that a majority of trips in many cities include a walking component (see Figure 3).

For a variety of reasons, women walk more than men and so they also benefit more from improved pedestrian infrastructure. Some studies suggest women walk longer distances and use public transport more frequently because they shoulder a larger share of responsibility for household chores and child care and are less able to afford (or lack access to) private transport.[17]

People with disabilities benefit directly from investments in universally accessible pedestrian infrastructure, which helps improve their mobility and independence. More than 1 billion people, or 15 percent of the global population, live with some form of disability, and this number is growing.[18] There is a higher incidence of disability among the poor, women, and elderly, and children from poor and ethnic minority families are at significantly higher risk of having a disability.

Inaccessible transportation is a key barrier for people with disabilities to enter the workforce.[19] An OECD study showed that the employment rate of working aged people with a disability was only 44 percent compared with 75 percent for people without a disability.[20] Providing accessible trip chains so that all users, whether a wheelchair user, someone with vision impairment, or someone with cognitive limitations, can access opportunities for employment, education, and social connections, will have widespread social and economic benefits.

Figure 3: Modal shares by major city globally, 2011.[21]

Economic vitality

Well-designed streets and street networks have proven to be a strong stimulant for a city's economic development. The economic benefits of pedestrian facilities and connected streets have provided a strong case for their creation in many cities around the world. Well-designed streets deliver economic benefits to cities by reducing the use of motorized vehicles and the related costs of traffic congestion, increasing retail sales and business transactions, raising property values, providing a lower-cost alternative to construction and maintenance of road infrastructure, and lowering household transportation costs.[22,23]

Good walking facilities that encourage a shift from driving to walking and public transport will remove cars from the road. Traffic congestion is common in cities everywhere and is on the rise. Using GPS data, TomTom estimates congestion has increased globally since 2008. Between 2015 and 2016, congestion increased 5 percent in the United States, 7 percent in South America, 9 percent in Europe, 12 percent each in Asia and Oceania, and 15 percent in Africa.[24] Mexico City and Bangkok top the list as the world's most congested cities. Congestion in the Mexican capital adds an extra 59 minutes per day or 227 hours per year to residents' commutes.[25] In 2013, traffic congestion was estimated to cost each car-owning household in the United States an average of US$1,700, and in France, US$2,500.[26]

Congestion results in lost productivity and higher transport costs, which translates to higher cost of goods. These higher costs erode economic productivity. One study estimates residents of Lagos collectively lose 3 billion hours per year to traffic congestion, at the cost of US$1 billion.[27] In Los Angeles, ranked the eleventh most congested city in the world, traffic congestion cost the city US$24 billion in 2013.[28] Traffic congestion is estimated to cost developing Asian countries 2-5 percent of their GDP annually.[29]

Walkable neighborhoods have been shown to encourage more walking trips.[30] To the extent that the increased walking trips are shifted away from motorized vehicles, more walking can result in less traffic congestion. Minimizing hours wasted sitting in traffic will improve labor productivity and increase economic growth and competitiveness. A more efficient transport system also reduces the cost of transporting people and goods.

Well-connected streets with high-quality pedestrian facilities attract more customers, resulting in higher retail sales.[31] Germany has several very successful examples of pedestrian-only shopping streets that receive high volumes of visitors each day. A survey in 2010 counted 13,240 visitors in one hour to Cologne's Schildergasse pedestrianized street, and more than 11,000 visitors each to Munich's Kaufingerstrasse and Frankfurt's Zeil pedestrian streets.[32] All of these pedestrians boost economic activity, so it is understandable that pedestrian infrastructure is linked to higher retail sales, lower vacancies, and higher rents**.** For instance, a survey of consumers in Portland, Oregon (United States), concluded that each month at restaurants, bars, and convenience stores, transit riders and pedestrians together spend more than drivers.[33] Similarly, results from a 2013 survey of shoppers visiting London's town centers revealed average spending by transport mode. While pedestrians spent on average less per trip than car, train, and bus users, they tended to make more frequent trips, and so ultimately spent the most per month compared to others.[34] Likewise, a New York City study showed that street improvements which improve safety and design, welcoming more pedestrians, bicyclists, and transit users to an area, were associated with higher retail sales compared to unimproved streets and the neighborhood or city as a whole. For instance, New York City's DOT improved the intersection of Amsterdam and St. Nicholas Avenues in Harlem by simplifying traffic movements and adding public space, which resulted in a 48 percent increase in retail sales, exceeding sales on neighboring streets as well as Manhattan-wide trends.[35]

Furthermore, businesses along streets with higher sales volumes themselves have more transactions. They can support other businesses, which cater to their own business needs. Demand for business services grows, leading to an agglomeration of benefits.[36]

Walkable and connected streets contribute to reduced vacancies and increase surrounding land values. For instance, in New York City's Union Square, the creation of a pedestrian plaza and protected bike lane contributed to a 49 percent reduction in commercial vacancies.[37] A study of walkable areas of the Washington, D.C., metropolitan area also found that such neighborhoods were more likely to see increases in office, residential, and retail rents in addition to higher retail revenues and for-sale residential values.[38] Higher property values lead to increased property tax revenues, which further fuels economic growth.[39]

The construction of facilities for pedestrians is many times cheaper than infrastructure for private vehicles and dramatically reduces transport costs for users. Guiding new growth so that it supports and encourages walking has a minimal cost. Shifting commuters away from private vehicles and toward walking makes transport infrastructure investments less costly. According to recent research, a shift to more compact cities that provide high levels of accessibility through walking,

cycling, and public transport could reduce the global societal cost of infrastructure, vehicles, energy, operations, and maintenance by up to 40 percent by 2050.[40]

Furthermore, connected streets and good walking facilities can provide people an affordable mobility option, reducing household spending on transport. Compared to driving, relying on non- transport typically lowers household spending on transport.[41] Households in drivable suburban neighborhoods devote on average 24 percent of their income to transportation; those in walkable neighborhoods spend about 12 percent.[42]

Personal security

Provision of well-designed walking facilities can contribute to improved personal security for pedestrians. Personal security is a common concern for pedestrians, especially among women. The statistics are universally shocking:[43]

- According to a 2014 survey, 37 percent of Americans, nearly half of them women (48 percent compared to 27 percent men) felt unsafe walking alone at night near their homes;
- An Australian study found 87 percent of women had been verbally or physically attacked while walking;
- 40 percent of women surveyed in Delhi in 2016 reported having been sexually harassed in a public place in the last year with most of the incidents occurring during the daytime;
- In 2016, 98 percent of Nepalese women reported facing harassment on the streets;
- In Sana'a, Yemen, 70 percent of women surveyed said they had been verbally harassed while walking.

Well-lit, unobstructed, and accessible sidewalks can improve pedestrians' real and perceived safety, which may encourage more walking trips, including to transit. The presence of other people on active streets may provide increased security in some contexts.

Special attention should be paid to providing safe pathways to transit as safety concerns about walking to transit are common. For instance, a survey in South Africa revealed more than 50 percent of heads of households were unsatisfied with security while walking to commuter rail stations; 38.4 percent to minibus taxi ranks; 35.1 percent to bus stops; and 25.8 percent to the BRT stations.[44] In some communities, women consider walking to and from public transport and waiting at stops the most dangerous parts of their journey. Among the Port Moresby survey respondents, women felt more unsafe than men walking to and waiting at a bus stop: more than 80 percent of women compared to approximately 50 percent of men.[45]

Concerns about safety while walking may affect people, especially women's, travel choices and mobility. They may limit where and when they travel and restrict them to particular modes that are perceived as safer.[46] This restricted mobility may prevent women from obtaining an education or fully participating in the workforce, diminishing their access to economic opportunities and reducing the country's overall economic growth. For instance, a 2006 household survey in Delhi revealed that perceived lack of safety was a key reason for women's lack of participation in the workforce.[47] As a result, women are underemployed. There are, therefore, gender equity, poverty reduction, and economic growth benefits to eliminating barriers for women to enter the workforce. Safe walking facilities can certainly contribute to empowering women.

Public health

Non-motorized transport, including walking, can improve public health by increasing physical activity. There is a global epidemic of obesity. Diseases such as heart disease and high blood pressure are on the rise. Many of these diseases are caused or exacerbated by inactive lifestyles. The health impacts from low levels of walking and physical activity can be staggering—estimated to cost China up to 8.5 percent of its GDP from 2005 to 2025[48] and South Africa 3.6 percent of its GDP based on 2015 Road Traffic Crashes (RTC) data.[49]

The creation of walkable neighborhoods is a proven method for encouraging more active lifestyles and improving the overall health of residents.[50] Access to shops, public transport, and amenities such as parks and public spaces encourages residents to walk and, therefore, increases the amount of physical activity they engage in daily. Residents of walkable neighborhoods are twice as likely to meet daily recommended amounts of physical activity as residents in areas unamenable to walking.[51] Walking connections to public transport can increase physical activity as well since public transport users tend to walk more daily than non-users.[52]

This increased physical activity from walking can reduce the incidence of chronic diseases. Walking just one kilometer per day was linked to a 4.9 percent decrease in the likelihood of obesity, and also lowers the risk of heart disease.[53,54] Thirty minutes of moderate exercise such as walking can reduce a person's risk of diabetes between 30 and 50 percent. Investment in pedestrian infrastructure can also positively impact mental health as 30 minutes of walking three times per week is associated with reduced anxiety and depression.[55]

Residents of walkable neighborhoods have been shown to have higher measures of social capital.[56] By improving access to the city, pedestrian facilities provide residents with increased opportunities to interact with their neighbors and to make positive contributions to their community.

Walking facilities also improve public health by reducing local air pollution from motorized vehicle emissions. Poor air quality is a global public health problem affecting millions, especially in cities. The WHO attributes at least 3 million premature deaths each year to ambient air pollution.[57] The Asian Development Bank estimates 500,000 premature deaths from local air pollution in Asia alone, resulting in a loss of 2-4 percent of GDP.[58]

Tailpipe emissions from motorized vehicles contain harmful chemicals, including particulate matter, nitrogen oxide, and sulfur dioxide which contribute to local air pollution.[59] Exposure to these pollutants increases a person's risk of cardiac and respiratory diseases, including asthma and lung cancer.[60] Shifting trips from motorized to non-motorized modes such as walking and bicycling will reduce tailpipe emissions and local air pollution. This, in turn, reduces incidences of disease and premature death.

Climate change mitigation and resilience

Street designs that incorporate high-quality walking spaces increase environmental sustainability since they contribute to reductions in greenhouse gas (GHG) emissions and improvements in climate resilience. A lack of pedestrian facilities leaves commuters dependent upon motorized transport, leading to a rise in GHG emissions.

As an alternative to motor vehicles, walking can reduce GHG emissions in two primary ways. First, improved walking facilities can help retain existing pedestrian trips and shift trips in motorized modes to walking, thus reducing vehicle emissions. Well-connected pedestrian facilities encourage the use of walking as a mode of transport over the private automobile, thus reducing car dependency and managing travel demand.[61,62] This reduction in motorized transport trips translates into significant GHG emissions reductions.

Second, a better walking environment is key to the success of new public transport investments (see Image 2: The positive impact of high-quality pedestrian facilities.). Accessible pedestrian connections to transit can contribute to increased transit ridership by enticing people to shift their trips from private motor vehicles or taxis to more efficient mass transportation. Dense, walkable neighborhoods accentuate public transport's strengths: a high number of potential passengers within walking distance of new infrastructure contributes to a well-trafficked system. The provision of pedestrian facilities ensures that potential passengers are able to safely reach public transport and will increase their likelihood to use such systems.[63] Reliable public transport and walkable neighborhoods reinforce each other's strengths and contribute to urban development patterns that do not require residents to have access to a private automobile to complete their day's chores. By shifting transport demand from private vehicles to public transport, walking, and bicycling, cities will be able to lower their carbon emissions while facilitating economic growth.

Provision of safe and connected walking facilities can be part of a city's climate resilience strategy. One indicator of resilient cities is a diverse transportation system that is not overly dependent on a single asset.[64] High-quality pedestrian infrastructure provides residents an additional mobility option, ensuring that they do not have to rely on a single mode—a motorcycle, car or even bus—to get around. During heavy rains, good sidewalk connections may allow people to continue walking to work and school even when other modes, such as motorcycles, are inoperable or unsafe on flooded muddy roads. Furthermore, the design of sidewalks and pedestrian spaces themselves can help mitigate flooding and other climate impacts. Green infrastructure, such as street trees, plantings, and bioswales, incorporated into the design of pedestrian environments can enhance resilience by introducing permeable surfaces which can discharge rainwater and floods more quickly than concrete and asphalt. Streets with plantings or trees are estimated to be three to six times more effective at managing storm water than those without.[65]

A walking environment should encompass a broad range of pedestrian services and facilities, including street furniture (e.g., benches and tables) and infrastructure (e.g., curb ramps, crosswalks, traffic calming devices, and center refuge islands) in conjunction with the roadway and public transport systems that are provided as part of the public right-of-way. The walking environment is also influenced by the design of buildings and the layout of the street network. These elements are described in more detail in the following sections. Policymakers must rise to the challenge of providing adequate pedestrian infrastructure as it is vital to the development of healthy, equitable, prosperous, and sustainable communities.

Image 2: The positive impact of high-quality pedestrian facilities.

By complementing public transport investments, high-quality pedestrian facilities can encourage a shift toward sustainable mobility: Nairobi (left) and Dar es Salaam (right).

Pedestrian mobility and the Sustainable Development Goals

The safety, equity, economic, health, and environmental benefits of walking infrastructure help advance at least eight of the United Nations' Sustainable Development Goals (SDGs):

- **Goal 1:** End poverty in all its forms everywhere.
- **Goal 2:** Ensure healthy lives and promote well-being for all at all ages. By 2030, substantially reducing the number of deaths and illnesses from air pollution.
- **Goal 3:** Achieve gender equality and empower all women and girls.
- **Goal 8:** Promote inclusive and sustainable economic growth, employment, and decent work for all. Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 percent gross domestic product growth per annum in the least developed countries. By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value.
- **Goal 9:** Build resilient infrastructure, promote sustainable industrialization, and foster innovation. Develop quality, reliable, sustainable, and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all. Facilitate sustainable and resilient infrastructure development in developing countries.
- **Goal 10:** Reduce inequality within and between countries. By 2030, empower and promote the social, economic, and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status.

- **Goal 11:** Make cities inclusive, safe, resilient, and sustainable. By 2030, provide access to safe, affordable, accessible, and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons. By 2030, provide universal access to safe, inclusive, and accessible green and public spaces, in particular for women and children, older persons and persons with disabilities.
- **Goal 13:** Take urgent action to combat climate change and its impacts. Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries. Integrate climate change measures into national policies, strategies, and planning. Promote mechanisms for raising capacity for effective climate change-related planning and management in least-developed countries and Small Island Developing States, including focusing on women, youth, and local and marginalized communities.

3. Planning and designing good walking environments

Accessibility and safety of the pedestrian environment is often hindered by low investment, transport planning that favors driving, and a lack of robust institutions to manage pedestrian spaces. Walking often has a negative image and is perceived as having little relevance as a solution to traffic and mobility challenges. Authorities reinforce this perception through inadequate investments in pedestrian infrastructure, highway-style street design practices, and poor management of pedestrian spaces (see Image 3 and Image 4).

Image 3: Dire conditions for pedestrians.

In the absence of adequate facilities in Gaborone (left) and Lagos (right), pedestrians are forced to walk in uncomfortable and unsafe conditions.

Image 4: Challenges facing pedestrians.

Compound walls, security gates, and large setbacks create deserted, uninviting, and insecure environments for pedestrians in upscale residential areas of Kampala.

Urban expansion is taking place primarily at the periphery of major cities and is now characterized by large peri-urban areas with informal and illegal land-use patterns, combined with a lack of infrastructure, public facilities, and basic services. This expansion is often accompanied by a lack of adequate access roads and public transport access. The trend toward peri-urban expansion is often

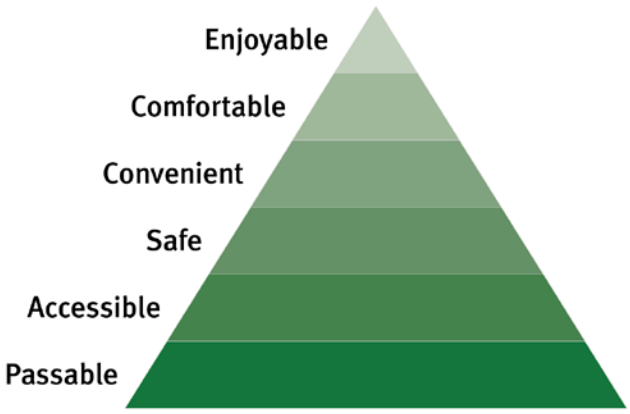
characterized by irregular street patterns with numerous unplanned dead-end roads. A UN-Habitat report found that less than 10 percent of land is allocated to streets in the suburbs surrounding cities in Africa, Asia, and Latin America.[66]

Design of the pedestrian environment

Walking is the most basic form of transport, open to all, but people make very different decisions about how, when, and how much to walk depending on a wide variety of factors. For the poorest people, walking is often the only option and people will walk almost regardless of the walking conditions. Wealthier residents, however, can afford other alternatives such as shared vans, buses, motorcycles, and private cars, and are much less likely to walk if the walking environment is less convenient, unsafe, or uninviting.

The provision of basic access—for instance, good connectivity and clear pathways—is the first step in creating a good quality pedestrian environment. Beyond creating passable spaces, the design of the pedestrian realm should aim to improve safety and convenience (e.g., through lighting and trees) to make walking not only possible but attractive. This perspective stems from the pyramid in the image below, which identifies the feasibility of walking in the first place as the most important metric, and then builds up steadily toward increasing comfort and enjoyment (see Figure 4). Unfortunately, many cities fail to provide passable facilities for pedestrian movement, let alone measures to address higher pedestrian needs.

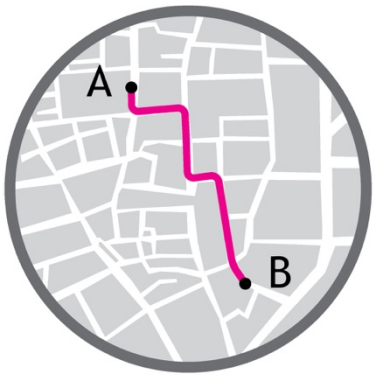
Figure 4: Improvements to pedestrian comfort and enjoyment should be layered upon a foundation of basic spaces that are unobstructed, safe, and accessible for all.



Source: Image adapted from: Michael Flynn, Sam Schwartz Engineering.

In order to overcome the infrastructure challenges pedestrians face, the design of transport facilities must create high-quality pedestrian spaces. Three key physical elements that have an effect on the quality of the pedestrian environment—street design, network design, and building design—should be considered when designing pedestrian-access infrastructure and transport networks. Clear design standards are required to ensure that these elements contribute to an accessible, safe, and convenient pedestrian environment. The metrics that comprise the three broad areas are summarized in Figure 5.

Figure 5: How the design of the physical environment affects pedestrian mobility.

 **Street design**	 **Building design & land use**	 **Network design**
• Safe, accessible sidewalks • Safe, accessible crosswalks • Adequate shade/shelter from rain • Adequate lighting • Traffic calming • Amount of space dedicated to driving & parking	• Visually active frontage • Physically permeable frontage • Complementary uses • Compact urban form	• Small blocks • Prioritized connectivity for pedestrians • Integration with public transport

There is increasing consensus around best practices that constitute a high-quality pedestrian environment. Table 1 compares the pedestrian mobility elements covered in a representative set of design guides from cities in different regions. Street design elements are discussed at length in all of the documents. Coverage of building design, land use, and network design is mixed, with some guides providing in-depth analysis and others touching briefly on the subjects.

Table 1: Comparison of pedestrian environment standards (● = detailed, ◖ = mentioned, ○ = not included).

Category	Element	World Bank-SSATP (2001): Productive and Livable Cities	Chicago Department of Transportation (2013): Complete Streets Chicago – Design Guidelines	Buenos Aires Ciudad (2015): Manual de Diseño Urbano	Transport for London (2016): Streetscape Guidance	Department of Transport South Africa (2003): Pedestrian and Bicycle Facility Guidelines	Abu Dhabi Urban Planning Council (2010): Abu Dhabi Urban Street Design Manual	Indian Road Congress (2012): Guidelines for Pedestrian Facilities	Government of Ireland (2013): Design Manual for Urban Roads and Streets	Global Designing Cities Initiative (2017): Global Street Design Guide
Street Design	Safe sidewalks	◖	◖	◖	●	●	●	●	●	●
	Safe crosswalks/ intersections	●	●	●	●	●	●	●	●	●
	Universal access	◖	●	◖	●	●	●	●	●	●
	Traffic calming/ speed restriction	●	●	●	●	●	●	◖	●	●
	Low driveway density to reduce of conflicts	○	●	○	◖	◖	●	○	○	◖
	Low % of public ROW dedicated to driving & parking	◖	●	◖	●	◖	●	○	○	●
	Carriageway lane widths	●	●	●	○	○	●	○	●	●
	Shelter from rain/shade	◖	○	◖	●	◖	●	◖	◖	●
	Lighting	◖	◖	●	●	●	●	●	●	●
	Seating	◖	◖	●	●	◖	●	●	●	●
	Maintenance	◖	●	◖	●	◖	●	◖	◖	●
Building design	Visually active frontage	○	○	○	◖	◖	◖	○	●	◖
	Physically permeable frontage	◖	○	○	◖	◖	◖	○	●	◖
	Continuous street wall	○	○	○	◖	○	◖	○	●	○
Transport network	Small blocks	◖	○	◖	○	○	◖	○	●	●
	Prioritized connectivity	◖	●	◖	●	●	◖	◖	●	●
Land use	Integration with public transport	○	●	◖	●	●	◖	◖	●	◖
	Complementary (mixed) uses	○	◖	○	◖	●	●	○	○	◖
	Adequate land use density	○	○	○	◖	●	●	○	◖	◖
	Compact urban form	○	○	◖	◖	●	●	○	◖	◖

Within each guide, quantitative guidelines are provided on specific elements that aid in creating successful walking environments. Key quantitative metrics include sidewalk clear space; maximum footpath height; and the frequency of formal pedestrian crossings. Table 2 summarizes the recommended standards in the respective guides.

Table 2: Comparison of pedestrian design element standards.

