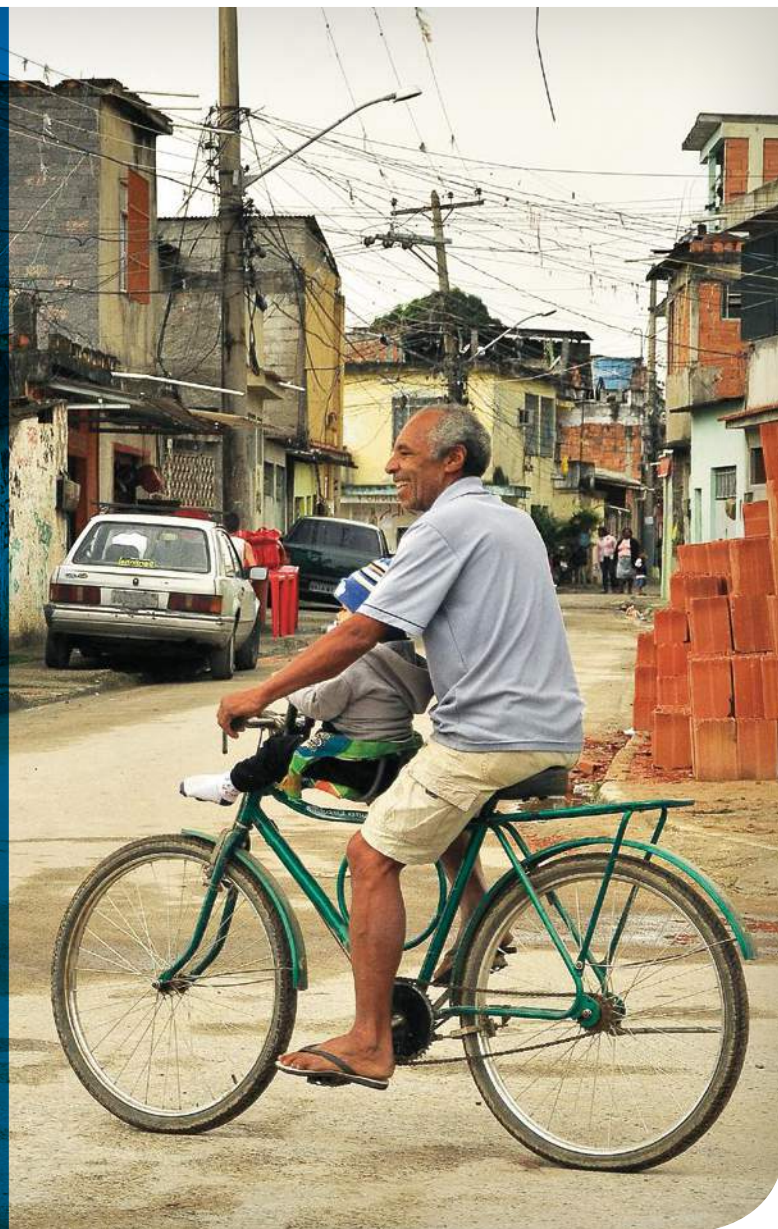


PROJECTS AND PROGRAMS MANUAL TO ENCOURAGE CYCLING IN COMMUNITIES





PROJECTS AND PROGRAMS
MANUAL TO ENCOURAGE
CYCLING IN COMMUNITIES
2014 – 2nd Edition

RIO DE JANEIRO

CITY HALL

Municipal

Housing Department

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Bicycles can provide a low-cost, health-positive, low-carbon, and flexible transport option for all. This manual provides a practical approach and guidelines on how to provide an entire bicycle infrastructure for those in informal communities who often lack good transport options.

EMBARQ Brasil's manual was written for a Brazilian context, but we believe that it is worth presenting an English translation to share the recommendations this manual offers for low-income, informal settlements in many contexts as well as the case of Rio. Low-income housing in Rio is often presented as vulnerable yet picturesque structures precariously located on dramatic hillsides, however, the reality is more diverse, with multiple morphologies, topographies, and challenges.

This manual presents practical yet tested techniques for insertion of bicycle systems and infrastructure in different settings. It is clear that those interested in applying these guidelines in their own communities will need to contextualize them for the local conditions for maximum impact.