Element	World Bank-SSATP (2001): Productive and Livable Cities	Chicago Department of Transportation (2013): Complete Streets Chicago: Design Guidelines	Buenos Aires Ciudad (2015): Manual de Diseño Urbano	Transport for London (2016): Streetscape Guidance	Department of Transport South Africa (2003): Pedestrian and Bicycle Facility Guidelines	Abu Dhabi Urban Planning Council: (2010) Abu Dhabi Urban Street Design Manual	Indian Road Congress (2012): Guidelines for Pedestrian Facilities	Government of Ireland (2013): Design Manual for Urban Roads and Streets	Global Designing Cities Initiative (2017): Global Street Design Guide
Minimum sidewalk clear space (m)	1.0	○	1.5 - 1.8	1.5 (1.0 only as exception for limited stretches)	1.5	1.8	1.8 (1.5 only as exception for limited stretches)	1.8	1.8
Sidewalk clear space: moderate commercial activity (m)	Sized as per pedestrian volume	○	○	1.5	1.8	2.8	2.5 (Commercial / mixed use areas)	2.5 (Sidewalk with moderate ped. mob.)	1.8-2.4
Sidewalk clear space: heavy commercial activity (m)	Sized as per pedestrian volume	○	3.5 (Pedestrian street)	2.0 (Preferred minimum unobstructed width)	2.5 – 3.5 (Business Centers)	3.5 (Boulevard)	3.5 – 4.5 (Shopping frontages)	3.0 – 4.0 (Sidewalk with high ped. volumes)	2.4-4.5
Max. sidewalk height (mm)	○	○	○	Min. 60, Standard 125	○	150	150	125	○
Max. gradient for sidewalks / curbs	○	○	1:12	1:12	1:12	1:12	1:12	○	1:12
Min. distance between pedestrian crossings (m)	"As many as possible"	Crossings should be located where pedestrians want to cross, and where drivers can reasonably expect pedestrians to cross.	○	○	50-180	Max. spacing: 120–150	Spacing range: 80-250	Regular intervals, when distance between junctions is over 120 m	80-100 m
Pedestrian bridges	○	○	○	At-grade crossings are preferred to subways and footbridges.	Min. 2 m width, 5.2 m height	Shall not be used on streets considered in this manual.	Least priority since the walking length increases considerably.	○	Grade changes at bridges should be kept to a minimum.
Carriageway lane width (m)	3.0-3.5 (3.5 m lanes to be reduced to 3.0 at ped. crossings)	2.8-3.4 (3 average)	3.5	○	○	2.7 – 3.5 (3.3 standard)	○	3.25	2.7-3.0
Max. block size (in meters)	Short blocks preferred, but no minimum.	○	○	○	○	Short blocks preferred, but no minimum.	○	60–100	○

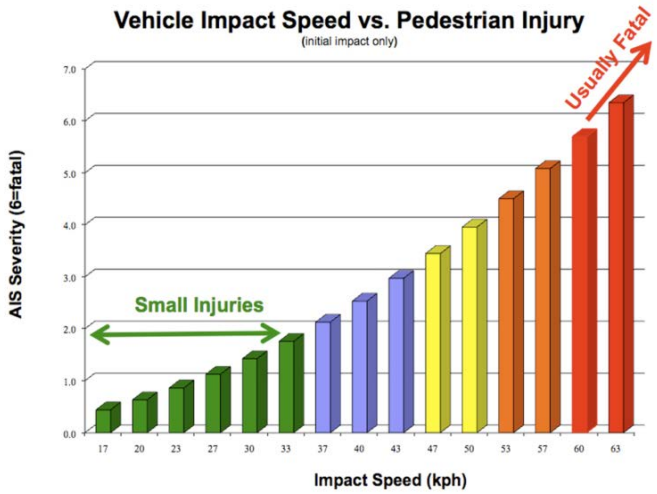
Lighting (min. lux, kelvin)	○	Un-signalized marked crosswalks shall be lit as brightly as a signalized intersection.	4,000 – 6,000 K LED	4,000 K LED / Plasma Light	According to SA Bureau of Standards	5 – 60 lux	25 – 40 lux, for sidewalks, 80 lux for pedestrian crossings	○	3,000 K
Shade (min. frequency of trees)	○	○	○	○	○	Architectural, sculptural, trees and landscaping	Street trees and plantation are essential on every street to provide shade and climatic comfort.	○	○

The following is a synthesis of the standards from these best practice guidance documents as well as current literature and case studies that summarizes walkability basics—the key features of high-quality pedestrian environments.

Street design

The physical design of streets and the provision of sidewalks, crossings, and other walking infrastructure is crucial to creating a high-quality walking environment. Street design that reduces motor vehicle speeds can significantly improve pedestrian safety since the likelihood of pedestrian death in a traffic collision increases dramatically when motor vehicle speeds rise above 30 km/h (see Figure 6). A pedestrian has a 90 percent chance of surviving being hit by a car travelling less than 30 km/h, but only a 50 percent chance of surviving impacts at 45 km/h.[67]

Figure 6: Speed reduction is critical for safe pedestrian environments because the chance of pedestrian death in a collision increases dramatically when vehicle speeds exceed 30 km/h.



Source: Chester Chellman.

Whereas wide carriageways, large turning radii, and oversized intersections encourage high-speed driving (placing the full burden of ensuring safe driving on traffic police), a well-designed urban road or street protects pedestrians from the negative impacts of motor vehicles. All streets require dedicated

slow zones that are accessible to pedestrians—whether in the form of dedicated pedestrian sidewalks or slow-speed shared spaces (see Figure 7 and Image 5). To ensure streets are universally accessible for all—including a person in a wheelchair or a family using a stroller—sidewalks should be level, free of obstacles, and well maintained with curb ramps at intersections. Traffic calming measures, such as raised crosswalks, tighter turning radii, narrower lanes, restrictions on free turns, and speed bumps, improve pedestrian safety. Crossings are made safer with pedestrian islands, curb extensions that minimize crossing distances, signals, and other traffic safety mechanisms.

Figure 7: All streets require "slow zones," or safe spaces for pedestrians, whether shared zones (left & right) or segregated footpaths (right).

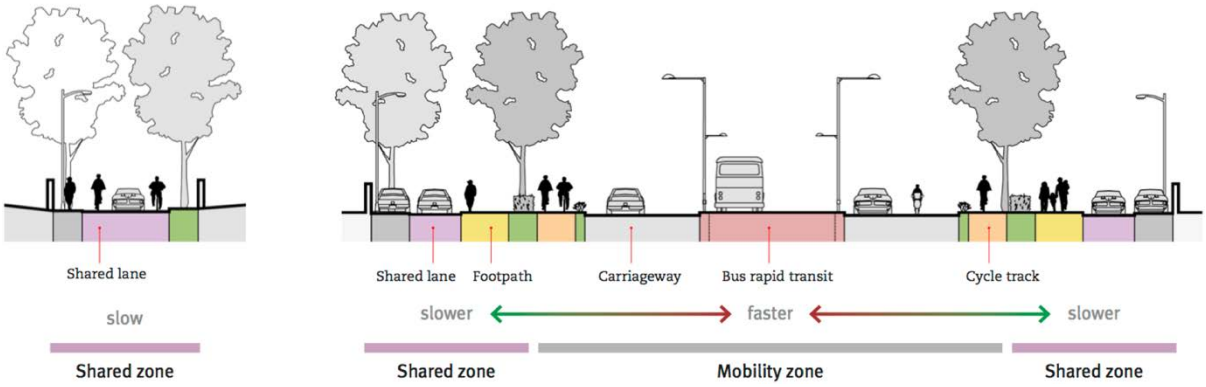


Image 5: Smaller streets with speeds under 15 km/h can function as shared spaces (left), but larger ones with heavy vehicles and faster speeds require separate pedestrian spaces (right).

Too often, streets fail to provide basic facilities for pedestrian movement, making walking unsafe and uncomfortable. The design of transport infrastructure often focuses on improving private motor vehicle mobility by allocating more space to it—often at the expense of other functions of the street. While sidewalks may vanish, the pedestrians do not, and the lack of proper pedestrian infrastructure forces people to walk on the carriageway. On streets with inadequate pedestrian facilities, attempts are often made to control pedestrian movements by using fences, walls, and other barriers to pedestrian movement—instead of redesigning the street to provide safe walking spaces. If these elements make pedestrian movements too inconvenient, people are likely to ignore them. An important theme in the

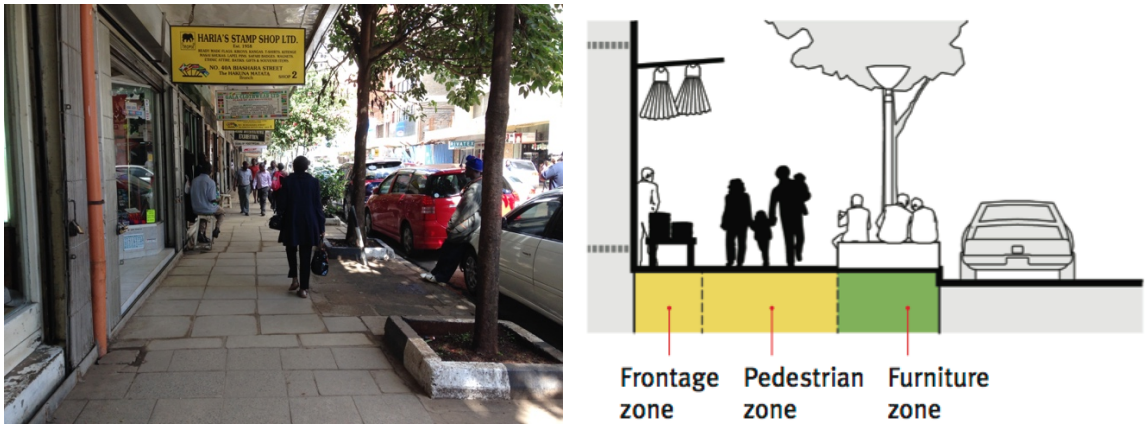
design of pedestrian elements is the need to acknowledge human nature and create designs that are intuitive and self-enforcing.

The following sections detail multiple aspects of good street design that creates safe, comfortable, and convenient pedestrian space. These aspects include the design of sidewalks themselves, as well as intersections, crossings, and other street design elements.

Sidewalk design. Sidewalks require sufficient clear width for pedestrians and an appropriate arrangement of elements such as trees, utility boxes, light poles, and other types of street furniture to facilitate passage. The safest and most accessible spaces for pedestrians are unobstructed, continuous, shaded, and well lit. Sidewalks should be wide enough to prevent crowding and should consist of three zones (see Image 6):

- The **frontage zone** provides a buffer between street-side activities and the pedestrian zone and should be 0.5 to 1 m wide. Frontage zones should provide space for shops to display their goods, and furniture zones should provide space for plantings, benches, parking meters, vending, and parking.
- The **pedestrian zone** provides continuous space for walking. The pedestrian zone should be clear of any obstructions, level differences, or other obstacles to pedestrian movement and should have a clear width of at least 2 m, and wider as volumes dictate.
- The **furniture zone** offers space for landscaping, furniture, lights, bus stops, signs, and private property access ramps.

Image 6: Sidewalks designed with the three zones in mind ensure pedestrians have ample, unobstructed, safe, and comfortable walking zones.

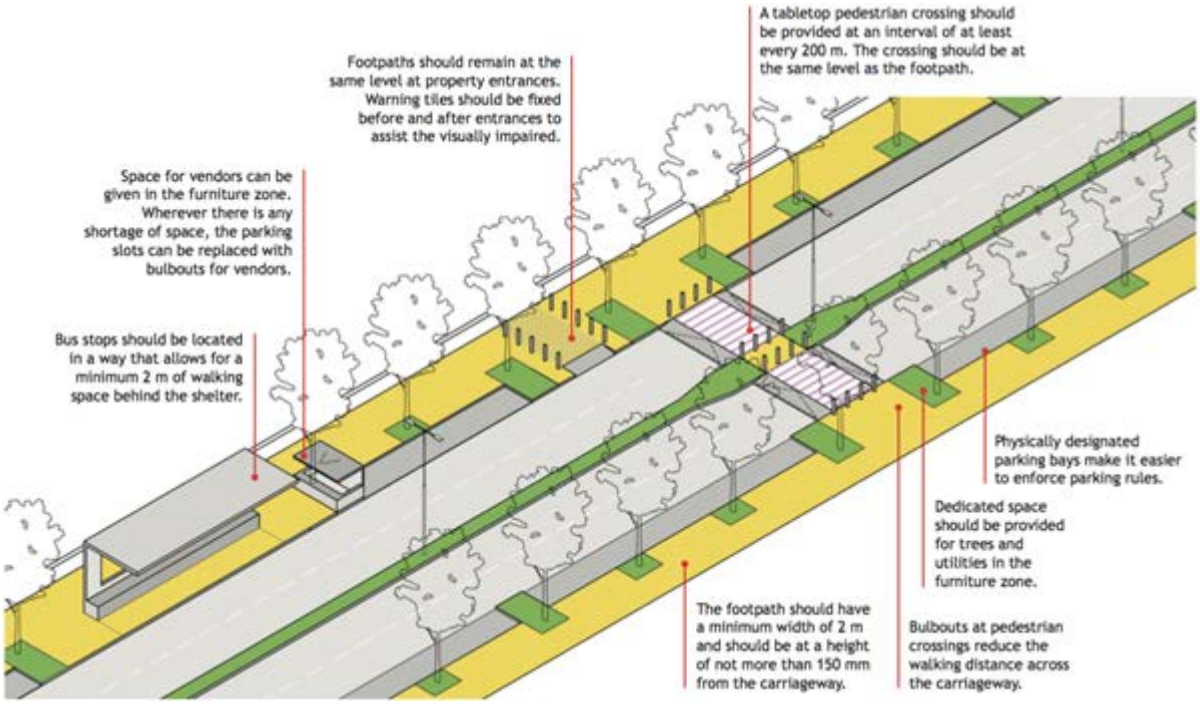


Additional sidewalk design standards are as follows:

- Sidewalks should be raised 150 mm above the carriageway level. Excessive heights discourage use of sidewalks.
- Sidewalks should have a smooth surface—asphalt or concrete are preferable.
- Pedestrian infrastructure should include sidewalk grade that ideally does not exceed 1:12 and includes ramps to ensure accessibility for all, including a person in a wheelchair or a family with a stroller.

- Sidewalks should be designed without abrupt level differences, especially at property entrances and intersections (see Figure 8). Abrupt and frequent curb cuts that require pedestrians to constantly step up and down discourage people from using sidewalks. Unavoidable level differences must be bridged with ramps that offer full access to persons with disabilities.
- Driveways should be designed so that the sidewalks remain at the same level, with provision for motor vehicles to mount the sidewalk to cross into a parking or drop-off area. The number of driveways should be strictly limited in order to minimize the number of points of conflict between pedestrians and motor vehicles, a goal mentioned in multiple guides.
- Detectible warning strips should be installed so that people with visual impairments know where vehicles and pedestrians interact.
- Bollards can help prevent vehicles from parking on footpaths.

Figure 8: Essential design elements for a continuous and unobstructed pedestrian realm.



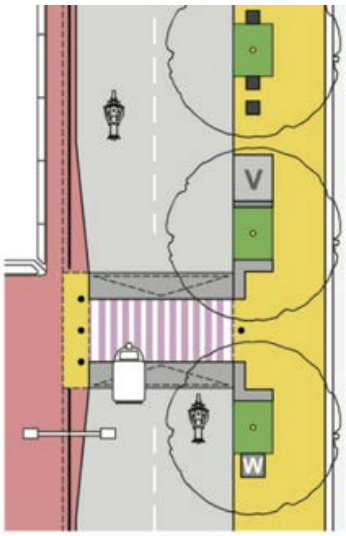
Intersections. Dedicated and protected space should be provided for people to cross the street at intersections. Motor vehicle traffic should be controlled through traffic signals so that adequate time is dedicated for people to walk across the street. In addition, reducing motor vehicle speeds through measures such as tighter turns, narrower lanes, restrictions on free turns, and speed bumps can improve safety for all road users, but especially pedestrians and bicyclists. Finally, bollards are useful for defining refuge islands and other pedestrian spaces and preventing vehicles from driving over these spaces (see Image 7).

Image 7: Intersection modifications in Mexico City improve pedestrian safety by reducing vehicle lane widths and turning radii.

Pedestrian crossings. Pedestrians may have difficulty crossing high-speed streets in the absence of traffic signals or physical measures to reduce vehicle speeds. As dangerous crossings are a primary cause of pedestrian deaths, crossings can be made safer with the addition of pedestrian islands, curb extensions that minimize crossing distances, signals, and other pedestrian safety measures (see Image 8). Pedestrian refuge islands are recommended to reduce the distance that someone must cross at one time. This is particularly helpful to people who move at slower speeds, such as the elderly, people with disabilities, and children. Intersection designs should attempt to be as self-enforcing as possible.

Universal accessibility principles dictate that crossings be built so that pedestrians in wheelchairs are able to cross without any detours. This can be done through ramps to bring pedestrians from the sidewalk down to the street-level crosswalk, or with raised crosswalks that remain at sidewalk level across the intersection.

Image 8: High-quality pedestrian crossings, such as this crossing at a Dar es Salaam BRT, reduce motor vehicle speeds with table top crossings and other physical elements.



Grade separation. To increase motor vehicle speeds, at-grade pedestrian crossings are frequently replaced by foot overbridges or subways. Since these facilities are inaccessible to many people, including those with a disability, limited mobility or a heavy load, they should be avoided as much as possible. These facilities typically increase pedestrian travel distances and times, thereby inconveniencing all users and discouraging walking. They also increase mobility barriers for the disabled and the less mobile who are unable to mount stairs (see Image 9).

The walking environment in grade separated facilities is generally poor since these facilities are removed from street-level activity and the passive security it provides. For these reasons, foot overbridges and subways can be, or feel, dangerous, particularly at night. Grade separation also tends to increase motor vehicle speeds, further degrading the walking environment.

Elevators and escalators, while sometimes employed in an attempt to make grade separated facilities more accessible, are expensive to maintain and prone to frequent breakdowns. Finally, they often obstruct the footpath, forcing pedestrians to walk in the carriageway. Given the inconvenience involved, pedestrians avoid using such facilities, instead seeking out the shortest path to their destinations, which may include a risky dash across the busy surface street.

Image 9: Foot overbridges are poor-quality infrastructure that pedestrians often avoid.

Shared spaces. Creating spaces that are shared between motor vehicles and pedestrians is also possible, but only recommended when motor vehicle speeds and volumes are both very low. This is typically done by limiting access to local motor vehicle trips (deliveries and drop-offs) or through street management measures. The safest and most effective shared spaces restrict motor vehicle speeds to less than 15 km/h and include only a narrow single-lane driving area with limited on-street parking.

Traffic calming. Slower vehicle speeds result in less deadly collisions, when they do occur. With reduced vehicle speeds, collisions are less likely as drivers have better visibility and more time to react. This can be accomplished with wide, raised crosswalks, narrowed travel lanes, speed humps, and other designs. In addition, avoiding excess motor vehicle travel space is also crucial to maintaining safe speeds near pedestrians.

Lighting. A lack of street lighting hampers pedestrian safety by reducing visibility—both the pedestrian's ability to survey his or her surroundings and drivers' ability to see pedestrians. Poor street

lighting also contributes to the perceived and actual threat of criminal activity. Designing streets with proper lighting, therefore, contributes to improved safety and security for pedestrians at night and encourages walking trips (see Image 10).

Protection from elements. In cities with hot climates, a lack of shade on walking paths can become a significant deterrent to walking. Beyond the discomfort that is faced by healthy pedestrians, exposure to intense sunlight can prove daunting for the elderly and the very young. The provision of shade protects pedestrians from exposure to the sun on hot, sunny days and makes walking a more enjoyable experience (see Image 10). Shade can be provided with trees, awnings or arcades built into the building line to maintain cooler temperatures for walking.

In areas with heavy rain, lack of sheltered walkways can also deter walking trips. Pedestrian walkways can be covered to protect major portions from rainfall. Since most transit trips begin with walking, bus shelters can be designed to protect waiting passengers from the elements as much as possible. The shelters should be located outside the pedestrian zone so they do not interfere with people's ability to walk past.

Image 10: Importance of proper shade and lighting for pedestrians.

Continuous shade and lighting is important for creating a comfortable, safe pedestrian environment: Nairobi (left) and Kisumu (right).

Utility design. Utility lines, poles, boxes and utility access points located on the sidewalk hinder pedestrians and may render a route completely inaccessible to a person with a wheelchair or stroller. Placing utility hardware underground is ideal from an accessibility perspective since it removes them from the walking environment. If utility boxes have to be above the surface they should be located in the furniture zone so that they do not obstruct pedestrian movement. Where possible, utilities should be placed in organized conduits where they can be easily reached without excavating the sidewalks or roadbed, which can also impede walking. Where this is not feasible, the utilities should be buried under the motor vehicle space, away from pedestrian activity.

Street design in Kampala

Kampala, the capital of Uganda, has a population of 1.8 million residents and an estimated daily workforce of 4.5 million. The city has an annual growth rate of 3.9 percent.[68] Around half of daily trips in Kampala are by foot and further 30 percent of commuters who travel by paratransit rely on walking at either end of their journeys.[69]

In spite of the massive widespread reliance on walking, pedestrian facilities are currently lacking (see Image 11). With the exception of the city center (see Image 12) most streets in Kampala lack adequate sidewalks, lighting, shade, and other pedestrian facilities. The lack of pedestrian facilities is particularly acute in market areas serving informal settlements in the city. The lack of adequate, well-maintained pedestrian space greatly degrades the pedestrian experience and discourages the use of walking as a means of transport for those who have the economic means to choose other modes (see Image 13). Kampala does feature examples of good pedestrian infrastructure. The central business district has arcaded sidewalks and median refuge islands that offer safe places to cross between intersections. These elements can serve as a model for improvements elsewhere in the fast-growing metropolitan region.

Image 11: Many of Kampala's streets lack sidewalks, shade, and safe pedestrian crossings.

Image 12: Notable pedestrian facilities in: Notable pedestrian facilities in the Kampala CBD include wide, arcaded sidewalks and median refuge islands that offer a safe place to cross between intersections.

Image 13: Improper street furniture placement (left) and poor maintenance (right) leads to inadequately accessible and obstructed sidewalks.

Building design and land use

The built form in a city can contribute to a vibrant pedestrian environment if streets are lined by active storefronts and frequent entrances. Streets with many kiosks and shops that open directly to pedestrian environments help create a feeling of safety, while producing a more active and vibrant atmosphere. Active frontages—such as shop entrances and windows—contribute to an eyes-on-the-street effect where shop owners and other individuals keep an eye out on the public realm and help ensure that pedestrians are safe as they walk through a neighborhood.[70] Buildings with active frontages are more likely to bring activity to the public realm in the form of sidewalk cafes and sandwich boards.

Unfortunately, in many cities, new developments are characterized by blank walls, security gates, large setbacks, and other defensive architectural elements that sever the relationship between the street and the private realm. The lack of active frontage compromises safety for pedestrians, particularly at night and at times when there are few other pedestrians on the street. The adoption of policies to encourage more pedestrian-friendly building façades is an important part of creating a high-quality pedestrian environment. The following elements can help foster an active street environment.

Permeability. A permeable street wall—one that has a large number of pedestrian entrances—creates more activity by creating more places where people enter and exit the street. This is as opposed to a street where a long block has only one building entrance and exit, making it feel long, uninteresting, and insecure.

Visually active ground floors. Buildings with a large number of windows on the ground floor contribute to a safer, more inviting pedestrian environment (see Image 14). This means that buildings have activities on the ground floor that directly face and engage people walking on the street. Active ground floor uses could include shops, residences, schools, and churches that create a visual connection between the people inside the building and the people walking on the street. This creates a walking environment with many eyes on the street. In contrast, streets surrounded by compound walls, ground-floor parking, and large setbacks have almost no interaction between the people inside buildings and people walking on the street, creating a much less supervised environment, and reducing security.

Image 14: Importance of visually-active ground floors.

A safe and attractive pedestrian realm in Guangzhou, with many windows and building entrances, and a mixture of uses attracts people throughout the day.

Mix of uses. When land-use policies promote a balanced mix of complementary uses and activities within a local area (e.g., a mix of residences, workplaces, and local retail commerce), many daily trips can remain short and walkable. The greater mixture of uses in an area, the more trips that can be made by walking, which is often the fastest mode for short-distance tips. By contrast, low densities and segregated land uses increase trip distances and make it less likely that people will walk.

A mixture of uses also creates a pedestrian environment that is active during many hours of the day. This keeps eyes on the street around the clock, greatly improving both actual and perceived security, improving the walking environment. Diverse uses peaking at different times keep local streets animated and safe throughout the day. In general, it is desirable to have new buildings add different uses to the existing area in order to ensure that a neighborhood is not dominated by a single land use. Ideally, no one land use should account for more than half of all built space in an area.

A lack of mixed uses in many new developments hampers the creation of a healthy pedestrian environment. Traditional zoning regulations remain in force in many cities, preventing the integration of multiple land uses in the same block or building. In addition, social housing policies in many regions encourage the construction of single-use housing developments far from economic activities, leading to increased trip lengths and making it hard for residents to meet their daily needs by foot.

Density. Higher densities are also critical to creating environments that are more conducive to walking trips. The more residences and offices that are located in an area, the more services and other uses that residents and workers would want to access that can be supported in that area (see Image 15). This further reduces trip distances, allowing more trips to be made by walking.

Image 15: Compact, mixed-use development.

Compact, mixed-use development, as shown along BRT corridors in Dar es Salaam (left) and Guangzhou (right), can reduce trip lengths and encourage walking.

Built form in Dar es Salaam

Dar es Salaam, the largest city in Tanzania, has a rapidly growing population. In 2003, the population stood at 2.6 million. That number grew to 4 million in 2015 and is expected to reach 5.8 million by 2030.[71] The city center of Dar es Salaam has many buildings that contribute to an active pedestrian environment. A number of active storefronts and mixed-use buildings with upstairs residential space contribute to a vibrant street throughout the day and evening. However, many newly developing areas of Dar es Salaam are seeing a proliferation of developments with high compound walls, security gates, and large setbacks (see Image 16, Image 17). These structures, found both on major arterial streets and on smaller residential lanes, are not conducive to pedestrian safety. Inactive edges are found in several parts of the city, ranging from upmarket Palm Beach and Oyster Bay to middle-class areas such as Temeke. Moving forward, there is a critical need for policy to encourage active frontages that create an eyes-on-the-street effect where visually permeable façade help ensure that pedestrians are safe as they walk through the neighborhood (see Image 18, Image 19).

Image 16: Walled-off unsafe walking environments.

In Dar es Salaam's Temeke area, compound walls block eyes from the street, creating an unsafe and unattractive walking environment, even where good facilities exist.

Image 17: Obstructed sidewalks.

New buildings in the Dar es Salaam CBD are often designed with parking setbacks, which interrupt the pedestrian environment and force people to walk in the carriageway.

Image 18: A greater sense of personal security.

In informal residential settlements, frequent building entrances and a softer boundary between public and private spaces contribute to a greater sense of personal security.

Image 19: Pedestrian-friendly elements.

The city center's traditional buildings have pedestrian-friendly elements (left). Mixed uses attract continuous foot traffic to Morogoro Road's BRT and pedestrian mall (right).

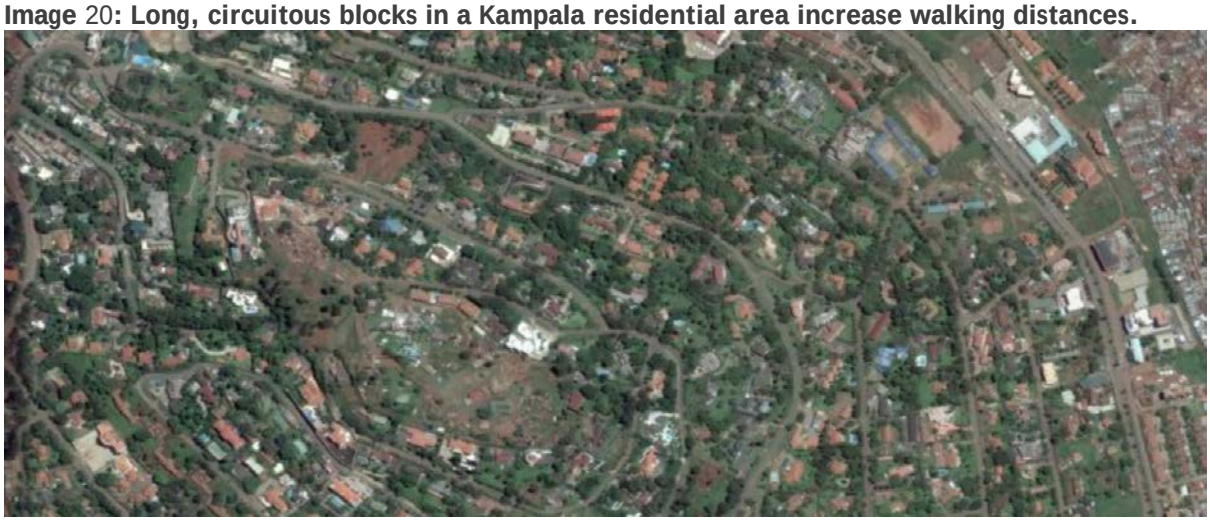
Network design

Pedestrians typically seek out short, direct routes to their destinations. The long block lengths seen in many new developments lead to circuitous routes that are more difficult for pedestrians to navigate. Large compounded developments often have only one entrance. While such a design might be acceptable from the perspective of a motor vehicle user, it leads to significant inconvenience for pedestrians. Long, meandering routes discourage walking and create unnecessary and uncomfortable trips for those who have no other option (see Image 20). Often, street networks are built without regard to existing pedestrian patterns. This leaves existing communities disconnected from their everyday needs. As urban areas expand and build out their street networks, it is vital that these networks prioritize pedestrian access.

There are many types of urban road networks. However, the key to pedestrian mobility is a high ratio of intersection nodes to road links so that streets and pathways are well connected. An interconnected

pedestrian network, whether organized as a grid or a more loosely formed spider web, provides more convenient and direct routes to destinations with minimum detour distances and helps reduce travel distance.

Image 20: Long, circuitous blocks in a Kampala residential area increase walking distances.

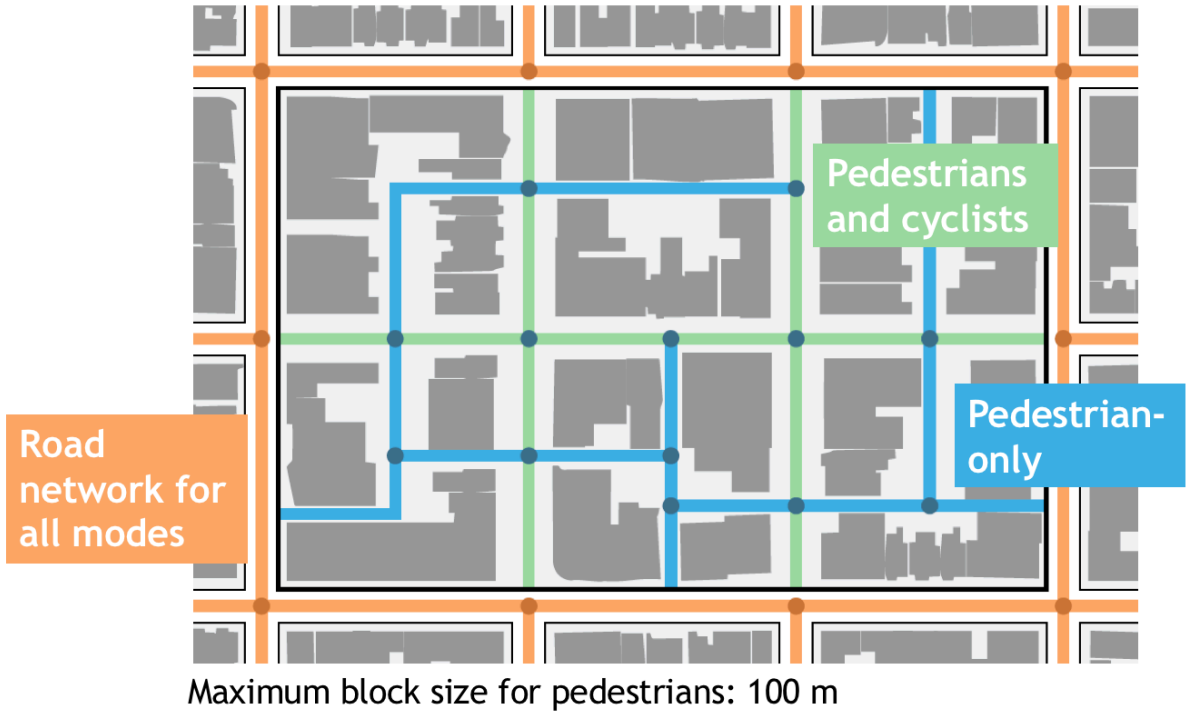


Block size. Street networks should be designed with small block sizes—under 100 m in length—to improve connectivity and shorten pedestrian trip distances. While disconnected networks force longer trip distances, shorter blocks provide a variety of paths to any destination in a city. Small blocks also help to reduce traffic speeds by limiting the amount that motor vehicles can accelerate between intersections.

The network can also encourage walking through "prioritized connectivity" for pedestrians. That is, the network is designed to provide a greater number of walking routes than driving routes, making walking a more direct option for many trips. This is accomplished through pedestrian-only streets and passages, and streets that permit through access for walking but only local access for motor vehicles (see Figure 9, Figure 10).

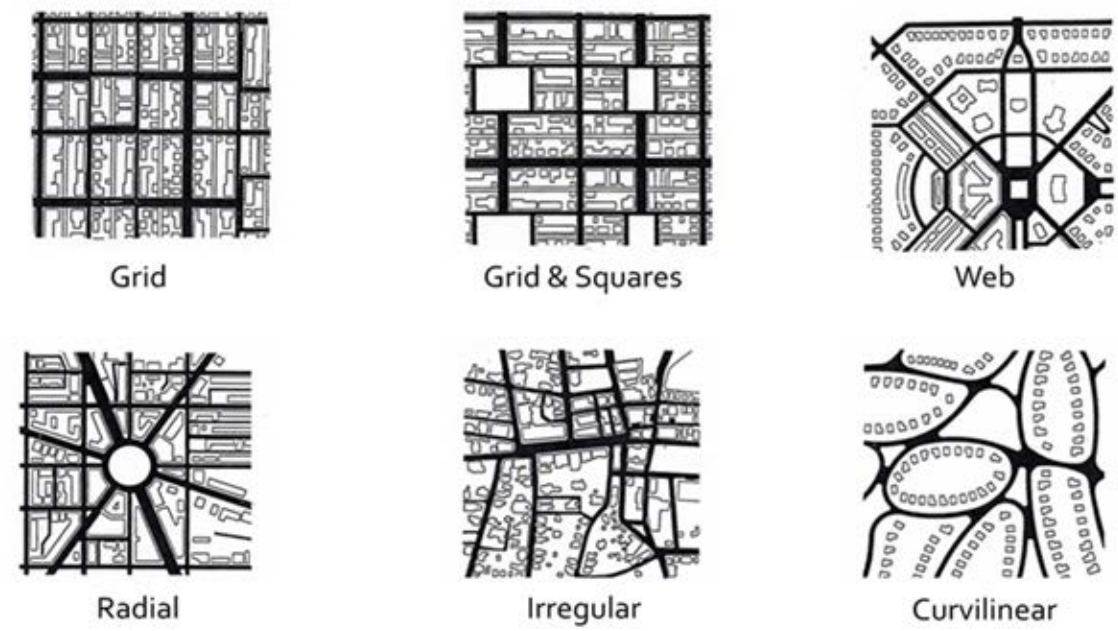
In areas where connectivity is poor, the process of property redevelopment offers an opportunity to create new pedestrian connections through large blocks. To facilitate this process, the alignments for future streets should be identified in a statutory physical plan. When plots come up for redevelopment, plans can be approved subject to the allocation of the mid-block spaces for public use. New streets or pedestrian alleys can take the form of public easements on private parcels or public streets carved out through the redefinition of building envelopes, depending on the local legal framework and existing land-use regulations. Policies to create network-level adjustments must establish a standard to guarantee fairness among plots and earn the buy-in of land owners.

Figure 9: Pedestrian and cycling networks provide direct access to the core of each block, while vehicle access is limited to the perimeter streets.



Source: ITDP.

Figure 10: Regardless of geometric form, a road network should offer a high ratio of intersection nodes to road links to provide convenient access for pedestrians.



Source: Glatting Jackson Kercher Anglin, Inc.

Directness. Other factors that are important for connectivity include sufficiency of route choice and consistency in infrastructure quality (see Image 21). It is important to maintain the overall quality of a route from origin to destination since weak points can undermine the route's utility. An example that is often cited is that of a footbridge over a large road: it provides a safe crossing point but the detour to get to that point and the difficulty that some users may have in climbing the stairs may result in a low use of the facility. If, on the other hand, a footbridge is part of a direct pedestrian route with proper slopes, it is more likely to be useful.

Image 21: The importance of pedestrian-friendly connectivity.

The alignment of a pedestrian passageway with the street network reduces walking distances in Abidjan (left). A Pimpri Chinchwad alleyway prioritizes walking connections (right).

Connectivity to public transport. The pedestrian environment is also a key element for ensuring the success of a "trip chain" that consists of many links. This implies the consideration of travel patterns that are already conducive to safer and healthier transport options, and that circumvent reliance on car driving as the easiest transport option. A walking network that is well integrated into a larger network of public transport and other non-motorized transport (NMT) options can encourage walking. In larger cities, many walking trips have origins or destinations at public transport stops and stations. Without good access to public transport, many commuters would opt for private motor vehicles. Therefore, walking, cycling, and public transport networks must be integrated.

Missing connections in Gaborone's city center

Gaborone, the capital of Botswana, had a population of 213,384 in 2007, with projections showing a population of 256,203 by 2016.[72] Increasingly, the city finds itself beset with traffic from private automobiles. The quality of pedestrian facilities—including sidewalks, lighting, shade, and other elements—differs widely across the city. On major roads and destinations, pedestrian facilities are generally present, but facilities are often lacking outside of these areas. Further, existing facilities are not always part of a robust network.

The best facilities are found in the Main Mall, which has a pedestrianized core, and the New CBD. The facilities provided in the Main Mall and New CBD, however, are not well connected to the surrounding areas, particularly the Bus and Taxi Rank, the city's main public transport hub, and the new CBD. The walk from the Main Mall to the New CBD is uncomfortable and features dangerous crossings. This is unfortunate as both areas have good pedestrian facilities and will serve as centers of commerce. It should be convenient and pleasant to walk from one to the other. A robust pedestrian network not only allows for navigation within a neighborhood but also to others. Strong pedestrian connections between these areas would reinforce their strengths and ensure a lively and active central business district is achieved.

Image 22: Conditions for pedestrians in Gaborone.

Poorly lit tunnels (left) and the lack of paved walkways (right) limit connectivity between the three hubs of central Gaborone.

The Greater Gaborone Multimodal Transport study calls for the improvement of the city's non-motorized transport system through the construction of new pedestrian walkways and cycle tracks while improving the existing paved facilities. Among these plans is a long-term proposal for a pair of intersecting pedestrian corridors in the center of the city, connecting a series of landmarks and open spaces. These corridors would connect areas such as Main Mail, the New CBD, Government Enclave, and the Bus and Taxi Rank (see Image 23).

Image 23: Central Gaborone's long-term pedestrian plan calls for vital pedestrian linkages between key destinations.

Outside of the city center, the study calls for an NMT network to be implemented to provide connectivity between the residential peripheries of Gaborone and the urban center; to provide connectivity between the residential extension blocks and the core radial NMT network; to provide the above connectivity using dedicated green routes where possible; to provide pedestrian access to public transport stops; and to provide formalized access routes to important destinations such as schools, local commercial shopping areas, the CBD, and industrial areas.

4. Institutional, policy, and financial frameworks

In many cities, the lack of an enabling policy and legal environment can hamper the development and management of the pedestrian environment. In order to provide a high-quality pedestrian experience as described in the preceding sections, strong institutional support is required to plan, implement, and maintain the pedestrian environment. Key elements of the institutional framework for pedestrian mobility include political leadership, systematic data collection, adoption of statutory design guidelines, adoption of a formal design review process, identification of dedicated funding sources for pedestrian infrastructure, institutional coordination, and public participation. These themes are discussed in more detail below.

Institutional and policy frameworks

Cities must overcome several institutional barriers to achieve a high-quality pedestrian environment. These challenges range from a lack of political will to support pedestrian improvements to the need for better coordination among the multiple agencies responsible for different aspects of the pedestrian environment. Adequate planning capacity; street design procedures, policies, and regulations; street management and maintenance practices; and project evaluation are essential ingredients for the provision of a high-quality pedestrian environment.

Political leadership. While pedestrian infrastructure provides basic mobility for a large portion of residents in most cities, investments in pedestrian infrastructure are often ignored in favor of projects that are perceived as being more politically attractive. In addition, measures to provide a pedestrian environment often threaten powerful interests. Removing road space used for car lanes, taking away on-street parking spaces, or introducing traffic calming elements can generate a powerful backlash, making it difficult to reallocate the space needed to create a high-quality pedestrian environment. A critical step is to raise the awareness of pedestrian needs on the part of legislators, institutional decision makers, and staff of public institutions.[73] This is a prerequisite for agencies to prioritize the safety, comfort, and efficiency of walking in future policies, regulations, and enforcement mechanisms at all levels.

Provision of high-quality walking facilities depends in part on a prominent political champion who understands the benefits of investing in walking. For example, in 2016, the mayor of London appointed the city's first commissioner for walking and bicycling to implement the mayor's Healthy Streets plan and increase physical activity by making walking and cycling easier and more enjoyable.[74] In New York, Mayor Michael Bloomberg along with Transportation Commissioner Janette Sadik-Khan embarked on an ambitious agenda to implement traffic calming measures and create new public spaces. Reflective of the Bloomberg administration's willingness to take political risks was the decision to implement the pedestrianization of Times Square shortly before a mayoral election.[75] Major transformations in cities from Curitiba to Copenhagen to Seoul have been driven by committed mayors who staked their political reputations on initiatives to improve the pedestrian environment.[76]

A national NMT policy can be effective in elevating the importance of walking and improving pedestrian infrastructure in cities and rural areas alike. South Africa and Uganda have each published national NMT policies to raise the profile of walking and bicycling.[77,78] The policies promote inclusion of NMT within integrated transport systems, provision of safe walking and bicycling infrastructure, and allocation of funding for developing and promoting NMT.

Planning. Many cities lack metropolitan-level plans for pedestrian improvements. The pedestrian environment requires coordinated planning at several levels: ranging from the design of a city's street

network to the plan of individual buildings and local sidewalks. As a result, a coordinated NMT planning framework is needed at the metropolitan level to ensure consistent quality of pedestrian infrastructure throughout an urban area. Many transport plans emphasize large infrastructure projects and downplay the importance of walking.[79] Plans often omit data on the quality of pedestrian infrastructure and fail to present information on pedestrian travel patterns. Proposed budget allocations to pedestrian infrastructure are often minimal in spite of the large mode share of pedestrian trips.

At the city level, governments need to identify street networks that ensure connectivity and walkability as areas develop. Creative approaches are needed to address the existing long blocks in developed areas. These network plans can guide the provision of new mid-block walkways when buildings are redeveloped, which can be encouraged through development bonuses for redevelopment projects that add new public street connections.

Transport for London (TfL) published the city's first walking plan in 2004, which presented the vision of London becoming one of the world's most walking-friendly cities by 2015.[80] The walking plan identified several objectives, including improving institutional coordination for pedestrian planning, promoting walking in London, improving street conditions, improving the walkability of development proposals and public transport interchanges, and improving pedestrian safety and security.

Portland, Oregon, demonstrated early leadership in pedestrian planning, releasing its first Pedestrian Master Plan in 1998.[81] The 20-year plan aimed to enhance the pedestrian environment and increase opportunities for people to choose walking as transport. Portland's first pedestrian plan called for a street network that served short trips and public transport in a convenient and safe environment, and included walking-friendly policies, a street classification system, pedestrian design guide, capital improvements, and funding strategies.

Seoul's Pedestrian Master Plan

The city of Seoul (Republic of Korea) has pursued a comprehensive approach to improvements in the walking environment through a series of pedestrian plans prepared in 1998, 2004, and 2013.[82] The pedestrian planning process aims to identify solutions to several issues, including a lack of adequate pedestrian sidewalks, a high rate of crashes involving pedestrians on smaller streets, and low pedestrian satisfaction. The Seoul Transport Vision 2030 outlines a paradigm shift from a previous emphasis on car-oriented mobility to a new focus on access and shared mobility. In support of these goals, the Vision identifies a number of quantitative targets, including an increase in the fraction of street length with sidewalks and a reduction in the number of pedestrian fatalities. The Vision proposes several actions, including district-level pedestrian plans, school zone regulations, at-grade crosswalks, pedestrian improvements near public transport stops, expanded pedestrian signage, universal access improvements, public toilets and other streetscape amenities, and walking events (see Image 24). The master plan is expected to strengthen existing initiatives to improve convenience for pedestrians. In recent years, the city has implemented over 3,000 at-grade pedestrian crossings while decommissioning numerous pedestrian footbridges. Seoul has 24 pedestrian-only streets and is planning new car-free streets in several districts across the city.[83] These measures, in combination with other interventions, have brought about a steady reduction in the rate of crashes over recent years.

Image 24: Seoul's Transport Vision 2030 proposes citywide pedestrian mobility interventions, including traffic-calming measures and universal access.

Source: GFES via Flickr.

Design review. In conjunction with urban street design guidelines (see below), design review audits help ensure that projects comply with the new guidelines. These audits decrease the risk of having projects being rejected in the detail design phase. Then, the project can be realized according to standards and policies of the respective context.