We hope that this manual will help improve transportation via bicycles thereby making connections with opportunities more accessible for all.

Robin King and Paula Manoela S. da Rocha
2015 English Edition based on 2nd
edition Portuguese version



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CHAPTER 1

INTRODUCTION



BACKGROUND

Around 3.2 million families live in informal settlements in Brazil and at least 10 million face inadequacies in public infrastructure. In 1994, the Mayor's office of Rio de Janeiro launched the Favela Bairro ('from Slum to Neighborhood') program which, by building on the Projeto Mutirão launched in the 80's, implemented policies to address urbanization, regularization, sanitation, mobility and social-environmental concerns. Building on previous projects to include the communities in the formal city, the Morar Carioca program (Municipal Plan for the Integration of Informal Settlements) was launched in 2009, in which the majority of the city's communities were considered appropriate for upgrading because of their characteristics of consolidated settlements, according to criteria established under the Urban Land Regularization Act.

The implementation, relocation and restoration of housing units naturally led to a need to extend and improve infrastructure to travel through Rio de Janeiro's communities. With their narrow and winding roads, these areas would not support the introduction of a transportation system in the style of the wider city, since this would entail rebuilding them almost entirely from scratch and would mean ignoring the physical and social complexity of a vibrant urban fabric. The challenge is to come up with urban transportation and design solutions that overcome unfavorable conditions, such as hilly terrain and built environment in order to provide better mobility and accessibility to people who live in these communities.

The seemingly unplanned land use also adds to the challenges and opportunities for stimulating mobility by non-motorized means. Even though the conditions in terms of steep inclines and built environment are unfavorable, 57% of journeys made inside the communities are made by bike and on foot. This statistic is from the study conducted by EMBARQ Brasil and UFRJ-COPPE with the support of the Lincoln Institute for Land Policy, which aimed to fill the data gap regarding mobility of the communities' residents. The study also revealed that 33% of the communities' residents own a bicycle, making it the most popular vehicle purchase. Despite this statistic, people still feel unsafe using non-motorized transportation – 64% of cyclists and 53% of pedestrians are afraid of being involved in accidents with motorized vehicles inside the community.

Furthermore, the study reveals that 77% of cyclists and 72% of pedestrians do not feel safe enough to cycle or walk on the streets of Rio de Janeiro, implying that the residents consider the streets within their communities to be safer. The residents' mobility habits show that local identity, with the compact and self-produced aesthetic of the communities, should be maintained because people appreciate the way of life in these neighborhoods and want to go on living in them. Interventions within the communities should be extended to the interfaces between them and the city at large to create conditions to connect the two realities.

ADDITIONAL REFERENCES AND GUIDELINES

Monteiro, E. (2011) Cidade Nua. Versus Digital Magazine. No. 2.

Brasil (2009) Federal Law No. 11.977, dated July 7, 2009.

Study conducted by EMBARQ Brasil and UFRJ-COPPE:
Koch, J. L.; Lindau, L. A.; Nassi, C. D. (2013) Transportation in Favelas of Rio de Janeiro. Working Paper, Lincoln Institute for Land Policy. Available at: http://www.lincolninst.edu/pubs/2231_Transportation-in-the-Favelas-of-Rio-de-Janeiro

Lindau, L. A.; Vargas, J. C. B.; Santos, P. M.; Arioli, M.; Werberich, B.; Caleffi, F. (2011) Desafios para o Transporte Sustentável em Assentamentos Urbanos Informais Precários (Challenges for Sustainable Transportation in Perilous Informal Urban Settlements). In: XXV ANPET - Congresso de Pesquisa e Ensino em Transportes (Transportation Research and Learning Conference), 2011, Belo Horizonte/MG. Panorama Nacional da Pesquisa em Transportes (Brazilian Transportation Research Overview) 2011.







THE MANUAL

The bicycle is an accessible, healthy and fun means of transportation that can provide communities' residents with access to school, work, leisure and integration with other forms of transportation. Due to the organic urban form and human scale building, some communities favor use of the bicycle. The destinations are close by, the roads follow the natural contours of the steep hillsides and there are few cars and other motorized vehicles. These conditions favor sustainable transportation, be it on foot, by bicycle or public transportation.