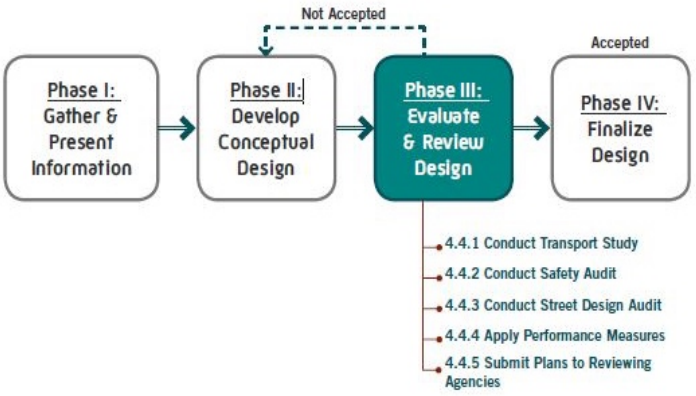
In many cities, there is an opportunity for quick wins by ensuring that infrastructure projects that are already underway include good pedestrian design. In Yichang, China, the city's first phase BRT project included many improvements to the pedestrian environment, including larger sidewalks, safer crossings with refuge islands, and public spaces. Yichang also removed nearly 1,000 on-street parking spaces along the main portion of the BRT corridor along Dongshan Avenue to provide more space for pedestrians. Similarly, in Dar es Salaam, the government took advantage of Phase 1 of the DART BRT system to develop high-quality sidewalks and pedestrian crossings throughout the BRT corridors (see Image 25).

Image 25: Bundling pedestrian enhancements with major infrastructure projects can accelerate upgrades to the walking environment: Dar es Salaam (left) and Yichang (right).

Design review in Abu Dhabi

Abu Dhabi has instituted a design review process as a core element of the planning process as part of a series of reforms aimed at facilitating pedestrian-friendly street designs. Abu Dhabi's Urban Street Design Manual outlines a four-step design process: gather and present information; develop a conceptual design; evaluate and review the design; and finalize the design (see Figure 11). All street design projects must go through a review process.[84] During the review, designers may be required to gather extra information and make necessary design adjustments. Additional steps of review may be required if proposed designs are not consistent with established design guidelines.

Figure 11: In Abu Dhabi, conceptual designs are evaluated against adopted design standards, including a checklist of mandatory pedestrian elements.



Pedestrian Provisions
Are pedestrian crossings well designed?
Are crossing distances minimized?
Do signalized crossings have adequate time?
Does the design ensure that pedestrians can easily walk to and through the area?
Are uses easily visible and inviting to pedestrians?
Does the design ensure that vehicles do not detract from the pedestrian experience?
Are protected pedestrian crossings shown at the correct spacing, and do these crossings relate to areas where pedestrians desire to cross?
Is there leftover space in the pedestrian realm, or is there too large a furnishing zone? If so, how can this space be minimized or programmed?

Inter-agency working groups. Uncertainty regarding who is responsible for the construction of pedestrian facilities can hamper the development of a consistent pedestrian network. Responsibilities over the planning, design, management, and maintenance of the pedestrian environment are often split between multiple agencies and levels of government. Institutions involved in the planning, implementation, and management of the pedestrian environment include transport ministries, road building agencies, traffic police, public transport operators, road safety agencies, urban development ministries, and utility agencies (e.g., electricity, water, and telecommunications providers).

The existing institutions' responsibilities need to be clearly delineated so all stakeholders understand who has the authority to mandate, set standards; coordinate; review building permit applications; supervise construction and management; and carry out monitoring activities. Institutional boundaries hamper the sharing of data, plans, and designs. Better institutional coordination is critical to the success of pedestrian facilities, which depend on a close working relationship between financing, planning, and management agencies. The responsible institutions should be convened to compare, coordinate, and standardize their regulations, processes, and enforcement mechanisms.

One option for improving institutional coordination is for cities to create empowered working groups as a way to share data, conduct peer reviews of road designs, and synchronize the implementation of road projects. The coordination group would need to have an empowered leader or facilitator and would carry out the following activities:

- Development of policies and standards for pedestrian facilities.
- Coordination of the implementation of road projects.
- Monitoring of pedestrian environment quality.

Through regular meetings, perhaps on a monthly basis, the coordination group can serve as a forum for discussions about multiple issues surrounding pedestrian mobility. By bringing stakeholders together on a regular basis, the group would facilitate the sharing of information among implementing agencies. In addition, coordination group scrutiny on proposed projects would help establish expectations among stakeholders that all new road projects need to include high-quality pedestrian facilities. Over time, the coordination group would form the basis for future cooperation under a regional transport planning body once the agency is formally established.

Singapore's Active Mobility Unit

In Singapore, the Land Transport Authority (LTA) created a new Active Mobility Unit (AMU) to help coordinate interventions related to walking and cycling. The AMU is a key component of LTA's overall goal of achieving zero growth in vehicle kilometers travelled (VKT) in the future. The availability of dedicated staff and planning funds have helped LTA accelerate the implementation of pedestrian improvements, including a network of greenways connecting parks and nature areas; a model walking and cycling town in Ang Mo Kio; a network of sheltered walkways connecting to public transport nodes; accessibility improvements to ensure that the pedestrian realm is barrier-free; and "silver zones" that improve access for the elderly through reduced motor vehicle speeds. AMU is also active in organizing activities such as a car-free day on the iconic Orchard Road as well as "Parking Day" events that repurpose on-street car parking slots as public spaces. Finally, AMU helps coordinate research activities, including a comparative study of sustainable transport options in Singapore and Seoul.

Institutional coordination in Chennai

In Chennai, an Indian city with a metropolitan population of 9 million, the government has taken steps to develop institutions to coordinate planning around pedestrian mobility. The metropolitan transport planning body, the Chennai Unified Metropolitan Transport Authority (CUMTA), created an NMT Subcommittee which is headed by the commissioner of the Chennai Municipal Corporation—the city government. This NMT Subcommittee facilitates meetings between various stakeholders to discuss plans for the city with special regard to improving the NMT infrastructure. The subcommittee includes the city corporation, the state highways department, the metro rail authority, the city bus agency, the electricity board, the state-owned telecommunications provider, academic experts, and various civil society organizations. During monthly meetings, the committee reviews the status of ongoing projects, provides feedback on pedestrian facility designs, and helps

resolve issues encountered during implementation. These meetings have been instrumental in sorting differences between the various stakeholders involved in the project and facilitating the exchange of best practices. In addition to committee meetings, members make regular site visits to experience the challenges faced by pedestrians firsthand and identify solutions (see Image 26).

Image 26: Tackling mobility challenges in Chennai.

Chennai officials discuss mobility system improvement strategies (left) and make a site visit to examine pedestrian facilities and identify solutions (right).

Public participation. Participation of local residents, businesses, and other stakeholders in the planning of the transport system can help foster the community's active use and sense of ownership of these spaces. Transport planning must be transparent to send a clear message that policies are being developed in close consultation with key stakeholders. The planning process should ensure broad and economically diverse citizen participation at all stages of planning and implementation. In Seoul, the municipal government was involved in an extensive engagement process during the implementation of the Cheonggyecheon restoration project, which involved the removal of an elevated highway and the introduction of a 6-km greenway.[85] As part of the outreach project, the government created the Cheonggyecheon Citizens Committee to gather input from concerned stakeholders. During stakeholder interactions, the government presented data on the potential benefits of the project and identified mitigation measures to address concerns about loss of business during implementation.[86] This process led to a plan to offer subsidies to cover business losses as well as alternate arrangements for street vendors during construction. Organizations, including the Cheonggyecheon Stream Restoration Project and the Seoul Development Institute, provided technical assistance, helping to develop implementation plans based on community input.[87]

Cities are increasingly relying on innovative, participatory activities to allow citizens to take part in the street-design process and test new designs before they are fully implemented (see Image 27). Tactical urbanism is an innovative participatory approach in which temporary installations allow people to test potential new pedestrian facility designs (see Image 28). After trials using traffic cones and barriers, semi-permanent pedestrian islands can be created using rocks, planter boxes, and other types of street furniture. After the success of the intervention is demonstrated over time, the new design can be implemented permanently by shifting curb stones and constructing new footpaths and refuge islands.

Image 27: Building project buy-in.

Chennai's mayor discusses street designs during a public consultation (left). Stakeholders prepare concept designs for pedestrian improvements in Ruiru, Kenya (right).

Image 28: Tactical urbanism at work in Manila.

Manila prototyped a street reconfiguration scenario using orange cones.

Source: Michael King.

Cities can begin improving the pedestrian environment by implementing highly visible projects in areas with high pedestrian demand. Pedestrian zones, crossings, and other elements can be fully implemented or prototyped quickly and at a reasonable cost, helping build political support for more extensive improvements (see Image 29). A common approach is to identify a range of strategic pilot projects that address technical and political goals:

- Projects that target the locations in the city that are the most lacking.
- Areas with frequent deaths and injuries from traffic crashes or locations with high pedestrian volumes but inadequate pedestrian infrastructure.
- Projects that build on existing assets. For instance, wider sidewalks in a popular commercial district.

- Politically “safe” interventions, such as the introduction of 30 km/h slow zones around schools.

The impacts of pilot projects should be monitored closely to evaluate the success of the intervention and to identify any necessary modification for future projects. The impact evaluation can cover quantitative impacts, such as the effect on traffic crashes and pedestrian volumes, as well as user experiences captured through interview surveys. It is important to disseminate information on the results to the public in order to build buy-in for further interventions.

Image 29: Testing street design ideas in New York City.

New York City tests street design ideas with simple, low-cost materials like paint, planter boxes, and rocks (left). Times Square’s redesign (right) was finalized after user testing.

Walkability in Pune: Institutional challenges and solutions

Pune, the second-most populous city in the Indian state of Maharashtra, faces pedestrian mobility challenges similar to many South Asian cities: inadequate footpaths, unsafe junctions, and a built environment in newly urbanizing areas that is dominated by large compounded developments. While the city has some good examples of pedestrian infrastructure, particularly in the historic urban core, city officials are under pressure to expand roads to cater to the increasing number of motorized two-wheelers and cars.

Over the years, proposed road projects have triggered strident debates between the municipal government, known as the Pune Municipal Corporation (PMC), the traffic police, and local civil society. In the absence of a robust consultative process, government proposals to expand roads and construct grade separators for vehicles were typically met with skepticism from non-governmental organizations (NGOs). These NGOs argued that such projects would harm pedestrian access and do little to address the city’s congestion challenges. Frequently, opposition would escalate to the level of public interest litigations filed to stop road projects through the court system.

With growing recognition that the traditional approach to road projects was failing, the PMC has launched a number of institutional reforms to chart a course toward a more sustainable approach to mobility planning and street design.[88] As a first step, the city began the process of empaneling qualified urban designers to prepare the designs for major street redesign projects (see Image 30). To be eligible to be part of the panel, firms needed to establish that they have experience in urban street design and knowledge of the basics of

sustainable transport. The firms are required to have interdisciplinary teams comprised of engineers, architects, planners, and urban designers.

To facilitate a more consultative approach to street design projects, the PMC established a street design committee comprised of senior city engineers, the local public transport agency, the traffic police, and local NGOs. The committee examines proposed designs for large streets and offers input to the empaneled consultants. With the appointment of the committee, the design review process has become more deliberate. Issues are debated in the open, giving multiple stakeholders a chance to air their concerns. In the event that the committee cannot reach consensus, the city commissioner, the administrative head of the PMC, takes the final call. Compared to the previous approach, the tendency for individual actors to challenge decisions and rehash old arguments has abated.

The city has also taken steps to consolidate the new approach to street design in official regulations and guidelines. The city's elected General Body adopted a Pedestrian Policy outlining principles and priorities that will govern street design decisions. In addition, the PMC published Urban Street Design Guidelines, a set of minimum design standards for all future street design projects. Parallel capacity building efforts have helped expose municipal staff to the principles outlined in these documents.

Finally, the PMC created an Urban Design Cell, comprised of eight urban designers who are responsible for designing neighborhood streets. The Urban Design Cell represents a major improvement over the previous functioning of the city government. While improvements on small streets were previously implemented directly by contractors without survey drawings or detailed designs, the members of the Urban Design Cell now prepare designs prior to construction. The result is more sensitive street designs that are tailored to the local context.

Given the recent nature of the reforms in Pune, the full impacts of the institutional changes are yet to be felt. Still, there is a growing sense among government officials and civil society activists that the PMC has begun to make pedestrian needs a central consideration in the development of the city road network.

Image 30: Street design in Pune.

One of the first corridors chosen for a demonstration of Pune's new Urban Street Design Guidelines in JM Road, a popular retail street in the core of the city.

Policies and regulations

The lack of supportive legal provisions can hamper the implementation of a high-quality pedestrian environment. A range of legal measures, discussed below, can impact pedestrian mobility.

Street design standards. The presence of high-quality guidelines and standards plays an important role in the provision of pedestrian spaces, ensuring that implementing agencies follow best practices when pursuing capital projects. Unfortunately, many cities lack such tools. Pedestrian facilities are implemented without a proper reference guide. The result is the implementation of projects that do not match international best practices. Where guidelines exist in developing cities, they are often outdated, having been adapted from car-centric highway design guidelines in countries with a much higher percentage of travel by car (e.g., Australia, the United Kingdom, the United States) (see Figure 12). While some newer guidelines have been updated to include mention of pedestrian infrastructure, the guidance is not sufficiently detailed to ensure consistent results on the ground. Among other shortcomings, many documents lack specific guidance pertaining to universal accessibility. Standards and regulations that guide the development of the built environment often lack provisions to ensure that buildings contribute to a safe, vibrant pedestrian environment.

Figure 12: Sidewalk design standards in the Tanzania Road Geometric Design Manual contain insufficient detail and fail to reflect design principles such as the sidewalk zoning system.

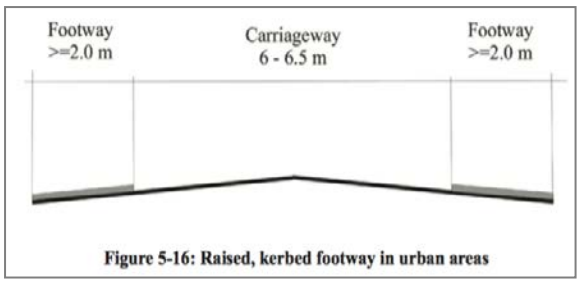


Figure 5-16: Raised, kerbed footway in urban areas

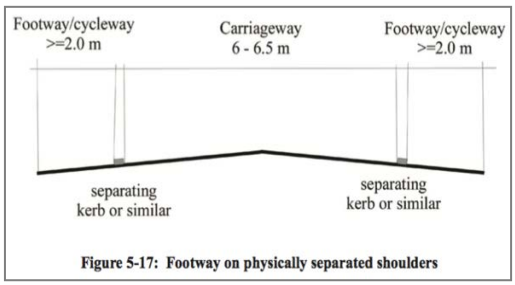
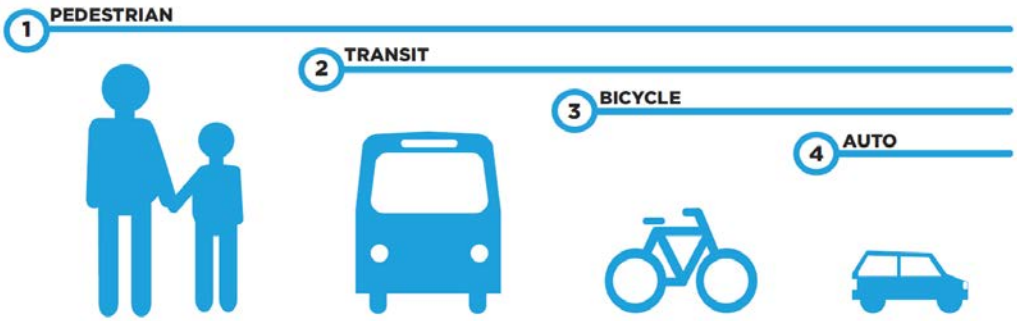


Figure 5-17: Footway on physically separated shoulders

On the other hand, many cities have begun to adopt pedestrian-first design standards to ensure that all streets are built to accommodate pedestrian needs. Urban street design guidelines can help address the shortcomings of existing highway-oriented design manuals, and the common standards help provide guidance to consultants who are responsible for preparing street designs. They also offer statutory backing for government officials who wish to request design modifications during the planning process. The guidelines should incorporate design standards for key elements of the pedestrian environment, including sidewalks, crossings, bus stops, intersections, street furniture, street vending, and underground utilities. In many cases, the ministry of transport is the appropriate agency to develop and approve such standards, but the standards should be developed in consultation with other agencies, including municipalities, road-building agencies, and the traffic police.

The Chicago Department of Transportation's Complete Streets Guidelines provides a notable example.89 Agency policy requires that new and reconstructed streets are built as complete streets and provide adequate spaces for pedestrian facilities (see Figure 13). This institutional endorsement makes certain that the agency invests in pedestrian infrastructure and seeks to alleviate the city's congestion by providing alternatives to private automobiles rather than creating new kilometers of carriageways.

Figure 13: Chicago's Complete Streets Guidelines define a pedestrian-first hierarchy for street design, whereby infrastructure projects must prioritize pedestrian needs above other modes.

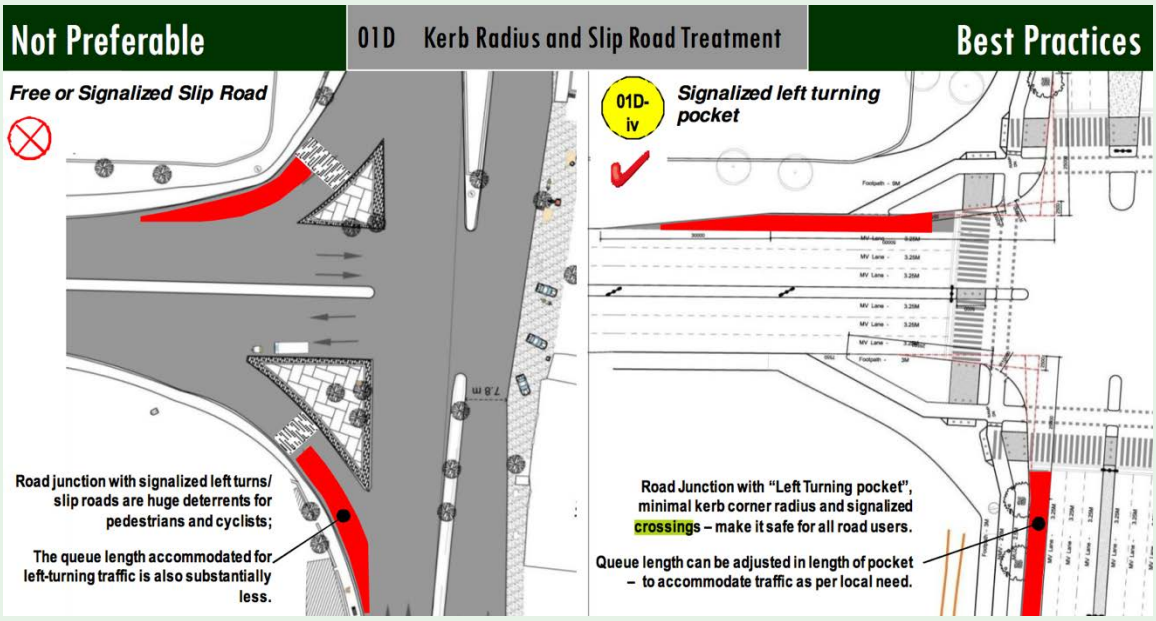


Source: Nelson Nygaard.

Localized design standards in Delhi

In the National Capital Territory of Delhi, the Unified Traffic and Transportation Infrastructure (Planning & Engineering) Centre (UTTIPEC) created a comprehensive set of Street Design Guidelines to provide guidance to the multiple authorities involved in the implementation of pedestrian infrastructure in the city, including the Delhi state Department of Public Works and the three municipal governments in Delhi. The guidelines cover key elements of the pedestrian environment, such as sidewalks, crossings, and traffic calming elements (see Figure 14). Along with the broad guidelines, UTTIPEC created specific guidance documents to address issues that are critical to the Delhi context. For instance, recognizing that foot overbridges have resulted in severe obstacles for pedestrian mobility in the greater Delhi region, UTTIPEC's "Foot Over Bridge (FOB) Need Criteria and Design standards/requirements" provide clear guidance that pedestrian bridges should only be implemented as last resort and define the minimum standards to be applied in cases where foot bridges are built.

Figure 14: Delhi's street design guidelines illustrate how typical intersections found in the city can be transformed through the introduction of safe, accessible crossings.



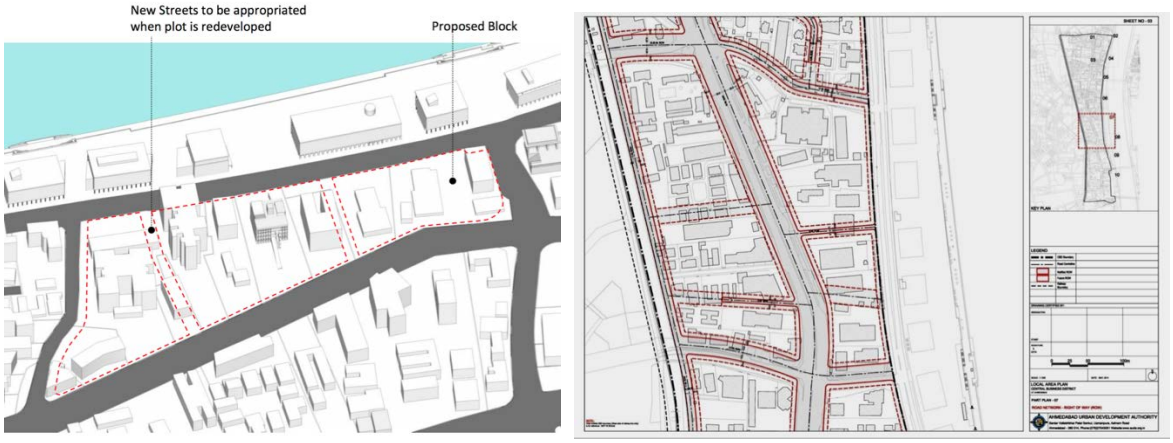
Source: UTTIPEC.

Building codes and urban design guidelines. Rules governing the construction of private buildings are often enshrined in legal code. Building codes, which regulate the design and construction of buildings, can encourage pedestrian-friendly design. Walking-friendly elements in building control regulations may include encouraging active façades in place of compound walls, limiting off-street parking and driveways, incentivizing active ground floors and other people-oriented uses, and establishing mechanisms for breaking up large blocks during the redevelopment process. Codes, guidelines, and standards also should be harmonized across the jurisdictions that make up a metropolitan area (see Image 31, Figure 15).

Image 31: The challenge created by inconsistent street design guidelines.

In Dar es Salaam, a lack of consistent design guidelines (and enforcement) has resulted in frequent changes in levels (left) and horizontal alignment (right).

Figure 15: In Ahmedabad, Local Area Plans identify where inserting new public streets can reduce block sizes. Accompanying regulations specify how properties can be redeveloped.



Source: Ahmedabad Urban Development Authority.