This manual is a tool developed to increase the use of bicycles in Rio de Janeiro's communities. The goal is to inspire architects and urban planners to design solutions and provide a fundamental tool for the regulatory bodies responsible for managing the infrastructure and social programs within the communities. Participation of the local residents during the re-urbanization procedure is key to acceptance and development of any project, including projects aimed at encouraging cycling.

The **Projects and Programs Manual to Encourage Cycling in Communities** is financed with the support of Bloomberg Philanthropies and was produced by a team led by EMBARQ Brasil and Alta Planning + Design. This project is a supplementary effort to Rio de Janeiro's Morar Carioca initiative, which has been working to improve infrastructure in communities as part of the city's preparations to host the 2014 FIFA World Cup and the 2016 Olympic Games. This manual sets out infrastructure concepts and support programs designed to make cycling safer, more accessible and pleasurable.

Based on observations made in field studies and on the Morar Carioca projects, this manual was developed around two central elements: **programs and infrastructure**. The programs describe education, enforcement and incentive initiatives for residents to harmonize with and benefit from the new environment. Possible applications of the manual include, amongst other initiatives, bicycle repair, educational programs teaching safe cycling techniques, and funding for small businesses. On the issue of infrastructure, this manual describes the different types of bike path infrastructure and potential improvements to the environment. These infrastructure improvements include alleyways, roads, traffic calming measures, ramps and stairways, bicycle parking, tracks and trails. Since each community is unique, the proposed efforts can be adapted for use in a wide variety of neighborhoods, communities and other urban scenarios.

This material is important for the city of Rio de Janeiro and other cities in Brazil and around the world that want to create positive solutions for sustainable mobility. We hope this manual will be used and published so that it can be updated and improved in the future. The project team considers this initiative to be just one part of a wider approach to improve the quality of life in the communities which, in addition to mobility, involves other important issues such as water supply, sanitation, healthcare, electricity, public lighting, diet, safety, employment and transportation.

Please forward comments and suggestions to: cidades@wri.org

GLOSSARY OF BASIC CYCLING INFRASTRUCTURE

Bikeway: describes a path, signalized or otherwise, that represents a route that is favorable to cyclists. It is not segregated from normal traffic by means of surface markings or delimiters, although part or all of the route may be classified as a bike lane or bike path.

Bike lane: part of the roadway designated for exclusive use by cyclists, indicated by specific signage.

Bike path: a designated path intended for bike traffic that is physically separated from regular vehicular traffic.

Shared lanes: spaces used by cyclists on sidewalks or roadways shared either with pedestrians, in the first case, or with automobiles, in the second case.

Bicycle parking station: a long-term parking facility for bicycles offering a large number of spaces and controlled access. Stations may be public or private.

Bicycle parking rack: facility for parking bicycles in public spaces, they keep bikes organized and allow owners to securely lock their bikes to ensure minimum protection against theft. Intended for short or medium-term parking only, their smaller size, fewer spaces, unrestricted access and simple design means parking racks differ greatly from parking stations.

ADDITIONAL REFERENCES AND GUIDELINES

The Ministry of Cities (2007) Coleção Bicicleta Brasil. Brazilian Bicycle Mobility Program. Reference guides for developing an Urban Bicycle Mobility Plan. Department of Transportation and Urban Mobility.

The 'Mobilize Brasil' Portal: www.mobilize.org.br

Go by bike: www.vadebike.org



MOTORCYCLES AND THE COMMUNITIES

Another two-wheel vehicle, the motorcycle, has attracted many users away from public transportation in developing countries. With their low fuel and maintenance costs and easy parking, motorcycles have emerged as an attractive alternative to conquer the steep slopes and beat traffic congestion in Brazilian cities.

The growth in number and use of motorcycles in Brazil has led to a huge increase in the number of motorcycle-related accidents. The statistics are worse in regards to victims with permanent disability, with the vast majority being young people starting out on their careers, bringing economic and personal repercussions. Between 2000 and 2012, the Third-Party Liability Insurance System (DPVAT) paid out 958,000 motorbike users involved in accidents, 82% of which suffered permanent injuries.

Once pedestrians, cyclists and public transportation passengers migrate to motorcycles, it is very difficult to win them back. Building well designed infrastructure for pedestrians and cyclists is an important step towards attracting people to cleaner and safer modes of transportation, which will also help reduce the number of traffic accidents.

ADDITIONAL REFERENCES AND GUIDELINES

Vasconcellos, E. (2013) Risco no trânsito, omissão e calamidade: impactos do incentivo à motocicleta no Brasil (Traffic dangers, omission and calamity: impact of motorcycle incentive in Brazil). São Paulo, Brazil.

Vasconcellos, E. (2013) Motocicleta, ainda um grave problema de saúde pública (Motorcycle, still a serious public health issue). Opinions: Experts opinions for your knowledge and discussion. ANTP. Brazil.

TO PEDAL OR NOT TO PEDAL?

“There are three main groups that must be confronted: the “bikeless”, those concerned about parking and those worried about safety.”

2010 World Conference on Transportation Research. To pedal or not to pedal? Factors that Influence the Decision to Use Bicycles to Access Public Transportation [in Rio de Janeiro]. Lisbon, Portugal.

THE KEY TO **SUCCESS**

When designing and installing infrastructure for bicycles in the communities, it is important to observe:



SAFETY

Guarantee safe cycling for residents and visitors.



DESIGN

Use an organic design and human scale to develop roads and neighborhoods.







PROCESS

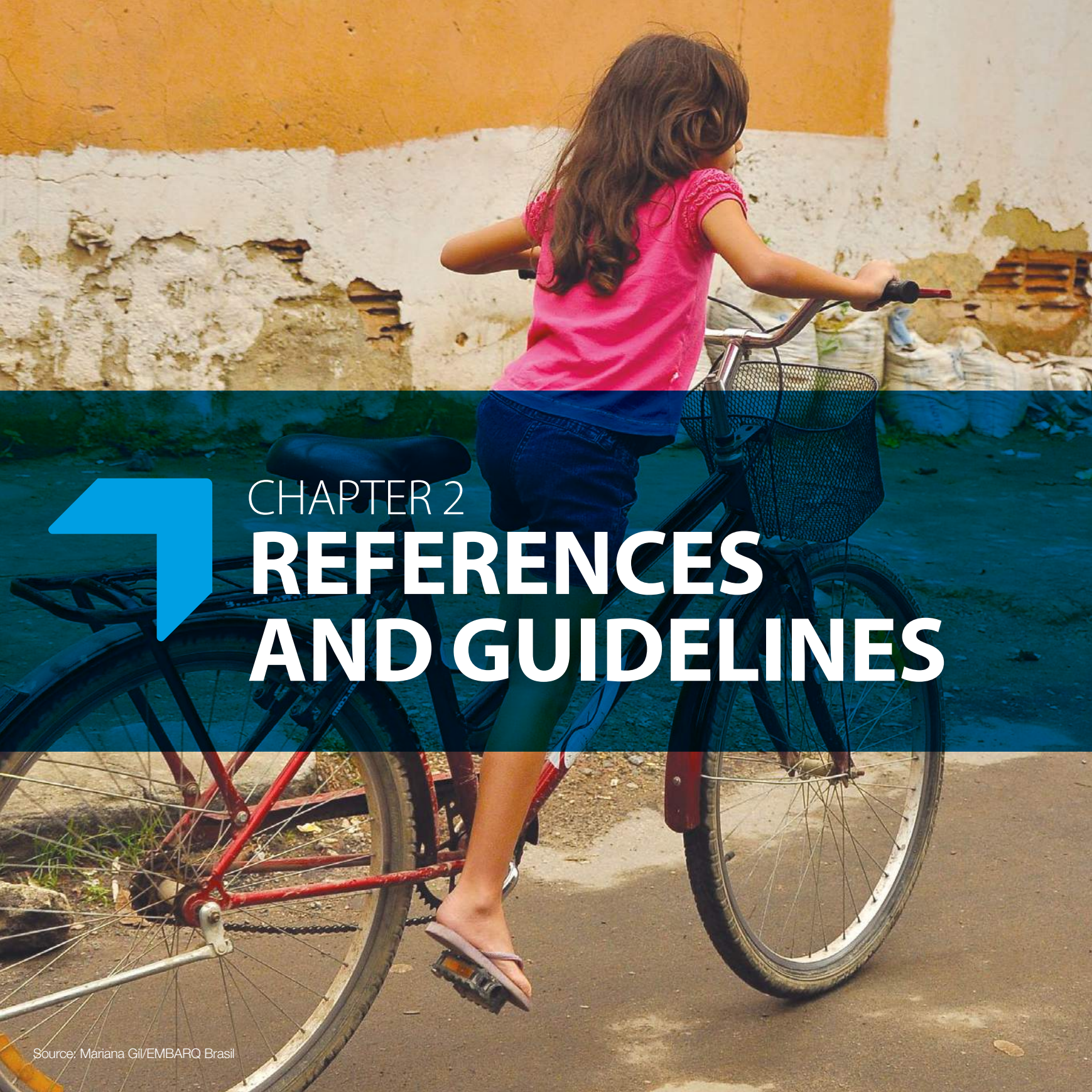
Find out what the population wants and needs in order to guide actions, empower the local communities, and involve residents right from the planning stage through implementation and management of the proposed initiatives.