Speed limits. Speed is critical to pedestrian safety.[90] The faster a vehicle is traveling, the less time the driver has to react and stop before a collision, increasing the likelihood of a pedestrian fatality. A pedestrian has a 90 percent chance of surviving a crash with a car travelling at or below 30km/h, but only a 50 percent chance of surviving impacts at 45 km/h.[91] Yet many cities have legal speed limits that are too high to ensure that pedestrians can cross streets safely. For instance, 47 countries (representing 13 percent of the global population) do not allow speed limits of less than 50 km/h.[92]

Motor vehicle laws. Laws can help deter unsafe driving that threatens pedestrian safety. Ambiguity in laws about determining who is at fault in a traffic crash can make it difficult to hold an errant driver accountable. In the Netherlands, the driver of a motor vehicle is assumed to be at fault in a crash with a pedestrian or cyclist unless he or she can establish that the crash resulted as a result of factors out of his or her control.[93] On the other hand, light penalties for crashes that cause fatal injuries to pedestrians create an environment where drivers can retain their licenses even after a severe violation of traffic rules. For instance, in New York City in 2015, less than 1 percent of drivers involved in hit-and-run crashes that led to injury or death were prosecuted.[94]

Street management

Even where good pedestrian facilities exist, poor street management can compromise their usability. On-street vending and parking need to be managed to avoid conflicts with pedestrian movement. Sidewalks need to be unobstructed and continuous. If vehicles are allowed to park on sidewalks, pedestrians are forced to walk in the roadway. This degrades the quality of life of pedestrians and creates an unsafe environment. These challenges need to be addressed through a combination of physical measures such as bollards to keep cars off of sidewalks and designated spaces for street vending (see Image 32). Local governments need legal backing to manage the pedestrian environment. In some cases, enforcement agencies lack the authority to remove parked cars from sidewalks. In addition, the corresponding fines may be too low to serve as a strong deterrent.

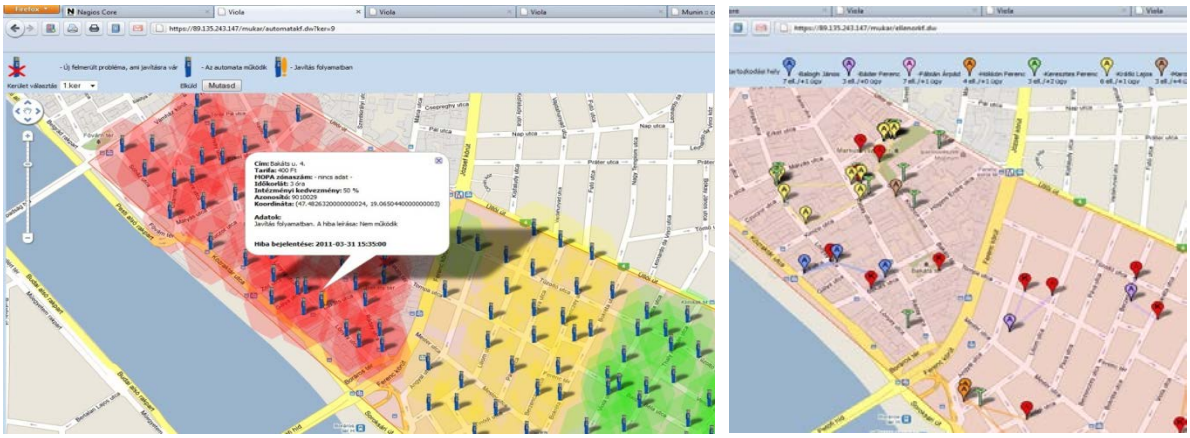
Cities also need to introduce better management systems to complement these physical measures. These may include information-based parking management systems to monitor parking vacancies, capacity, and enforcement.

Parking management. On-street parking management can be strengthened through a service contract with a management agency that collects fees and carries out enforcement activities. The service provider would be responsible for providing clear customer information in the form of road markings and signage so that customers are aware of parking regulations. An IT-based information system can send regular updates to the government regarding the number of vehicles parked, the number of enforcement incidents, and the level of revenue collected (see Figure 16). Revenue from the service provider should go to the government, which then pays the operator a set fee for the management and enforcement activities carried out, subject to penalties and incentives. If the payment is tied directly to enforcement, then the operator will become too aggressive.

Image 32: Creating car-free pedestrian spaces.

Bollards can help prevent parking encroachments on pedestrian spaces: Bengaluru (left) and Dar es Salaam (right).

Figure 16: Parking enforcement in Budapest.



Budapest's parking management system provides real-time information on the status of all parking meters (left) and enforcement personnel (right).

Vending management. Vending spaces should be clearly delineated (see Image 33). Monitoring agencies can issue licenses to street vendors, set standards for vending stands, and monitor the upkeep of vending areas. Formalizing the relationship between the government and vendors would reduce the pressure on vendors to enter informal relationships with police and other government officials to maintain their ability to operate.

Image 33: Pedestrians crowded out.

On-street parking impedes walking in a commercial area of Abuja (left). With inadequate space designated for vendors, sidewalks in Dar es Salaam become unusable (right).

Parking management in Yaoundé and Abidjan

Poor parking management compromises the usability of city center sidewalks in many cities. These problems are particularly acute in the city centers of Abidjan and Yaoundé. Vehicles are often parked within pedestrian spaces, damaging the quality of facilities and turning public space into storage for private vehicles (see Image 34). Vehicles parked on sidewalks limit their usability for pedestrians and forces citizens to walk in the roadway with motor vehicles. Parking spaces must be properly managed to ensure that cars are parked in their proper spaces. Besides preventing cars from being parked on sidewalks, proper parking management schemes can generate revenue for cities that can be used to fund the construction of pedestrian facilities.

In Abidjan and Yaoundé, sidewalk parking has been officially sanctioned, thereby legalizing parking encroachments that severely restrict pedestrian movement. Municipal governments allow businesses to reserve adjacent parking spaces, including spaces that are striped directly on sidewalks, in return for an annual fee. Even after Abidjan carried out a major investment in pedestrian sidewalks, cars have been allowed to park on the new, high-quality sidewalks (see images below). Moving forward, it will be essential to adopt parking management practices that ensure that the alignment of on-street parking areas leaves sufficient clear space for pedestrians.

Image 34: Rampant parking encroachments undermine the benefits of new wider sidewalks, street furniture, and landscaping on several streets in Abidjan's Plateau area.

Maintenance. Once facilities have been built, it may be unclear who is responsible for their maintenance. Too often, sidewalks are allowed to fall into a state of disrepair. There is no mechanism for managing underground utilities, so sidewalks are not put back into place after being torn up to install new utilities. This absence of clear and enforced regulations regarding the provisions of sidewalks has led to lack of sufficient pedestrian facilities in many parts of the world. Better regulations are needed if efforts to improve the pedestrian sphere are to succeed.

Monitoring & evaluation. To facilitate access to information about existing street infrastructure and underground utilities, cities can conduct regular assessments of the pedestrian environment, using the evaluation criteria developed in the street design standards to evaluate infrastructure on different corridors. For instance, to facilitate breaking up large blocks during the redevelopment process, the responsible agency could carry out a comprehensive survey of walking facilities and amenities on private property (arcades, passages, etc.). This survey would identify the gaps between existing and desirable walking facilities and walking-oriented building designs. The agency could then develop maps of required pedestrian facilities to guide the redevelopment process.

Quantitative data are critical inputs to pedestrian and transit planning. They can also be valuable for auditing pedestrian environments and revealing the pedestrian infrastructure needs across the city. Data can guide project evaluation by answering such questions as: To what extent have goals actually been achieved? How can success and failure be put into numbers? What do numbers tell about subsequent projects? For pedestrian mobility, key types of data to be collected include the following:

- **Built environment:** Sidewalk presence, sidewalk height, road width, crossing availability, presence of shade, lighting, landscaping, block size, frontage, etc.
- **Pedestrian demand and behavior:** Pedestrian volumes, movements, origins, destinations, etc.
- **Crash data:** Records on vehicle crashes involving pedestrians, including the location, time of day, at-fault vehicle.

This pedestrian mobility information should be in a citywide Geographic Information Systems (GIS) database. In addition, all new projects in the proposal, planning, or implementation stages would be brought into the database. A capable implementing agency should be selected to house the database.

A simple assessment tool that makes data collection practical and efficient can provide rich information about the state of the key elements shaping the pedestrian environment: street design, building design, and street network. A walking facility assessment tool ought to consider both micro scale design details and citywide indicators. A proposed walking assessment methodology is presented in Section 5 below.

Health Impact Assessments (HIA) are an evaluation tool for assessing the potential health impacts of policies, programs, and projects on a population, especially vulnerable groups.[95] This approach could be incorporated into a pedestrian environment monitoring and evaluation program to analyze the health impact of walking supportive and unsupportive policies, plans, and infrastructure.

Tracking the performance of street improvements in New York City

The New York City Department of Transportation (NYCDOT) has been following a data-driven approach to project evaluation in recent projects. Regarding pedestrian mobility and safety, a number of datasets are collected and used to evaluate project success. A central goal of many of NYCDOT's pedestrian projects has been to increase road safety through speed reduction measures, including traffic calming. In order to assess the extent to which this goal has been reached, several metrics were applied, including crashes and injuries of pedestrians and traffic speeds.[96] On this basis, NYCDOT has been able to judge the success of different types of traffic calming interventions (see Figure 17). According to the data collected by the city, these key treatments have been successful at encouraging safe user behavior: simplified intersections; dedicated left, right, and through lanes; pedestrian safety islands; protected bike lanes; leading pedestrian intervals; and split phasing.[97] In addition to data on road safety impacts, NYCDOT collects data on economic impacts, such as business turnover. The data collected by NYCDOT have proven crucial in making the case for pedestrian improvements in the context of court battles over controversial interventions.

Figure 17: Example of a data-driven evaluation of a New York City neighborhood traffic calming project.

Source: New York City.

Capacity building. The capacity of the institutions responsible for pedestrian environments needs to be improved across the board through better funding, staff training, and new hiring. Engineers and other city officials involved in the street design projects need basic training in street design principles and design standards (as opposed to highway design). Governments can partner with local academic institutions to develop certification programs (see Image 35). Private sector stakeholders (developers and property managers) also should be consulted and educated on their duties and on practical steps that can be taken to deliver high-quality pedestrian facilities. Finally, there is a need for academic institutions to reform university curricula to provide better training to the next generation of street designers.

Image 35: In a Chennai street design certificate course, road engineers prepare concept designs for pedestrian improvements (left) and present results to the city commissioner (right).

Funding

Pedestrian infrastructure often falls low on the totem pole when governments set priorities for transport investments. In many cities, funding for the construction of pedestrian facilities is lacking. No specific sources of funding for pedestrian walkways exist in contrast with the regular funds that are available for the construction and maintenance of motor vehicle infrastructure. Municipalities sometimes have their own funding sources, yet these revenue streams are not sufficient to cover the costs of large-scale pedestrian improvements. Even when road designs include provisions for pedestrian infrastructure, sidewalks are often the first element to be eliminated in the event of cost overruns. Therefore, it is important to identify dedicated sources of funding for pedestrian mobility improvements while adopting pedestrian-first policies to ensure continuity in these funding sources. Potential sources of funds for walking improvements may include parking fees, advertising revenue, property taxes, and even in-kind provision of infrastructure.

Parking fees. One way of carrying out pedestrian improvements is to reinvest revenues generated from parking fees back into the metered area. This method has been applied successfully in Old Pasadena, the downtown area of Pasadena, California, (see box below).

Revenue generation in Pasadena

Under the Old Pasadena Streetscape and Alleyways Project, launched in 1993, the city of Pasadena (United States) installed almost 700 parking meters, yielding US$1.2 million in parking revenue to be invested in additional public services.[98] Initially, city planners faced local critique and skepticism over the higher price of parking, which previously had been free. Planners explained to local businesses that the funds raised from the parking fees would be reinvested in the local area (see Image 36). Shop owners recorded increased revenues after the installation of parking meters. The pleasant environment, including tree-lined sidewalks, improved store façades, and better security, drew increased pedestrian traffic.[99] In sum, the intervention led to two major benefits for the Old Pasadena neighborhood: first, improved public infrastructure made the area one of the most walkable commercial districts in the United States, and second, the improvements led to increased private investments and business activity, thereby demonstrating the potential economic benefits of a better pedestrian environment. [100]

Image 36: Pasadena used on-street parking fees to convert alleyways to pedestrian zones. Their sales-tax revenues increased significantly after making pedestrian improvements.

Sources: Bunsh1ch1 via Flickr (left) and Teikan via Flickr (right).

Public-private partnerships (PPPs). In a public-private partnership project implemented with outdoor advertising revenue, a sponsoring agency would fund basic corridor improvements such as tree planting, lighting, and basic upkeep in return for gaining outdoor advertising rights along the corridor. Such arrangements could be established by the relevant government body, such as a roads agency or municipal government. The city of Ahmedabad (India) established a PPP for improving the street design along a major shopping corridor, C.G. Road (see Image 37). The city and corporation each contributed to the cost of incorporating shared service lanes and organized on-street parking bays. After the company recouped its investment through advertising and parking revenues from the corridor, the revenues then shifted to the city.[101]

Image 37: In Ahmedabad, a private company funded pedestrian facility and parking upgrades along C.G. Road, in a major shopping area, in exchange for advertising revenue rights.


Developer and property owner fees. Developers, investors, and property owners represent a potential source of financing for state-of-the-art public pedestrian facilities and amenities. Contributions can be mandated from private developers, either in-kind contributions in the form of sidewalks built in the public right-of-way along new developments or through mandatory financial contributions such as impact fees or other mechanisms. Any sidewalks constructed under such an arrangement would be subject to strict design and material standards. The builders of public sidewalks should be trained and certified by the municipal or metropolitan authority in charge of maintaining standards of quality and continuity. In addition, a fixed percentage of the taxes assessed by local governments on land and real estate properties can be allocated to pedestrian and public space improvements.

New York City property owners are responsible for construction, repair, and maintenance of the sidewalks abutting their property, and all sidewalk design must conform to the city's design guidelines.[102] Department of Transportation staff inspect sidewalks throughout the city and notify property owners when repairs are needed. The owner can take care of the repairs themselves or the city will hire a contractor for the work and bill the property owner the cost. New York also collects US$60 million per year in sidewalk permit fees from restaurants with sidewalk cafes, street vendors selling food on the streets, and property developers for the installation of sidewalk curb ramps, benches, and trash receptacles in front of their property.[103]

Similarly, in Minneapolis, Minnesota (United States), property owners are responsible for the cost of reconstruction and repair of sidewalks through a one-time fee. When a residential or commercial property requires new sidewalks, the city bills the owner for the cost of replacement. The city has created a sidewalk repair fund through the sale of municipal bonds and retains contractors at reduced rates.[104]

In 2015, the city of San Francisco implemented the Transportation Sustainability Fee, a development impact fee imposed on new development and land-use changes in the city to finance citywide transit and non-motorized transport improvements. Three percent of the fee revenue supports bicycling and walking infrastructure improvements, including upgrading sidewalks and intersections.[105]

Fairfax County in Northern Virginia, United States, assessed several fees on a Tysons Corner Service District in order to finance street improvements in the area to complement new Metro rail stations. A

fee imposed on new development in the district will generate approximately US$304 million over 40 years to build out a local street network and improve walkability.[106]

Hybrid programs. In 2016, the Los Angeles City Council approved the Safe Sidewalks LA program committing US$1.4 billion for repairing and maintaining the city's sidewalks over the next 10 years.[107] Under this Fix-and-Release style program, the city takes responsibility for fixing the city's sidewalks now and then transfers the repair and maintenance duties to property owners in 10 years. The program is in response to a lawsuit against the city seeking to make public sidewalks more accessible to people with disabilities.

Property tax. Property taxes can be an important source of revenue for sidewalk construction and repair. For example, the city of Ann Arbor, Michigan (United States), held a successful referendum to increase property taxes and raised funds to construct or rehabilitate over 689 km of sidewalks.

Value capture mechanisms. Land and property values tend to increase with proximity to public transport facilities, reflecting the economic benefits of increased accessibility.[108] The city can capture some of this increased value and invest it in improving public transport and walking facilities. Several mechanisms exist for capturing this location-based value.

Location benefit taxes impose higher land or property taxes on those properties that stand to benefit from proximity to public transport. London has implemented several location benefit taxes to finance Crossrail, its £16 billion rail system expansion. The Crossrail project will invest £130 million in improving the public realm adjacent to the new rail stations, including 40 improved public spaces, 20 new pedestrian crossings, new street trees, and bicycle parking.[109] Existing commercial properties in London are expected to benefit from improved productivity and higher property values as a result of the transit system expansion, and so will pay an additional fee according to their assessed property value. This tax is expected to generate £4.1 billion to partially finance Crossrail.[110,111] Furthermore, new development in the city will pay an infrastructure tax, with the highest tax rates imposed in Central London zones that are forecast to benefit the most from Crossrail.[112]

Through tax increment financing (TIF) the incremental property tax revenue resulting from increased property values is reinvested in public amenities and improvements in the district.[113] Chicago created a TIF around its McCormick Place convention center and redirected the increased property tax revenue to improve pedestrian facilities and streetscape in the district.[114]

Examples of cities that have taken the lead on pedestrian mobility

Mexico City's Vision Zero strategy

Mexico City counts no less than 8.5 million inhabitants within the city and about 20 million residents in the metropolitan area.[115] These residents make around 32 million vehicle trips daily, more than half with various means of public transport: rail, subway, LRT, BRT, trolleybus, minibuses, and public bicycles.[116] However, an increasing number of residents use private cars and the city records a comparably high amount of road accidents: about 500 pedestrians die each year due to traffic crashes. The pedestrian fatality rate is high even though the road infrastructure, including sidewalks, is quite good for the most part. There are a number of chaotic crossing points that see frequent collisions between pedestrians and motor vehicles.[117]

To address these issues, the municipality of Mexico City has been working to adopt a more integrated approach to the planning, financing, and regulation of pedestrian mobility. Civil society organizations have been actively involved in this process, frequently consulting with the government and advocating for road safety improvements. The city won the Sustainable Transport Award in 2013 for its improving pedestrian mobility, which goes hand in hand with ameliorating livability.[118]

Policies

Mexico City recently implemented two pioneering policies on urban transport and specifically pedestrian mobility, namely a new Mobility Law (2014) and the Vision Zero policy (2015). To encourage a shift towards a culture of integrated, people-oriented mobility, Mexico City Mayor Miguel Ángel Mancera announced a new Mobility Law in July 2014. This law refers mainly to pedestrians' rights and needs, the role of which is regarded as crucial to the creation of vibrant public spaces. So far, long distances and fast traffic have made walking unattractive in Mexico City. Consequently, interventions on redesigns of streets have been done in areas with a strong pedestrian presence, including several major avenues.[119] Key objectives of the new mobility law might fundamentally change walkability in Mexico City with regards to public perception, social inclusion, and safety.[120] Next, the city moved to implement a Vision Zero policy to help guide implementation of the Mobility Law. The key provisions of the strategy are shown in Table 3.

Table 3: Major elements of Mexico City's Vision Zero policy.

Key provisions	Features
The "right to mobility"	• Including citizens in the planning, regulation, and managing processes of the mobility system. • Taking a holistic approach to changing the city's mobility systems, incorporating principles of urban resilience, inclusive governance, and active transport.
Prioritizing pedestrians and cyclists	• Establishing a mobility hierarchy that shapes the city's priorities for road use planning and budget allocation. • Prioritizes people-oriented transport policies such as the promotion of complete streets, safe crossroads, and increased public bicycling infrastructure.
Consolidating operations for social inclusion	• Eliminating the "one-man, one-bus" operating scheme. • Establishing the groundwork for the creation of a regulatory body for mass transit corridors and transport operators, bringing more cohesion to overall transport systems in the city. • Protecting citizens' rights to high-quality public transport and helping public transport services to become more efficient, safe, and inclusive.
Improving road safety and resilience	• New Road Safety Integrated Plan to improve traffic safety. • Saving lives by prioritizing improved safety for pedestrians and cyclists through improvements to infrastructure design and increased road safety regulations (e.g., additional regulations for driving licenses or permits).

Vision Zero is built upon three pillars which are followed by concrete measures. A central aim of the policy is to improve safety and comfort for pedestrians in alignment with the global road safety movement. It states that pedestrians' lives need to be prioritized over vehicles (see Table 4). For example, accidents caused by cars and injuring pedestrians (mentioned above) should be reduced by 35 percent by 2018 and by 50 percent by 2021. For this purpose, interventions with additional policies at dangerous intersections are necessary.[121]

Table 4: Mexico City's 2015 Vision Zero policy guides not only legislative questions but also road design and mobility culture.[122]

Pillars	Measures
• Law enforcement	• Decreasing speeds for motorist on major roads
• Road design	• Improving intersection design
• Establishing a (new) culture of mobility	• Traffic calming

Pedestrian infrastructure

Mexico City has begun putting the pedestrian policies into practice through various initiatives. The Avenue 16 de Septiembre initiative is a major project to redesign streets to give more priority to pedestrians (see Image 38). Advanced traffic calming measures were implemented in order to facilitate shared use by different forms of public transport, including pedestrians, cyclists, and cars. The pedestrian priority design provides greater security, mobility, and accessibility through an expanded sidewalk, which is separated from the road by bollards. More trees have been planted and new benches have been installed. Moreover, vehicle traffic is permitted at significantly reduced speeds, allowing 150,000 pedestrians daily to safely and comfortably use the corridor.[123]

Image 38: Avenue 16 de Septiembre before and after pedestrian improvements.

Revitalization of public spaces

Convenient and safe public spaces are key to allowing people to walk. Mexico City has taken a number of steps to revive public spaces in its historic center. The Alameda Central park was recovered by improving sidewalks and renovating monuments (see Image 39). The park serves as a key walking link to nearby public facilities, shopping areas, and rapid transit stations. Similarly, Plaza Tlaxcoaque has been rehabilitated by installing a new illumination system and pedestrian spaces. To augment these efforts, the city has been installing traffic reduction measures in the historic area. These improvements

were closely coordinated with the implementation of the Metrobus BRT system in order to ensure that passengers can reach stations safely and comfortably.

Image 39: Alameda Central now has broad walkways, benches, and shared spaces.

Parking management

Until 2012, car users had parked their vehicles anywhere in the urban area free of charge. This situation brought about two serious problems: it directly encouraged urbanites to travel with private cars and contributed to a serious problem of parking encroachments on sidewalks that restrained pedestrians' mobility. In order to disincentive driving, it is essential to set an appropriate price for parking and to enforce parking rules to prevent encroachments on sidewalks. Since 2012, the city has installed hundreds of parking meters under an on-street parking program called ecoParq (see Image 40). By 2015, nearly 500 parking meters had been installed alongside 7,000 parking spots in two pilot neighborhoods. This program has various advantages, generating revenue and contributing to better manage the use of public space. The program encourages commuters to think about alternatives. As a result, private car use has decreased measurably.[124] In a broader sense, parking management has become a key tool to control and reduce congestion in the city.[125]

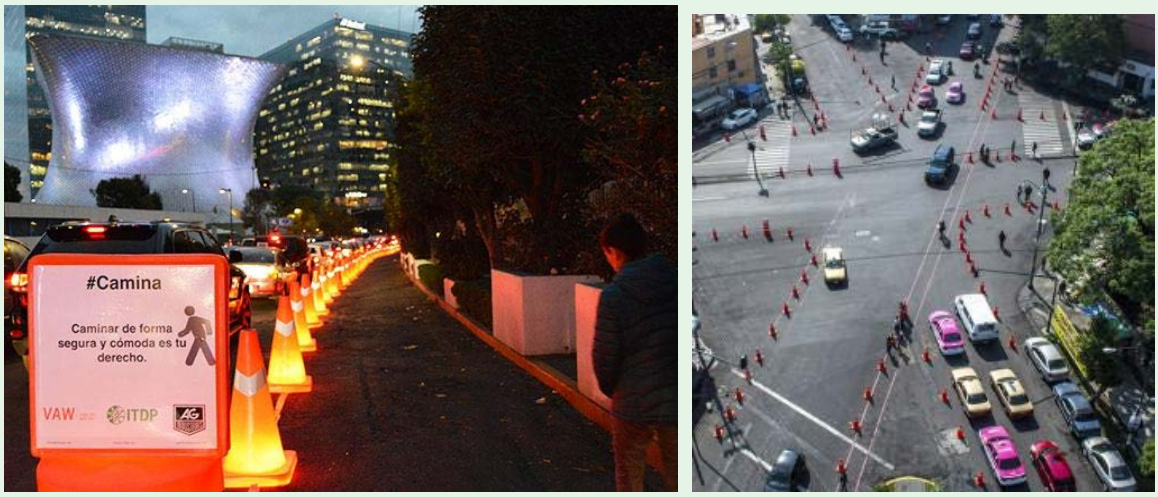
Image 40: The ecoParq parking management system has reduced car use in pilot areas (left). The city has also reallocated on-street parking spaces for other uses such as bulb-outs (right).

Civil society engagement

Many of the initiatives in Mexico City would not have come into being without the engagement of NGOs and civil society. For example, civil society actors and nongovernmental organizations formed a coalition in order to garner attention and provide technical support to the city government officials on the Vision Zero policy. This coalition hosted workshops on the benefits of pro-pedestrian measures, commented on laws and regulations, and encouraged strong political and fiscal support for pedestrian measures.[126] Moreover, the coalition advocated for the creation of a new federal fund to provide technical advice and financial support to Mexican cities for sustainable mobility projects instead of spending the majority of federal transportation funding on expanding road infrastructure.[127]

In another project, various local organizations conducted a campaign named Camina ("Walk") (see Image 41). Through temporary street interventions under the umbrella of tactical urbanism, pedestrian environments are improved (i.e., increased safety, efficiency, and comfort of walking). In the first intervention, the project installed illuminated traffic cones in order to redistribute road space more equally and give more space to pedestrians.[128]

Image 41: Campaign Camina redistributed road space by prioritizing pedestrian traffic on a car-oriented road in Mexico City (left), and led intersection redesign demonstrations (right).



Source: ITDP (left).

There are two civil society actors from Mexico City conducting particularly creative and effective work. First, Liga Peatonal (Pedestrian League), formed in 2013 by various groups from across the country, advocates for better traffic policy (e.g., lower speed limits on national roads, lower limits on blood alcohol content for drivers) and generally works against public policies that favor cars. In addition, it published the Mexican Charter for Pedestrian Rights.[129] Also, the activist Peatónito (Little Pedestrian) has had a significant impact on rising awareness of pedestrians' rights by fostering conversation that leads to policy changes and consequently the implementation of pro-pedestrian policies. With some of the highest pedestrian fatality rates in the world, the city government has been receptive. Peatónito has been invited to speak at public forums. In response to this advocacy, Mexico City Mayor Miguel Mancera has announced several traffic regulations. Peatónito "protects pedestrian rights in all kinds of quirky ways (see Image 42)[130] His appearance and actions, like blocking cars and giving speeches on pedestrian rights at intersections, are highly media-savvy and have inspired activists around the world.[131]

Image 42: Peatónito symbolically tries to move a car out of a pedestrian crossing (left). Liga Peatonal activists create their own walking facilities in underserved neighborhoods (right).

Source World Bank (left) and Liga Peatonal (right).

These examples show how Mexico City has worked to improve pedestrian infrastructure on various levels with the active involvement and engagement of civil society actors. The integrated efforts to achieve policy reforms, infrastructure improvements, and better enforcement have had a transformative effect on the city's transport system and have also led to reductions in traffic crashes.

Pedestrian strategies in Copenhagen

In 1962, long before the appearance of pedestrian zones in many European cities, Copenhagen introduced Strøget, a car-free pedestrian zone in the inner city. Stretching more than 3 km, Strøget is the one of the world's longest and oldest pedestrian street systems (see Image 43). It serves as a shopping area and attracts many visitors.[132] This example illustrates how Copenhagen began implementing pedestrian mobility initiatives comparably early. The city administration had realized that a pedestrian-friendly environment, as part of an integrated sustainable urban transport system, would have an immense impact on urban livability.

Image 43: Copenhagen's Strøget is one of the oldest and longest pedestrian street systems worldwide.

Source: Thousandwonders.net (left) and Wikimedia Commons (right).

Around 600,000 residents live within the city's municipal boundaries, with 1.3 million in the greater urban area.[133] At first sight, the old port city seems to be well suited to the use of non-motorized transport since the city center is quite compact and distances are short. While Copenhagen is perhaps better known for its efforts to encourage cycling, pedestrian mobility initiatives have received considerable attention as well. As a result, Copenhagen was recognized as the world's most walkable city in 2013 and again in 2015.[134,135]

Among the city's efforts, another iconic project is the Cirkelbroen (Circle Bridge) at the heart of the city, which was opened for pedestrians and cyclists in August 2015 (see Figure 18, Image 44). Since the city is surrounded by the Baltic Sea and has several waterways in the urban area, bridges are helpful for facilitating pedestrian movement. Cirkelbroen connects two central districts of Copenhagen (see map). It was designed by the famous Danish-Icelandic artist Olafur Eliasson and resembles a ship as a reference to Copenhagen's history. Therefore, it also serves as a tourist attraction

and further increases the attention to pedestrian mobility. It is illuminated at night to improve safety. Its design also encourages cyclists and pedestrians to linger on the bridge.[136]

Figure 18: Cirkelbroen enables pedestrians to cross central Copenhagen's waterways.

Source: Google Maps.

Image 44: The inauguration of Cirkelbroen attracted many locals and visitors. The bridge connects two vivid districts of Copenhagen and its famous design is illuminated at night.

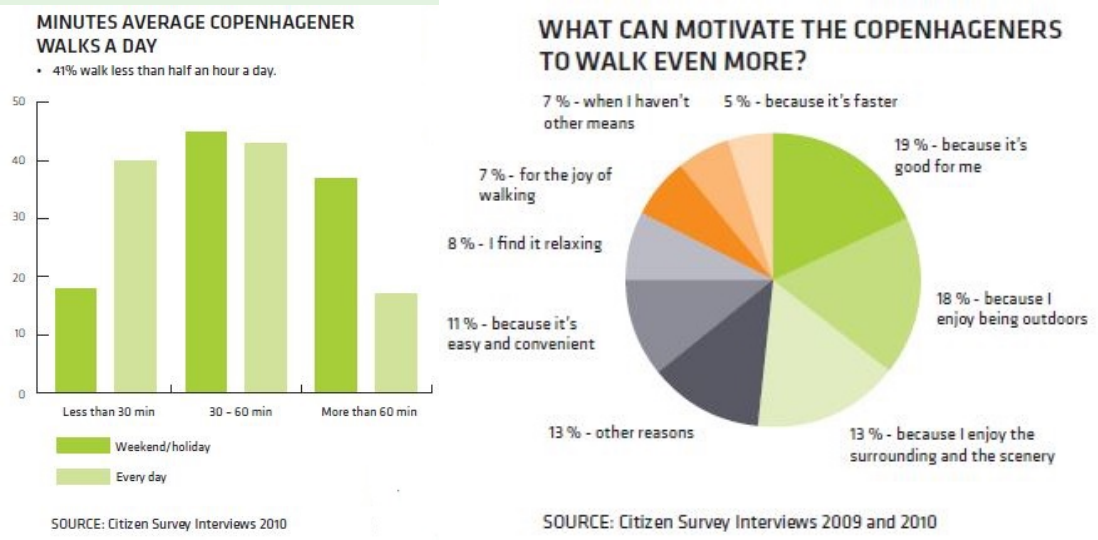
Source: Ingenieur.de and Politiken.dk (left) and Nordeafonden.dk (right).

Copenhagen has made continuous attempts to improve walking networks with regard to accessibility and safety.[137] Funding generally comes from the Danish government and measures are largely implemented by the City of Copenhagen's Department of Technical and Environmental Administration. Recent pedestrian transport policies form part of the city's climate plan CPH2025,

published in 2012 with an overall aim of directing approximately US$400 million of investment into projects aimed at reducing emissions and making the city carbon neutral by 2025. One pillar is the strategy on green mobility, which aims to have 75 percent of all journeys to be made on foot, by bicycle, or by public transport by that date. Since walking is free of GHG emissions, it should be promoted as one of "the most attractive means of transport for Copenhageners to get around in the city."[138]

Another policy, aimed specifically at pedestrian mobility, is More People to Walk More: The Pedestrian Strategy of Copenhagen (2011), published by the Technical and Environmental Administration of Copenhagen in partnership with Gehl Architects (see Figure 19).[139] Per the pedestrian strategy, the city's vision is to encourage more people to walk through several initiatives: the development and creation of a "walking culture," the implementation of pedestrian routes and meeting places, and the introduction of pedestrian priority on main shopping streets and traffic nodal points.[140]

Figure 19: Copenhageners walk more on weekends (left). They cite personal enjoyment, a desire to spend time outside, and city scenery as reasons they enjoy walking (right).



The pedestrian strategy is a core element of the city's urban life vision, A Metropolis for People (2009): In Copenhagen, a focus is on pedestrian mobility to create a healthier lifestyle and a better environment.[141] In this strategy, a number of reasons are given for the focus on pedestrian mobility: walking is environmentally friendly, healthy, and contributes to a better quality of life.

Another important policy is the ITS Action Plan 2015-2016 published in 2014. Walking is a key area for the implementation of intelligent transport systems (ITS). These measures are aimed at increasing pedestrian traffic by 20 percent.[142] The plan focuses on comfort and safety by shortening travel times and streamlining pedestrian traffic flows. Among other things, the plan seeks to introduce an intelligent traffic management system to optimize the traffic signal cycles for pedestrians and increase safety.[143] The application of "smart lighting" and communication between traffic signals and street lighting will raise awareness of the presence of pedestrians. For instance, new concepts are also being developed on how to focus greater attention on pedestrians who are crossing when lights are blinking.[144]

Copenhagen's policies on pedestrian mobility show that there is always room for improvement, even if the general status of pedestrian mobility is very good in comparison to other cities. Pedestrians have always played a central role in Copenhagen's traffic. As a result, the city records a relatively low number of accidents in which pedestrians are injured.[145] Even from this starting point, Copenhagen is making a concerted effort to improve safety and comfort of walking. Going forward, Copenhagen seeks to make the pedestrian environment more inclusive for disadvantaged individuals and groups such as elderly persons and the urban poor who cannot afford private vehicles. Due to these and other advantages, Copenhagen provides inspiration for other urban areas, including Singapore, whose mobility policy envisions the city as "walking in Copenhagen's footsteps."[146]

5. Assessing the walking environment

As described above, creating an urban environment that is comfortable, safe, and convenient for walking requires considering a variety of factors at both the local and regional scales. Planning, designing, and maintaining the pedestrian environment requires a good understanding of the mobility problems in a city. Pedestrian mobility assessments help cities identify problem areas and target necessary interventions.

Pedestrian Mobility for Urban Growth, a multi-city World Bank project, was established to address the critical challenges to the pedestrian environment in African cities. As part of this project, a tool was developed to conduct rapid assessments of the pedestrian environment in five pilot cities: Abidjan, Cote d'Ivoire; Kampala, Uganda; Dar es Salaam, Tanzania; Gaborone, Botswana; and Yaoundé, Cameroon.

Drawing from existing walking assessment tools as a starting point, the resulting assessment method is a simplified yet comprehensive tool to make largescale data collection practical and efficient. The methodology combines the relative strengths of several existing methodologies to capture all of the key elements affecting the pedestrian environment: street design, building design (including land use), and street network. Data on the elements with the greatest impact on walking are relatively easy to collect and can be collected consistently and reliably; and are most objective in nature. The resulting tool is a straightforward, easy-to-use survey process that can be scaled to the city level.

Review of walking assessment methodologies

Measuring the success of creating such an environment is challenging given the number of factors that influence the experience for pedestrians. An early effort to develop a walking assessment tool resulted in the Global Walkability Index, developed under the auspices of the World Bank.[147] In recent years, a number of tools for evaluating the walking environment have been created in a number of contexts. The methodologies range from the simple to the highly complex, and from highly objective to highly subjective. Some widely applied contemporary tools include the following:

- **Pedestrian Environment Quality Index:**[148] Developed by the San Francisco Department of Public Health, the Pedestrian Environment Quality Index (PEQI) covers numerous aspects of the pedestrian environment across five domains: intersection safety, traffic volume, street design, land use, and safety. The PEQI has been applied in a number of cities in the United States, including Denver, Los Angeles, Portland, and Pittsburgh.
- **Built Environment Assessment Tool:**[149] The Centers for Disease Control and Prevention created the Built Environment Assessment Tool (BEAT) to evaluate elements of the built environment that encourage walking, cycling, and other forms of active transport. The BEAT includes a lengthy and detailed survey covering specific elements of intersection design, street segment design, and built form.
- **iRAP:**[150] The International Road Assessment Program created the iRAP Star Rating system to judge the road safety performance of highway corridors. It is widely used in various contexts to carry out safety audits for existing and proposed highways. The rating system assigns a star rating to road segments based on a combination of safety metrics, some of which capture elements of the pedestrian environment, including crossing quality, footpath presence, and street lighting. The rating system is focused on safety and does not necessarily weigh factors such as pedestrian convenience, accessibility, and comfort.

- **Clean Air Asia Walkability Index:**[151] Inspired by the Global Walkability Index, a resource conceptualized as part of a World Bank research project, the Clean Air Asia Walkability Index was designed as a field survey tool to conduct a rapid assessment of the pedestrian environment in South and East Asian cities. The tool emphasizes factors that are relevant in the Asian context, including footpath encroachments, driving behavior, footpath maintenance, and the ease of crossing.

Table 5 compares the key elements of each pedestrian environment assessment tool. The tools have basic metrics to evaluate the presence of sidewalks, crossings, safe intersection design, and measures to reduce motor vehicle speeds. Other elements covering issues around pedestrian comfort, safety, and convenience, including shade, lighting, street furniture, appear to a varying extent among the standards. Among issues beyond street design, land use is covered in several of the metrics, but building and network design are not consistently included. Given the critical role of urban design and the street network in shaping the quality of the pedestrian environment, these elements may require greater emphasis in walkability assessment methods.

Table 5: Comparison of walkability standards (● = detailed, ◖ = mentioned, ○ = not included).

	iRAP	SFDPH PEQI	CDC BEAT	Walkability Index
Sidewalk presence	◖	●	●	●
Pedestrian crossings	●	●	●	●
Universal access	○	●	●	●
Driveway density	●	●	●	◖
Intersection geometry	●	●	●	◖
Carriageway width	●	●	●	◖
Traffic calming	●	●	●	◖
Official speed limit	●	●	●	○
School zones	●	○	●	◖
Lighting	●	●	●	◖
Shade	○	●	●	◖
Landscaping	○	●	●	○
Vending	○	○	●	◖
Street furniture (e.g., seating, bus shelters, etc.)	○	●	●	●
Cleanliness	○	●	●	●
Hostile social behavior	○	○	●	●
Traffic control	●	●	●	◖
Pedestrian volumes	●	○	○	●
Pedestrian crossing volumes	●	○	○	○
Traffic volume	●	●	○	◖
Driving behavior	○	○	○	●
Building design	○	◖	●	○
Land use	●	●	●	○
Street network	○	○	○	●
Public transport access	○	○	●	○

Proposed walking assessment methodology

Building on existing walking assessment methodologies, a comprehensive assessment tool was developed to evaluate the walking environment. While several of the existing tools depend on an elaborate data collection process, the new tool was designed for rapid deployment across large urban areas—particularly in developing city contexts. Consequently, the tool relies on a compact set of indicators and readily available survey tools. To aid in interpretation of results, the tool summarizes survey output to create aggregate scores for the four key elements of the walking environment: street design, building design, land use, and street network.

Indicator selection. A walking assessment tool must strike a balance between the level of detail and the ease of deployment on a widespread basis. To determine the most effective pedestrian mobility indicators, four factors were considered:

- Importance for pedestrian mobility: The tool should rely on a compact set of indicators that have the largest impact on walkability.
- Difficulty of obtaining data: In order to scale the survey at the city level, the tool must rely on data that are easily captured.
- Data reliability: The tool should capture accurate data.
- Data subjectivity: Results should be consistent across multiple surveyors.

Each priority was assigned a weight based on the team's judgment. The results were then normalized to a 0 to 100 scale to determine the most and least useful data points. Based on this analysis, none of the existing methodologies achieved a desirable balance for use in this study. The team developed a new set of indicators comprised of those that could be collected efficiently and objectively but which also have the largest impact on walkability. The final indicators selected for collection are shown in Table 6.

Table 6: Pedestrian environment indicators.

Area	Indicator
Street design	• **Sidewalk presence**: Presence of sidewalks with at least 2 m of clear space. • **Sidewalk condition**: Condition of the sidewalk surface. • **Ramps for grade changes**: Presence of curb ramps with a slope of 1:12—needed to make the sidewalk accessible. • **Parking blocking sidewalk**: Frequency of cars parked on sidewalks. • **Vending blocking sidewalk**: Frequency of vendors blocking sidewalks. • **Street width**: Total public right-of-way. The street width is used to evaluate the need for median refuge islands. • **Shade**: Assessment of the amount of shade from trees and/or building arcades. • **Midblock crossings**: Count of the number of mid-block crossings with traffic control (i.e., either signalization or traffic calming). • **Midblock pedestrian refuges**: Count of the number of mid-block refuges where people can wait before crossing the second half of the street. • **Lighting**: Presence of night-time lighting. • **Intersection crossings**: Count of the number of legs of each intersection with traffic control (i.e., either signalization or traffic calming). • **Intersection pedestrian refuges**: Count of the number of legs of each intersection where people can wait before crossing the second half of the street. • **Intersection curb ramps for grade changes**: Presence of curb ramps with a slope of 1:12 or pedestrian crossings raised to the level of adjacent footpaths—needed to make the intersection accessible.

Building design	• **Visually active frontages**: Transparent frontages comprising windows and doors. • **Permeability**: Building entrances directly along the street per meter of block frontage.
Land use	• **Mixed-use development**: A mixture of land uses, including residential, active, parking/industrial.
Network design	• **Block length**: The length of a block face.

Survey tool. The tool relies on two data collection methods: an on-site walking survey and desk-based GIS analysis. In the walking survey, data is collected through observation of the existing environment. This is done through Device Magic, a smartphone app that records the data as well as GPS location and time that data is collected. Most data points described above are collected in this manner, except for street right-of-way and block length, which can be ascertained from satellite imagery sources such as Google Earth and mapping tools such as Open Street Maps. The elements were formulated so as to make the survey as objective as possible, facilitating consistent documentation of pedestrian environment features across multiple surveyors. The variables are simple to observe and record—enabling cities to enlist survey teams with minimal formal training. The data from the app are automatically stored in a cloud-based spreadsheet format for fast and easy analysis.

The app has been designed to collect data quickly by aggregating response options to ranges. For example, the extent of active frontage along the block is described in 10 percent intervals. Some items have more aggregate ranges. For example, the sidewalk coverage is collected in four bins: 0-10 percent coverage, 10-40 percent coverage, 40-70 percent coverage, and 70-100 percent coverage. Some of the more qualitative elements, such as lighting and sidewalk condition, are described using a series of multiple-choice options (good, moderate, poor, N/A), allowing fast data collection. Other items require counting and inputting numbers. These include the number of mid-block crossings, the number of building entrances, and the number of locations a sidewalk is obstructed.

The data in the app are collected in two stages—a mid-block survey and an intersection survey—in order to avoid confusion between data that relates to an entire block and data relevant only to intersections. The mid-block survey collected data between intersections, including items such as the presence of sidewalks and the number of building entrances. The intersection survey collects data relevant to intersections, including the presence of crosswalks, intersection traffic control, and curb ramps.

To supplement the walking survey, many data pieces are collected remotely via various mapping tools. Total street right-of-way and carriageway width are collected by measuring aerial images from Google Earth or an equivalent mapping tool. Block lengths are determined using Open Street Map data, which contains street centerline files for the streets in each area surveyed. The street centerlines are imported into a Geographic Information System (GIS) program where they are broken into blocks. Using GIS, the user can measure the length of each block. From these data, the investigator can calculate factors such as the number of building entrances per meter of block face.

Analysis and scoring. To facilitate rapid interpretation of the final results, the tool develops final "scores" for the four categories that determine a walkable environment: street design, building design, land use, and street network. For this methodology, each element of walking is normalized based on a maximum score of five. The four categories of walkability were measured separately. Each metric within each category was weighted for its effect on walkability within that category (see Table 7). Several elements are combined to form aggregate measures. One example is for obstructions, where vendors, parking, and other items all block the sidewalk, and the effect is cumulative. In addition, the

degree of mixed-use element was calculated on an area-wide basis using three factors: the percentage of residential uses, the percentage of other active uses, and the percentage of negative uses. These scores were combined to form the overall mixed-use score. From this analysis, each item contributes to an overall score for each category that influences walkability. These can then be plotted on a map on a block-by-block basis for each study area.