Source: Alta Planning + Design

INTEGRATION

Make the bicycle a distinctive means of transportation to connect all neighborhoods, destinations and people in the city.





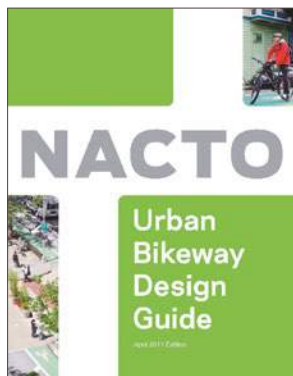
CHAPTER 2

REFERENCES AND GUIDELINES



RELATED PROJECTS AND MANUALS

A combination of engineering studies and opinions of the local population is recommended in all cases to ensure that the infrastructure and the programs make sense within the context of the community. This chapter presents several references with guidelines related to bike path infrastructure that can be applied in the communities.



2012 URBAN BIKEWAY DESIGN GUIDE

The urban bike path design guide, published by the National Association of City Transportation Officials (NACTO), is the most up-to-date design standards publication of this type in the United States, offering guidance on layout, signage, safety and aesthetics. The purpose of the guide is to provide essential guidance for cities interested in improving bicycle transportation, including in areas where competition between the different modes of transportation's right to use the roadway is a challenge.

Source: NACTO. 2012. *Urban Bikeway Design Guide*.



CROW DESIGN MANUAL FOR BICYCLE TRAFFIC

This Dutch design manual for bicycle traffic is one of the benchmark guides on international best practices in bike path networks. Based on decades of design experience, the CROW manual sets out specifications and considerations for implementing bikeways.

Source: CROW. 2007. *Design Manual for Bicycle Traffic*.

CITY OF RIO DE JANEIRO MASTER PLAN

This plan was published on February 1, 2011, to announce Rio de Janeiro's key urban and environmental policies. Unlike the previous plan, published in 1992, it provides information about environmental, social, transportation and housing issues. It also addresses preservation of Rio's landscape, land use and land occupation control measures, in order to counter and prevent risky situations.

Source: Municipal Department of Urbanization. 2011. *City of Rio de Janeiro Master Plan*.

NBR 9050: ACCESSIBILITY TO URBAN BUILDINGS, STREET FURNITURE, SPACES AND EQUIPMENT.

Brazilian Standard 9050 sets out the criteria and technical parameters in relation to accessibility requirements that must be observed when designing, building, installing and adapting urban buildings, street furniture and urban spaces and equipment. The regulation establishes standards for the design of ramps, stairs, handrails, tactile directional and warning signage and other facilities whose specifications must guarantee accessibility to people with different anthropometric characteristics.

Source: ABNT NBR 9050. 2004. *Accessibility to Urban Building, Street Furniture, Spaces and Equipment*.



BRAZIL BICYCLE COLLECTION: URBAN BICYCLE MOBILITY PLAN

Published by the Ministry of Cities, this document serves as a reference guide for Brazilian municipal towns and cities that want to create mobility plans that encourage cycling as part of their transportation system.

Source: *The Ministry of Cities and the Department of Transportation and Urban Mobility. 2007. Urban Bicycle Mobility Plan.*



COLLECTION OF CYCLING CONCEPTS

Launched in 2000 and updated in 2012, the Collection of Cycling Concepts presents new challenges and ideas. This guide is not intended to be a summary of the Danish standards, but to inspire and motivate the expansion and qualification of the bicycle network, in different cities around the world.

Source: *Cycling Embassy of Denmark. 2012. Collection of Cycling Concepts.*

THE INSTITUTE OF TRANSPORTATION ENGINEERS (ITE)

The ITE is an international organization of engineers, designers and architects that, amongst other activities, is responsible for publishing various best practice guides. The ITE's report entitled, "Traffic Calming: State of the Practice," provides guidance on tools and techniques to reduce the speed and volume of motor vehicles and create a more comfortable environment for cyclists and pedestrians.

Source: ITE. 1999. Traffic Calming: State of the Practice.

BRAZILIAN TRAFFIC CODE

The Brazilian Traffic Code, Law No. 9.503 came into force on September 23, 1997, establishing standards of behavior, infractions and penalties for road users. The bicycle is classified as a human powered vehicle and the law dedicates several articles regulating its use. Exhibit II of the Brazilian Traffic Code establishes standards for sizes, shapes and colors of horizontal and vertical signage as well as standard fonts and pictograms.

ADDITIONAL REFERENCES AND GUIDELINES

Articles of the Brazilian Traffic Code relevant to traffic signs and regulations for bicycles: www.escoladebicicleta.com.br/CTB.pdf



RIO DE JANEIRO MUNICIPAL DEPARTMENTS

INVOLVED IN BIKE PATH INFRASTRUCTURE

THE MUNICIPAL HOUSING DEPARTMENT – SMH (SECRETARIA MUNICIPAL DE HABITAÇÃO)

This Department is involved in the urbanization and regularization of communities and settlements, and promotes housing projects for low-income families in areas with existing public infrastructure. Its activities are based on an integrated urban planning process that focuses on public participation, social inclusion and respect for the environment.

MUNICIPAL ENVIRONMENT DEPARTMENT – SMAC (SECRETARIA MUNICIPAL DE MEIO AMBIENTE)

This is the central body of the Municipal Environmental Management System. It is responsible for environmental permitting and the oversight of potentially polluting activities. It oversees 18 municipal parks, three environmental education centers, community gardens, reforestation areas and tree nurseries. It is also responsible for planning, coordinating, and monitoring activities to implement the Bike path Program in the City of Rio de Janeiro. Its mission is to protect the environment, ensuring improvement in the quality of the city's natural resources and sustainable development.

RIO DE JANEIRO TRAFFIC ENGINEERING COMPANY – CET RIO (COMPANHIA DE ENGENHARIA DE TRÁFEGO DO RIO DE JANEIRO)

Its mission is to plan, coordinate and control the circulation of pedestrians and vehicles, and to define the use of roadways and streets, providing guidance and ensuring the safety and well-being of the population.

MUNICIPAL PUBLIC WORKS DEPARTMENT – SMO (SECRETARIA MUNICIPAL DE OBRAS)

All public works, including bike path projects, go through the SMO. The works are carried out in conjunction with other city hall departments. This department is also responsible for revitalizing the city by building new equipment, improving road access and installing essential public services.







CHAPTER 3 **PROGRAMS**



COMPLEMENTING THE INFRASTRUCTURE

Merely upgrading infrastructure is not enough to address the challenges of transportation in the communities. Without complementary initiatives, investments such as bike paths and signage will not be used as desired in the communities.

The programs outlined in this section are a combination of both traditional and innovative ideas; tried-and-tested techniques that not only increase bike usage but also make cycling easier, safer and more enjoyable.





EDUCATION

Providing education programs on topics related to safe cycling and basic bicycle maintenance can help to make people feel more confident and comfortable when cycling, either as a mode of transportation or for pleasure.

Some community leaders that were interviewed while developing this manual stated that the majority of residents learned to ride a bicycle out of necessity. With this in mind, the most useful forms of education should focus on the following topics:

- How to cycle safely and defensively on roads shared with motor vehicles (especially motorcycles) in order to reduce the risk of injuries from accidents.
- Appropriate use of bicycle lights and reflectors, child seats and helmets (especially for children).
- How to carry out bicycle maintenance and how to repair common problems such as flat tires and brake adjustments.
- Many people do not have access to affordable safety equipment and maintenance tools. The section “Promoting equity” offers some ideas to make them more accessible.