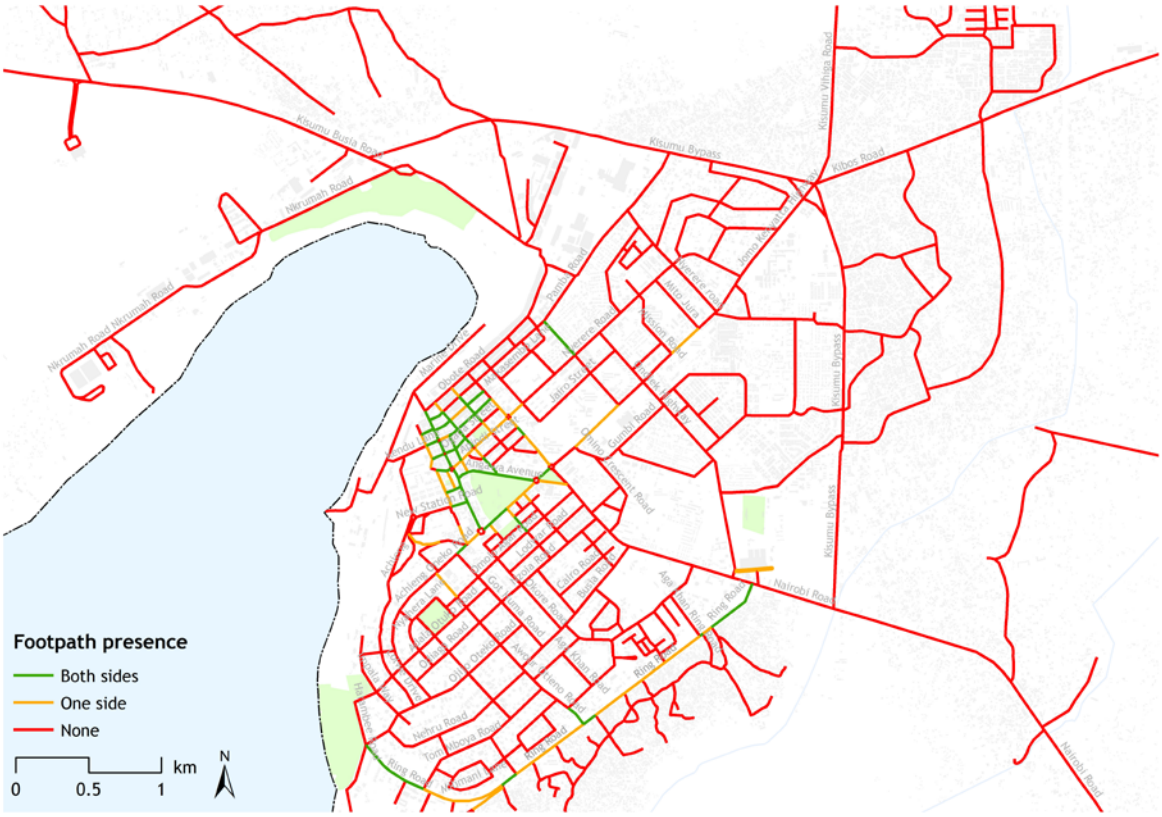
Table 7: Weighting for scoring elements.

Category	Element	Weight (%)
Land use	% residential uses	33*
	% active uses	33*
	% parking/industrial uses	33*
Street network	Block length	100
Building design	Active street and frontage	50
	Physically permeable frontage	50
Street design	Obstructions (including vendors, parking, and built obstructions)	20
	Sidewalk presence	35
	Sidewalk condition	15
	Lighting	10
	Shade	10
	Mid-block crossings per 100 m	5
	Mid-block pedestrian refuges	5

*** For land use, the scores for residential uses and active uses are averaged together. The % negative uses score is a deduction that is subtracted from the average score.**

Implementation strategy. The methodology has been designed with future use in mind. The data collection can be performed on any smartphone with GPS capabilities and does not require an Internet connection. The price of smartphones has dropped dramatically in recent years, making this an affordable means of data collection. Smartphone technology has also improved, reducing the risk of theft as the phone can be remotely turned off. The assessment tool can be deployed across any survey platform using the JavaScript Object Notation (JSON) survey coding language. The tool can be deployed on a citywide scale, allowing cities to provide a snapshot of pedestrian access across an urban area (see Figure 20).

Figure 20: The pedestrian assessment tool can be used to visualize provision of footpaths across an entire urban area, as shown here for Kisumu (Kenya).



6. Pilot projects: Developing good practice for better walking environments in five African cities

In order to address the critical challenges to developing a high-quality pedestrian environment in the African context, the World Bank's Pedestrian Mobility for Urban Growth project developed strategic plans for pedestrian improvements in five cities: Abidjan, Cote d'Ivoire; Kampala, Uganda; Dar es Salaam, Tanzania; Gaborone, Botswana; and Yaoundé, Cameroon. The project began with a field exercise to identify major issues faced by pedestrians in each city. The project also reviewed the institutional, policy, and financing landscape in each city to determine how these factors affect the ability of the respective government authorities to provide high-quality pedestrian facilities. Finally, the project organized stakeholder engagements in each city to develop time-bound action plans for pedestrian improvements. This section outlines the common themes that emerged from the study.

Assessment findings

Data were collected to provide a picture of the key issues affecting the walking environment in each city. For each city, nine study areas were surveyed using a new walking assessment tool (see Section 5 for a description of the methodology). The sample areas are chosen to represent different types of built environments found within each city, including inner informal settlements, outer informal settlements, sub-center residential, sub-center commercial, upscale residential, upscale commercial, central business district commercial, and government areas. In each sample area, 2 to 3 km of streets were surveyed with the goal of surveying all blocks and intersections in that area. The sample surveys provide snapshots of walkability for the various land use typologies found in each city, helping to illustrate critical walkability issues in the city as a whole. Common results from the five African cities are described below.

Walkable city centers, but limited infrastructure in the periphery. A common finding across the city centers is that historic cores have good pedestrian infrastructure and building design (see Image 45). These spaces were built with the needs of the pedestrian in mind as private cars were not available. Best practices in the five cities were found in these areas. These places are challenged by the needs of motor vehicles, however. Often, mismanaged parking has compromised the usability of city center sidewalks. Vehicles are parked within pedestrian spaces, damaging the quality of facilities and turning public space into storage for private vehicles. A lack of maintenance also endangers pedestrian spaces in these areas. Past investments in pedestrian infrastructure are left to degrade and urban spaces are poorer because of it. There is a lack of sidewalks in sub-centers, especially market areas and transport hubs with large pedestrian volumes. An inequality exists in the provision of spaces for those in city centers and those that live on the outskirts. This reduces the quality of life of those that live and work away from the central business district and its neighboring residential centers.

Image 45: A comparison of pedestrian facilities in inner and outer areas.

Inner areas often have sidewalks, although with encroachments (top). In outer areas, like Kinawataka, Kampala (bottom), sidewalks are seldom present beyond main roads. (Street design key: 5 = high-quality pedestrian facilities; 0 = low-quality pedestrian facilities).

Lack of shade. The lack of shade is a major obstacle to pedestrian comfort and a factor that drives many residents to switch to motorized modes of transport. During daytime hours, pedestrians avoid using pedestrian spaces if they are exposed to the sun and fear returning to their office sweaty.

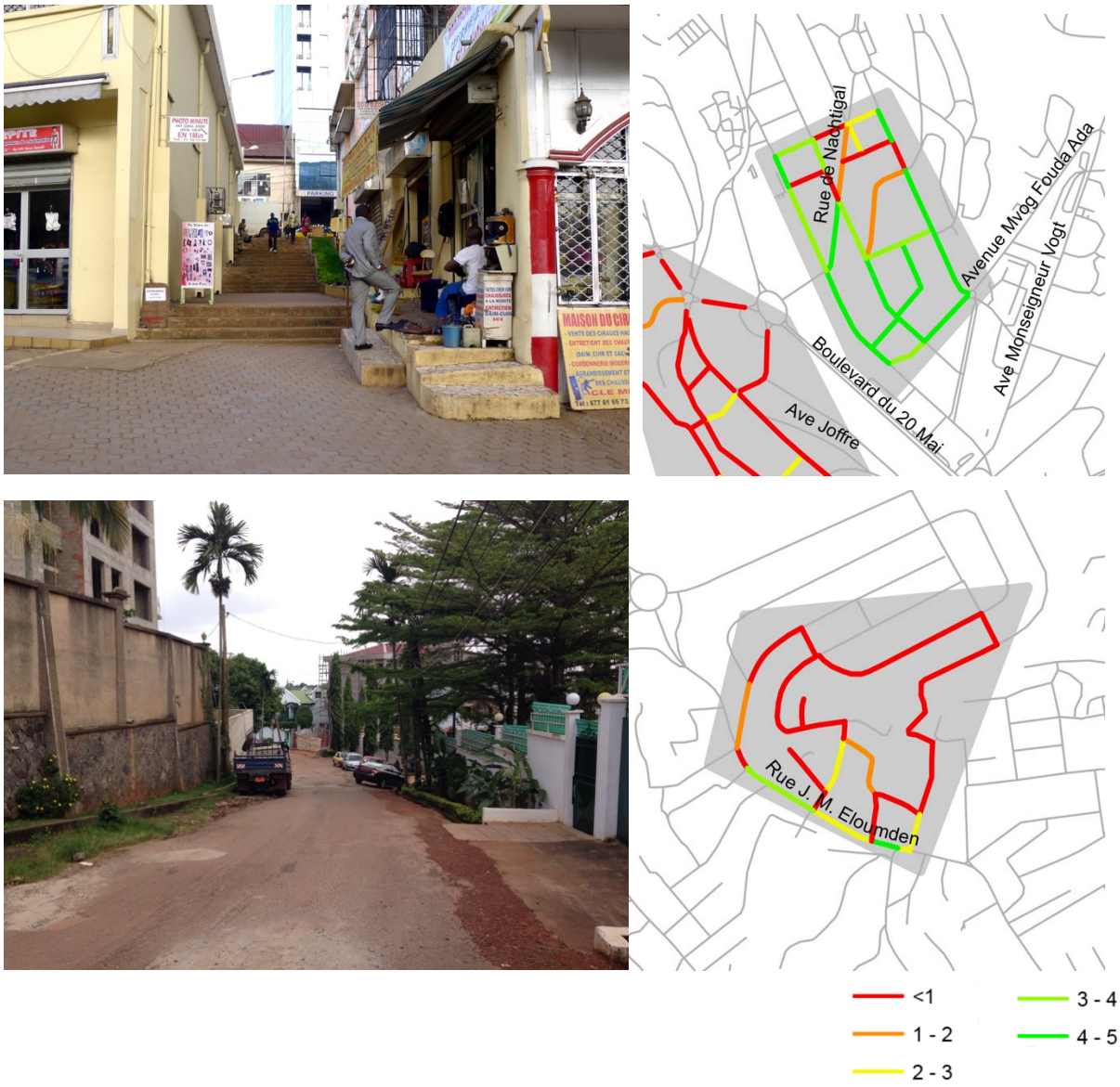
In Gaborone, a lack of shade along sidewalks discourages walking during daytime hours (see Image 46). Given the hot climate, shade is critical to pedestrian comfort. At present, shade is lacking in many parts of the city. This situation is particularly bad in the Government Enclave section. A lack of tree cover makes for an uncomfortable experience for pedestrians. Planting more trees in order to create more shade should be a priority. Better shade will make for a more pleasant walking experience and beautify the urban core. Further, increased tree cover will help alleviate the heat island effect that causes cities to experience higher temperatures than their surrounding suburbs.

Image 46: Non-existent tree cover drives pedestrians to shift to motorized transport.

Gaborone's streets lack sufficient shade cover for pedestrians, whether in the Government Enclave (top) or in newer residential areas like Mogoditshane (bottom).

Built forms that discourage walking. A growing trend toward compound walls and larger block sizes can be seen in suburban areas in all of the five African cities. Security gates and large setbacks prevent active frontages as well as more eyes on the street, decreasing pedestrians' safety (see Image 47).

Image 47: Active frontages versus walled-in compounds.



Active building edges are found in central Yaoundé and older residential districts. In rapidly growing areas like Bastos, developments are typically surrounded by compound walls. (Building design key 5 = active facades; 0 = blank facades).

Constraints to a better pedestrian environment

Stakeholder workshops were organized in the five cities to identify challenges and develop road maps to improve walking conditions. These workshops brought together a diverse group of stakeholders, including national transport ministries, municipal government(s), utility providers (e.g., electricity and communications), public transport operators, traffic police, development partners, donor agencies, academia, and representatives from civil society (e.g., road safety NGOs, persons with disabilities, elderly) to discuss pedestrian mobility and develop action plans. The workshops included an introduction to the elements of an efficient walking environment and a presentation of initial data findings from field surveys. During a site visit, participants observed streets and took note of existing challenges faced by pedestrians (see Image 48).

Image 48: Stakeholder workshops in action.

Workshop participants observe the pedestrian environment in Dar es Salaam (left) and Yaoundé (right).

Several common themes emerged from the discussions across the five cities (see Image 49):

- **Lack of inter-agency cooperation.** Participants felt that there are few formal mechanisms for ensuring cooperation among different agencies.
- **Limited street management capacity.** There is also little coordination between agencies that build streets and those that manage them. Mechanisms for managing on-street parking and street vending are inadequate, leading to encroachments on pedestrian space.
- **Limitations on data.** No systematic data are collected on pedestrian movement or infrastructure, let alone exploited to contribute to the provision of usable sidewalks. As a result, city officials are not able to bring evidence to bear when planning pedestrian infrastructure.
- **Funding limitations.** Little dedicated funding is available for projects aimed at improving the pedestrian environment. Project managers are typically encouraged to build the maximum length of roads for a given budget, resulting in the elimination of pedestrian elements, which are considered less critical than motor vehicle carriageways.
- **Connection between public and private space.** There is little awareness of the important relationship between building design and the pedestrian environment. In all of five cities, current standards for the planning, design, and delivery of pedestrian facilities and amenities by private builders have been too lax, poorly implemented, and have not led to the implementation of a high-quality walking environment.
- **Role of street network.** Many existing areas have large parcels with little connectivity for pedestrians. This creates a disjointed street network that is not conducive to walking. Where street network plans exist, implementation is impeded by political interference. Favored developers and individuals may be allowed to build things that go against the master plan, making the creation of a cohesive street network more challenging.

Image 49: An action plan in the making.

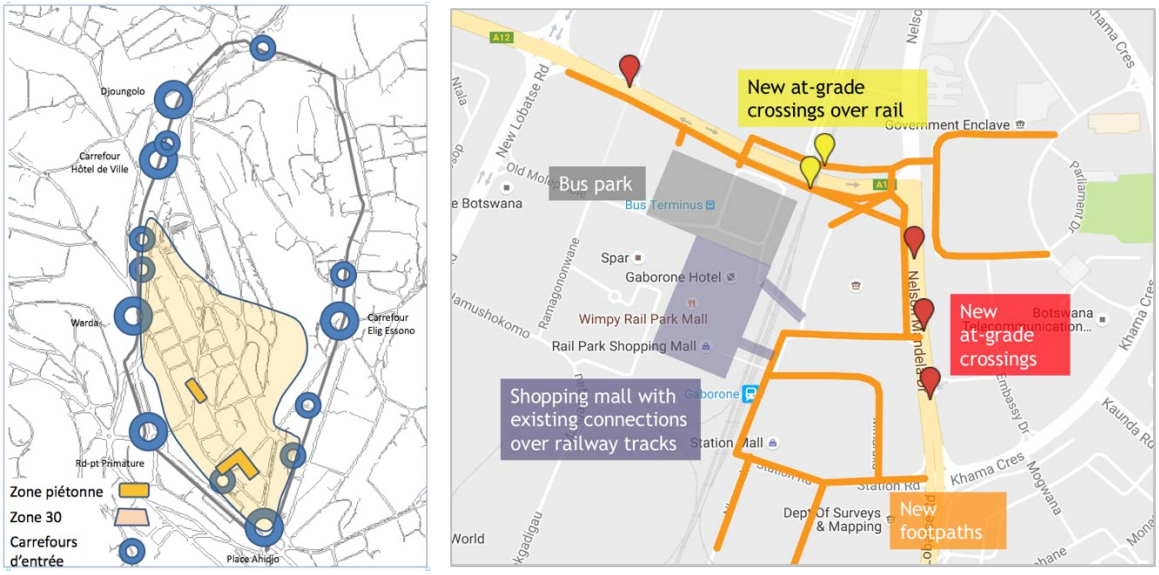
Participants in Gaborone (left) and Abidjan (right) deliberate on action plans to improve conditions for pedestrians.

Key actions to improve the pedestrian environment

During the stakeholder interactions, participants identified activities to help achieve a better pedestrian environment. Participants covered several critical dimensions for improving pedestrian environments as described in the preceding sections, including pedestrian needs and constraints; institutional and policy coordination; and project finance. Based on the workshop outcomes, action plans were prepared indicating key actions along with timelines, responsible agencies, and tentative implementation budgets. Government agencies are now working with the World Bank to implement projects identified in the action plans. Common recommendations that emerged from the workshops and action plans include:

- **Implementation of demonstration pedestrian projects.** The cities can implement highly visible, quick, and cheap projects in areas of high pedestrian demand in order to build political support for more extensive improvements. For instance, lighting improvements and pedestrian crossings along Gaborone's Main Mall could be implemented as pilot projects (see Figure 21).

Figure 21: Proposed demonstration projects.



Proposed demonstration projects in the pilot cities include a 30 km/h zone in central Yaoundé (left) and pedestrian improvements in the Gaborone CBD (right).

- **Design review for ongoing infrastructure projects.** In most of the cities, there is an opportunity for quick wins by ensuring that infrastructure projects already underway include good pedestrian design. The Botswana Integrated Transport Project's corridor designs could be improved by incorporating high-quality pedestrian infrastructure, as was done along Dar es Salaam's BRT corridors.
- **Adoption of design standards and comprehensive audit systems.** To help address the shortcomings of the existing highway-oriented design manuals, the cities need to adopt urban street design guidelines along with processes for design review audits to ensure that projects comply with the new guidelines. The cities can begin conducting regular pedestrian environment assessments using the evaluation criteria developed in the street design standards to evaluate infrastructure on different corridors.
- **Street management to prevent encroachments on sidewalks**. Even after good pedestrian facilities are built, poor management of on-street parking and vending compromise the usability of these spaces. These challenges need to be addressed through a combination of physical measures such as bollards to keep cars off of sidewalks and designated spaces for street vending (see Image 50). Parked cars blocking pedestrian footpaths are an obstacle to walking along Gaborone's Main Mall and in Yaoundé's Centre Ville district. On-street parking management can be strengthened through a service contract with a management agency that collects fees and carries out enforcement activities. Vending spaces in the cities should be clearly delineated, and monitoring agencies can issue licenses to street vendors, set standards for vending stands, and monitor the upkeep of vending areas. By formalizing the relationship between the government and vendors, this management system would reduce the pressure on vendors to enter informal relationships with police and other government officials to maintain their ability to operate.

Image 50: Dealing with parking encroachments in pedestrian spaces.

Workshop participants identified physical protection (left) as well as improved enforcement (right) as critical for preventing parking encroachments on pedestrian spaces.

- **Introduction of new funding mechanisms.** None of the five cities had dedicated funding sources for pedestrian infrastructure. New sources of funding for pedestrian improvements could include service contracts with outdoor advertising revenue and on-street parking fees. However, local government authorities would need to upgrade their parking fee collection and enforcement systems to incorporate an IT backbone. Such a system would enable real-time system monitoring and could help to reduce revenue leakage. To further improve local revenue generation, participants recommended that local government authorities improve property tax collection within their jurisdictions.
- **Reform of building control regulations.** More pedestrian-friendly building design with active storefronts can be found in some areas like Kampala's CBD, Abidjan's Adjamé district, and Gaborone's Broadhurst Mall, but the design in many other areas is not conducive to a vibrant pedestrian environment. Building control regulations in the cities need to be reformed to encourage active façades in place of compound walls and establish mechanisms for breaking up large blocks during the redevelopment process (see Image 51).

Image 51: Positive impact of planning regulations.

Planning regulations can encourage the development of active, transparent façades similar to those found in Kampala (left) and central Gaborone (right).

- **Preparation and implementation of pedestrian network plans.** At the city level, governments need to identify street networks that ensure connectivity and walkability as areas develop. The plans need to pay particular attention to the existing long blocks in developed areas. In the case of Gaborone, mid-block pedestrian connections are recommended in the CBD Master Plan, but these need to be implemented.
- **Creation of inter-agency working groups for pedestrian mobility.** These working groups can share data, conduct design review, and coordinate project implementation.
- **Capacity building for implementing agency staff.** Engineers and other city officials involved in the street design projects need basic training in street design principles and standards. Universities need to reform curricula to provide better training to the next generation of street designers.

Pedestrian mobility action plan for Abidjan

The final sessions of the workshop involved a facilitated discussion to generate a set of pilot actions that could help achieve early progress toward a better pedestrian environment. As an example, the priority actions for Abidjan are shown in the table below.

Time period	Strategy	Initiative
Short term	Demonstration projects	Pedestrian improvements in Adjamé, an important market area and hub for intercity transport and local paratransit services
		Pedestrian improvements near schools and hospitals
		Installation of street furniture
	Parking management	Enforcement to prevent sidewalk parking in the city center
		Introduction of a paid parking system in the city center
	Sustainable financing	Allocation of a portion of the transport budget to pedestrian mobility
	Capacity building	Creation of a coordination committee for pedestrian mobility projects
	Audit system	Review the designs of proposed road projects to ensure that pedestrian amenities are incorporated
Medium term	Demonstration projects	Improvement of road markings and signage
		Pedestrian improvements in marginal communities
		Lighting and shade project
		Street vending management program
	Parking management	Expansion of the parking management system to other city areas
	Capacity building	Capacity building on street design for implementing agency staff
	Audit system	Revision of street design guidelines
		Introduction of a standard process for assessing the pedestrian environment
		Promotion of car-free days

	Promotion of a sustainable mobility culture	Public information campaign to inform developers and architects about building control regulations and the importance of pedestrian-friendly design
Long term	Parking management	Review of off-street parking regulations to eliminate off-street parking requirements and create incentives to minimize disruptions to the pedestrian environment
	Building design and street network	Implementation of an urban design review process to ensure that building projects incorporate good pedestrian design features
		Removal of unauthorized walls to reclaim public streets that were previously gated
	Education	Reform of university curricula to include training on street design best practices

7. Annex

Resources on pedestrian mobility

General resources

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Pedestrian mobility assessments in infrastructure projects

To achieve successful outcomes for pedestrians in street design projects, the needs of pedestrians must be considered at several stages in the design process. Governments and donor agencies have a special role to play in ensuring that the design of walking facilities becomes a core element of the design process rather than an afterthought. The following key steps should be incorporated in the design and implementation process:

- **Project appraisal:** Ensure that the overall project is consistent with sustainable transport principles (e.g., encouraging a shift toward walking, cycling, and public transport; increasing the ease of pedestrian movement; etc.).
- **Hiring of design consultants:** A robust terms of reference (TOR) for design consultants can ensure that the consultants carry out all of the required activities to prepare designs that have a positive impact on the pedestrian environment. A model TOR is provided in the next section.
- **Review of detailed designs:** Ensure that detailed designs incorporate key features of an accessible, comfortable pedestrian environment. A design review checklist is provided below.
- **Oversight during implementation:** In many projects, pedestrian elements are often the first component to be eliminated in the case of cost overruns. Oversight is necessary to ensure that projects are implemented as designed.
- **Impact evaluation after implementation:** Conduct impact evaluations after implementation, tracking variables such as pedestrian volumes, the fraction of pedestrians using sidewalks, and pedestrian fatalities. The impact evaluation can be carried out using the metrics described earlier in this report.

Sample scope of work for street design consultants

The TOR for street design services should ensure that the planning and design process give sufficient attention to the pedestrian environment. The design process must begin with the collection of complete data on the pedestrian environment, including adjacent land uses, pedestrian movements, and black spots. The TOR will also mandate that designs incorporate facilities for pedestrians and that the designs meet best practice standards.

Introduction

Well-designed streets are a critical element of a safe and efficient mobility system. At present, poor design and management of streets in [CITY] are contributing to increased congestion, pollution, road safety risks, and maintenance requirements. Going forward, [CITY] seeks to establish a network of streets that offer convenience and safety to all users. [CITY] will implement streets with high-quality walking and cycling facilities, improved access to public transport, organized parking, and streamlined junctions.

A key aim is to ensure equitable allocation of road space to walking and cycling—collectively known as NMT. NMT modes provide basic mobility and affordable transport and bring significant health and recreational benefits. Improving conditions for NMT reduces the demand for travel by motorized vehicles and associated issues such as pollution and safety. NMT also provides crucial first- and last-mile connectivity to public transport.

[CITY] plans to redevelop XX of its streets, for a total length of XX km to facilitate, support, and prioritize the role of walking and cycling, as key components of the overall transport system, resulting

in better efficiency, reduced transport costs, and lower pollution levels. The design for this XX km of road length will be divided among the empaneled urban designers/architects, such that each designs approximately XX km of road length.

This document outlines the scope of work for the consultant along with details about the hiring process. The scope of work typically includes the following:

1. Project definition, goals, and study area
2. Assemblage of existing policies and plans, mapping of existing data
3. Initial ideas and proposals workshop
4. Mapping of topography, land uses, pedestrian facilities, roadways, parking, and other characteristics
5. Surveys of pedestrian movements, parking utilization, traffic volume, street vending, and related activities
6. Analysis of crash data
7. Conceptual design, including standard details
8. Modelling and revisions
9. Construction documents
10. Bill of quantities
11. Preparation of Terms of Reference (TOR) for contractors for construction

Project definition, goals, and study area

The following streets will make up the study area:

- [STREET 1]
- [STREET 2]
- [STREET 3]
- Etc.

All streets in the study area, along with their legal ROWs, should be mapped using a GIS or CAD platform. Consultant should prepare an inception report covering the proposed data collection and survey activities (including survey forms and proposed survey locations), the design methodology, and project timeline. The Inception Report will also establish goals of the project in the local context. Suggested goals include: no net increase in vehicle miles travelled (VMT; vehicle kilometers travelled VKT) for personal motor vehicles; improved safety, particularly for non-motorized transport users; reduced emissions of local pollutants and greenhouse gases; mode shift to walking, cycling, and public transport; and improved economic vitality in the study area. The client must approve the Inception Report before the consultant proceeds to the next step.

Coordination of existing policies and plans, mapping of existing data

The consultant is required to compile spatial information on plans for bus priority/bus rapid transit (BRT) networks, cycling networks, pedestrian networks, and pedestrian zones presented in the reports given by the client. The consultant will also compile information on underground utility networks as per information available with the client and urban local bodies. These engineering parameters should be mapped using the GIS platform or other illustration software. The consultant should also identify transport system goals that are stated in these reports.

Initial ideas and proposals workshop

The consultant will organize an initial stakeholder workshop to explore challenges and opportunities for the site. The workshop will include a site visit to the study area and a possible live demonstration of street design options using traffic cones.

Mapping of topography, land uses, pedestrian facilities, roadways, parking, and other characteristics

Topographic survey. The consultant shall conduct total-station survey to prepare base plans for critical sections and junctions to facilitate improvements. The survey must cover all streets in the study area plus any intersecting streets up to a distance of 50 m from the intersection. The TOR for hiring topographic surveyors will be provided by the client. It includes the specific elements that must be surveyed.

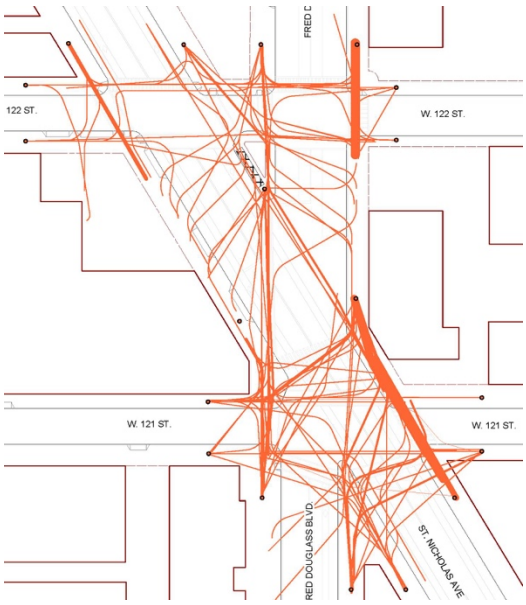
Land-use survey. The consultant will compile land-use information to help inform street design decisions. A land-use survey must be carried out for every building adjoining study area streets. In cases where the ground floor use is different from that of rest of the floors, the surveyors should make a note. The number of floors per structure also must be noted. Important activity generators in or immediately adjacent to the study area, such as shopping areas, theatres, and housing developments, should be identified. All land-use data should be recorded using the GIS or CAD platform.

Pedestrian facility survey. The consultant will document the quality of existing pedestrian facilities on all streets in the study area, noting properties such as the clear width of the sidewalk on each side every 200 m (if present), the number of obstructions per km in the clear width, and the presence of shade at 2 p.m. (from buildings or trees). These data should be stored and mapped using the GIS or another software platform. If cycle tracks are present in the study area, a similar survey should be carried out wherever they are present.

Surveys of pedestrian movements, parking utilization, traffic volume, street vending and related activities

Pedestrian movement survey. Surveys shall be carried out to assess NMT user flows at important locations in the study area. The survey shall be from 06:00 to 22:00 on a normal working day. The consultant will record the number of pedestrians and cyclists moving along the road on important corridors. The consultant will also conduct a tracking survey of pedestrian crossing movements at important intersections along each corridor in the study area (see Figure 22). The actual pedestrian movement lines should be mapped as in the example shown in Figure 1. Before conducting the surveys, the consultant must seek approval of the survey locations from the client.

Figure 22: Example of a tracking survey diagram. The orange lines represent pedestrian movements. Thicker lines indicate higher pedestrian volumes.



Parking survey. A parking survey must be carried out on all corridors in the study area to identify parking patterns and occupancy rates. Parking demand should be established by a manual count, classified by vehicle type. The count should cover the study area streets plus streets within a buffer of 300 m-500 m to either side of the study area streets. The survey shall be conducted for one hour during morning peak and one hour in the evening peak period in such areas. The survey should cover both on-street parking areas as well as off-street public or semi-public parking. Finally, parking fee levels should be noted. If the street falls under the city's parking management system, the consultant is required to consult the client to coordinate the design of parking slots with the parking management plan. All parking data should be recorded using the GIS platform or other illustration software.

Survey of street vending and related activities. The surveyor must make note of all the vendors in the study area. The survey should note the type of vending and the physical typology of the vending structure (i.e. permanent or temporary structure). The survey should also note whether the vendor is an obstruction to pedestrian and cycle movement. The location and characteristics of each vendor should be recorded using GIS or other illustration software. The survey should also capture social gathering spaces and other activities found in the public ROW in the study area. The location and number of people engaged in the activities should be noted using GIS or other software. This information will inform the placement of street furniture and other elements in the final design.

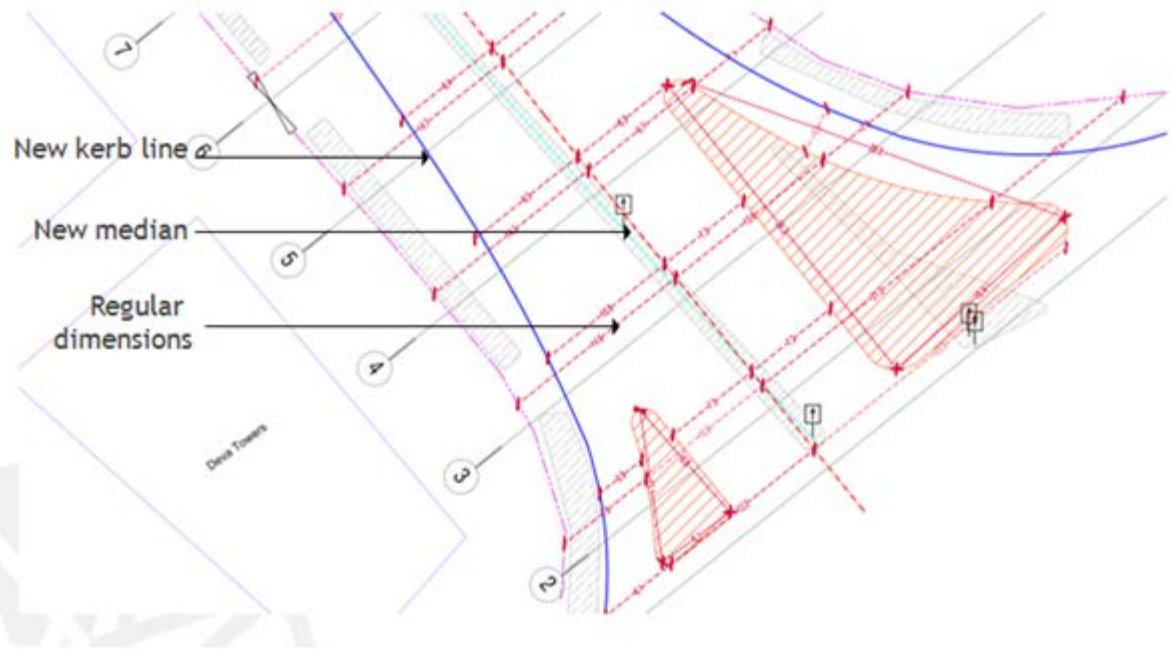
Analysis of crash data

The consultant will obtain data from the client on traffic crashes over the past three years. The crash location, type, and users involved (i.e. pedestrian, cyclist, two-wheeler, car, bus, etc.) will be mapped using a GIS platform or other software. This information will enable the consultant to identify major traffic safety "black spots" and suggest traffic calming, intersection modifications, and other interventions to improve safety for vulnerable street users.

Conceptual design, including standard details

Line drawings. The consultant shall prepare line drawings for all streets in the study area. Line drawings must clearly show the new curb line in reference to the centerline (see Figure 23). The drawing must be complete with dimensions at 2 m intervals. Line drawings should be marked on the road with chalk to ensure the survey drawing resembles on-site conditions. The consultant shall monitor the on-site markings and review the design as per site conditions.

Figure 23: Sample line drawing indicating the new curb line and road width dimensions at regular intervals.



Conceptual designs. The consultant shall prepare detailed street designs for all streets in the study area. The design must be consistent with relevant plans, including plans for public transport networks, cycling networks, pedestrian networks, and pedestrian zones.

The pedestrian paths should meet the following standards:

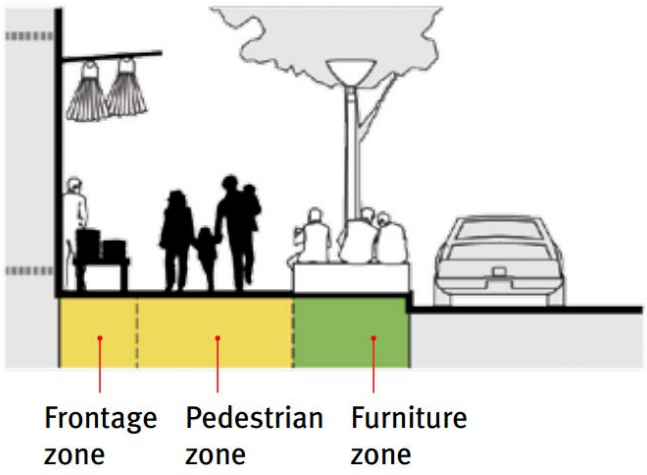
- A minimum of 2-m-wide clear pedestrian zone; wider to accommodate pedestrian volumes (see Figure Figure 24)
- Elevated above the roadway (typically 150-250 mm), or curbs/bollards where the vertical separation is less than 100 mm

- Flat walking surface without abrupt level differences
- Continuous walking path
- Integrated with landscaping plan to ensure continuous shade
- Pedestrian ramps at street crossing points

The cycle tracks should meet the following standards:

- At least 3.0 m wide for two-way movement
- Continuous cycling track
- Smooth surface without abrupt level differences; concrete or bitumen surface (paver blocks are unacceptable)
- Maximum grade of 1:12
- Integrated with landscaping plan to ensure continuous shade

Figure 24: All sidewalks must have separate zones for frontage, pedestrian movement, and furniture.



Street designs should include, but are not limited to, the following elements:

- Dedicated pedestrian sidewalks/walkways
- Dedicated cycle tracks (if the corridor falls on the cycle priority network)
- Pedestrian crossings, including formal speed table crossings as well as median breaks that serve as informal crossing locations
- Trees to provide shade for pedestrians and cyclists as well as decorative landscaping, including compensatory afforestation for the trees removed as part of the project
- Bus stops and paratransit stops
- Spaces for street vending
- Medians

- Traffic calming elements where needed to reduce vehicle speeds
- Physically demarcated on-street parking areas
- Street furniture, including benches, stools, tables, and other seating arrangements
- Signage locations
- Pedestrian refuge islands
- Carriageways, ensuring that the width remains uniform between intersections
- Street lighting
- Storm water drains
- Utility access points

Intersection designs should promote pedestrian safety through elements such as pedestrian refuge islands, reduced angles of approach, reduced turning radii, and traffic calming. The design of pedestrian crossings at intersections and in mid-block locations should ensure that pedestrians do not need to cross more than two lanes (≈ 6 m) at a time. Where extra ROW is available, the consultant should identify opportunities to improve and/or create plazas, markets, and other public spaces.

The consultant will submit a plan drawing as well as cross sections wherever the street dimensions deviate significantly from the base cross section. The plans will be submitted in hard copy and electronic format. It must include at least two 3D renderings and photomontages of the design proposal.

Modelling and revisions

The consultant will evaluate the performance of the proposed street designs. In addition, the designs will be evaluated by a review committee before preparing the final working drawings. The consultant may be asked to present the designs to the review committee.

The consultant may be required to present the plans at a public stakeholder meeting. The consultant will prepare revised conceptual designs based on the feedback received from the review committee and stakeholders. The revised conceptual design must be submitted to the client for approval.

Construction documents

Following approval by the client of the conceptual designs, the consultant will prepare detailed construction drawings for the study area. The designs should include geometric and vertical profiles and should incorporate drainage designs (see below). The designs should include the following components:

- Typical sections, as above
- Street plan
- List of existing street elements to be demolished
- Utility relocation plans (as necessary)
- Materials as per client’s specifications
- Construction details for each element

- The draft working drawings must be submitted to the client for approval

The consultant will prepare final working drawings based on the feedback received from the client. The final working drawings must be submitted to the client for approval. The consultant will submit all conceptual designs and final working drawings to the client in hard copy and electronic format.

Bill of quantities

The consultant is expected to prepare specifications, bills of quantities, cost estimates, and bid documents for the implementation of the proposed street improvements, including pavements, furniture, street lighting, landscaping, and other components. Bid documents shall be given item-wise (i.e. streets, lighting, landscaping, road markings, etc.). The consultant will work with the client to include appropriate mechanisms in the bid documents to facilitate long-term maintenance, such as annuity-based compensation of contractors.

Preparation of TOR for contractors for construction

The consultants will be required to prepare a TOR for contractors for the construction of street design. The client will coordinate with the consultants to prepare the joint TOR for contractors.

Pedestrian mobility checklist for the design review process

When new roads are being designed, an internal design review process can help ensure that the designs are sufficiently detailed and incorporate best practices pertaining to sidewalks, pedestrian crossings, intersections, carriageways, and parking. The checklist covers the design of sidewalks, pedestrian crossings, and intersections. The checklist elements are designed to cover the main factors included in the pedestrian environment assessment tools described in Section 5. The design review should be carried out by an interdisciplinary team, including architects, urban designers, transport planners, and traffic engineers.

Element	Evaluation criteria
Data collection	The topographic survey drawing includes property entrances, compound walls, building edges, trees, utility access points, and all side streets up to a length of 100 m.
	Pedestrian counts, vehicle speeds, and on-street parking surveys have been conducted, and crash hot spot data have been recorded.
Motor vehicle speed	Speed limits on urban streets no more than 30 km/h.
Sidewalk	Height 150 mm above the carriageway level.
	Minimum 2 m clear width in all locations.
	Wheelchair curb ramps have a maximum slope of 1:12.
	Bollards installed along the edge of the sidewalk to prevent driving and parking on the sidewalk.
	At least one set of bollards offers a clear width of 900 mm in order to provide space for wheelchairs to pass.
	The sidewalk surface is uniform and non-slippery, with slope of 1:50 towards the curb, to avoid water stagnation.
	Tactile warning are strips located at transition points (e.g., mid-block crossings, intersections).
Property entrances	The sidewalk remains at the same level through property entrances.
	Vehicle ramps are constructed with a slope of 1:6.
	Bollards are installed on either side of each entrance to prevent driving and parking outside entrance.
	Property access is provided at a discrete location for each plot, with a maximum entrance width of 6 m. The design should not permit continuous vehicle access along an extended length of frontage.
	Gates at the vehicle entrance open into the property instead of on the sidewalk.
Mid-block crossings	Pedestrian crossings are provided at intervals of 50-100 m.
	Crossing are raised to the level of the sidewalk with ramps for vehicles (minimum slope of 1:8) or provided at the level of the carriageway with curb ramps at each end of the crossing.
	Median refuge islands are provided at crossing points, with minimum width of 2 m.
	Crossings have a width of at least 2 m.

Intersections	Curb ramps on all corners of intersections to provide wheelchair access to the sidewalk.
	Median refuge islands with minimum width of 2 m are provided on all legs with more than two lanes to cross.
	Signalization is provided if any arm has more than two lanes to cross.
	Pedestrian crossings are located along the line of travel of pedestrians (the pedestrian desire lines).
	Inside turning radii are no more than 5 m to prevent fast turns.
Cycle tracks	The surface material is asphalt or concrete (not paver blocks). Utility access to be avoided.
	Raised at least 100 mm above the level of the carriageway and physically differentiated from the sidewalk.
	Located between carriageway and sidewalk, except at bus stops where the cycle track should be diverted behind the bus shelter.
	Clearance between bollards to be 1.3-1.7 m to allow for easy passage of cyclists, including those with trailers, but not motor vehicles. Bollard height typically 600 mm to 1 m.
Shade	Tree pits at least every 6-10 m.
	Vertical clearance of 2 m between the tree branches and sidewalk.
Street lighting	Spacing between light poles is three times the height of the pole.
	No dark spots on sidewalk or carriageway.
	Tree branches are trimmed regularly.
On-street parking	Parking is provided in parallel orientation rather than angled or perpendicular parking.
	Exclusive cycle parking is provided with locking facilities.
	Car parking bay size is no more than 5.0 m x 2.0 m. Motorcycle parking is no more than 1.0 m x 2.0 m.
Street vending	The design includes designated spaces for organized street vending to improve safety and security and prevent conflicts between pedestrians and vendors.
	Stall size does not exceed 1.5 m x 2.0 m.
	Vending is encouraged on the parking bays for a fee.

Glossary

Accessibility: Facilities offered to people to reach social and economic opportunities, measured in terms of the time, money, discomfort, and risk that is associated with reaching such opportunities.

Average trip length: The average distance covered by a transport mode for a trip. It is measured in kilometers.

Black spot: A location in a street network that experiences a high concentration of traffic crashes causing injuries and/or fatalities.

Block: An area of enclosed land surrounded by publicly accessible *walkways* (regardless of vehicular access).

Bus rapid transit (BRT): High-quality bus-based mass rapid transit system that delivers fast, comfortable, reliable, and cost-effective urban mobility through the provision of segregated right-of-way infrastructure, rapid and frequent operations, and excellence in marketing and customer service.

Complete streets: Streets that are designed for all uses as per actual local demand, including all modes of mobility as well as street vending, trees, street furniture etc.

Crosswalk: A marked and protected crossing point designated for pedestrians (and cyclists) across a road with vehicular speeds above 15 km/h. Crosswalks are basic elements of complete streets. Crosswalks should be designed for safe and easy crossing and implemented to maintain pedestrian connectivity across slow and fast vehicular roads.

Cycle sharing system: A flexible form of personal public transport with cycles stored in a closely spaced network of stations. A registered user can check out a cycle from a station and return it to any other station. Typically, usage is free for short-duration use.

Driveway: A motor vehicle access point across public pedestrian areas or between a roadway and street motor vehicle parking, loading, and service areas. Driveways should be designed for pedestrian priority and safety, and compatible vehicle speed.

Frontage, active: Building or block frontage that provides direct visual connection to interior building space through windows, doorways or other similar open or transparent façade elements.

Frontage, permeable: Building frontage that incorporates points of passage between walkways and active, interior building spaces; typically takes the form of main building entrances and entrances to retail establishments and other ground-floor-level goods and services. A block that is a public park or plaza, with no buildings or other physical barriers, is considered to have permeable frontage.

Greenway: A waterway or strip of land set aside for recreational use of environmental protection and where vegetation is encouraged along with exclusive facilities for cycling and walking.

Mass rapid transit (MRT): A high-quality public transport system characterized by high capacity, comfort, overall attractiveness, use of technology in passenger information system, and ensuring reliability using dedicated right of way for transit vehicles (i.e. rail tracks or bus lanes).

Mode share: The share of total trips carried out by different modes of urban transport, including walking, cycling, bus, rail, share auto rickshaws, private auto, two wheelers, and cars.

Mixed-use development: Development that combines complementary uses and activities within a local area (e.g., a mix of residences, workplaces, and local retail commerce). With a mix of uses, many daily trips can remain short and walkable.

Non-motorized transport (NMT): Walking, cycling, cycle rickshaw, pushcarts, and other forms of mobility that are powered by humans.

On-street parking: The space occupied by vehicles to park along the edge of the street or carriageway, which otherwise could have been used by motorized or non-motorized traffic.

Off-street parking: The term refers to the dedicated spaces provided for parked vehicles outside the right-of-way. It includes parking lots, multi-level car parking, and other off-street facilities.

Paratransit: The term refers to informal public transport, including vehicles like auto rickshaws, vans, jeeps, cabs, minibuses, and buses that operate on a shared or per seat basis on informally organized routes. The service may or may not have a "fare structure." The term "intermediate public transport (IPT)" means the same but is avoided in this document for consistency.

Parking management: A mechanism to ensure the efficient use of street space, and over time, parking fees can be implemented to manage demand.

Parking occupancy: The average percent of parking spaces occupied by different vehicle types on one or more block faces along the curb of the street, during a specified duration.

Prioritized connectivity: The practice of providing a high ratio of pedestrian intersections to motor vehicle intersections.

Sidewalk: A portion of a street, specially designated to accommodate pedestrians, that is physically separated from and raised above the space allocated for motor vehicles circulation.

Sustainable transport mode: The following modes are categorized as "sustainable modes" of urban transport because when compared with personal motor vehicles, they consume the least amount of road space and fuel per person-km and also cost much less to build the infrastructure: walking, cycling, and public transport (including a regular bus service as well as a MRT systems).

Taxi: A vehicle that can be hired with a driver for exclusive personal use for point-to-point commute as per the commuter's wish and charges the commuter based on the distance covered and time of day. A taxi vehicle may be a car, an auto rickshaw, a cycle rickshaw, or even a two-wheeler and may or may not have a meter.

Transit-oriented development (TOD): Mixed-use urban development that strategically houses people and jobs within walking distance of high-capacity public transport nodes. The land-use characteristics of TOD facilitate the use of public transport, walking, and cycling.

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