'WIN A BIKE' PROGRAMS

There are many variations on this type of program, but they are all based on the same premise: bicycles and bike parts that have been donated or discarded are collected and transformed into "new" bikes. When a resident needs a bike, he or she can volunteer for the group to learn how to rebuild them and, at the end of the program, win one for themselves.

BIKES FOR STUDENTS

One variation of the Win a Bike program that was suggested for use in communities involves a one-year educational experience for young students. The idea is that the bikes are loaned to each student for one year, teaching them about responsibility (maintenance and care of their bikes), health and transportation. They are graded on how well their bikes have been looked after and if their grades are high enough, at the end of the year they get to keep their bikes.

REBICYCLE

Rebicycle is a program set up by the Rio de Janeiro state government that recycles used bicycles and discarded bike parts. The goal of the program is to promote cycling and, consequently, social inclusion, focusing on improving quality of life. The initiative stimulates cycling as a mode of transportation, in particular among children and teenagers from low income communities. It promotes awareness of the importance of sustainability and the value of cycling and the environment.

The Rebicycle program also works in prison education classes, offering inmates informal training in bicycle mechanics. The inmates learn and teach repair techniques using discarded parts. The new bicycles are donated to the communities. An added benefit of this program is that it gives inmates the opportunity to return to society with an employment option for social reintegration.





Bicycle workshop in the Complexo do Alemão favela. Source: Silvia Ballan

RESOURCES FOR WIN A BIKE PROGRAMS

Some basic resources are essential for a Win a Bike program to be successful in a community:

- An organizer: it can be someone from an organization already existing within the community, a local volunteer or group of volunteers, or, in the case of the student program, a representative of the school.
- A place to store the bikes, parts and tools, with enough space to work on them.
- A system for collecting donated or discarded bikes and parts. Some international organizations offer assistance with this type of resource, but many programs in urban areas can function successfully using local resources. Police departments often donate recovered bicycles that have not been claimed after a certain period.

ADDITIONAL REFERENCES AND GUIDELINES

Rebicycle Program: www.recicleta.com.br

INCENTIVE

Incentive programs vary in terms of target-audience and goals, but they all serve to make the bicycle a more popular, convenient and attractive means of transportation than automotive vehicles.

SPONSORED RACES

Sponsored races in communities, similar to the Shimano races, are more than just entertainment - they offer training in bicycle maintenance and repair over the course of the event. The stand-out “graduates” receive job offers as bicycle mechanics in the city.

ADDITIONAL REFERENCES AND GUIDELINES

Shimano Races: www.weraceshimano.com



The RIO MTB Downhill Race, Source: Marcelo Maragni/Red Bull Photofiles



The RIO MTB Downhill Race, Source: Red Bull Photofiles



RICKSHAW AND “SCHOOL” TRICYCLES

Rickshaws make up a substantial portion of local transportation options in cities all over the world. Much of the equipment used in these systems is manufactured and serviced locally and can also be acquired and operated by people from the communities. In the case of “school” rickshaws, kids can be taken to school by rickshaw as an introduction to cycling before receiving bicycles loaned as part of the “Bikes for Students” program.



Rickshaw stand. Source: Shutterstock

SECURE BICYCLE STATIONS WITH HOME DELIVERY

For areas with steep inclines, a transportation system can be set up where people pedal downhill on their outward journey and walk back up on their way back (acknowledging that many people are unable or don't want to pedal up steep hills). Users leave their bikes at a station installed at the bottom of the hill, and the bikes are sent back up in trucks or using a cable system to predetermined storage areas at the top of the hill at the end of the day (or several times a day). People can then pick up their bikes near their homes the following day and ride back down again.

This idea is similar to the shared bicycle programs but the bikes are privately owned or part of a set of shared bikes.



Source: Jacob Koch



Mechanical transportation systems such as cables (like the one installed in the Santa Marta community) can be used to transport products as well as bicycles, thereby reducing the need for motorized transportation in the communities.

Source: Daniela Facchini/EMBARQ Brasil



Instead of building bike stations entirely from scratch, this program can be incorporated into existing community buildings and services, which will also help advertise it within the community.

A low cost and short-term solution to return the bikes to the top of the hill is to use a trailer.



Source: Alta Planning + Design

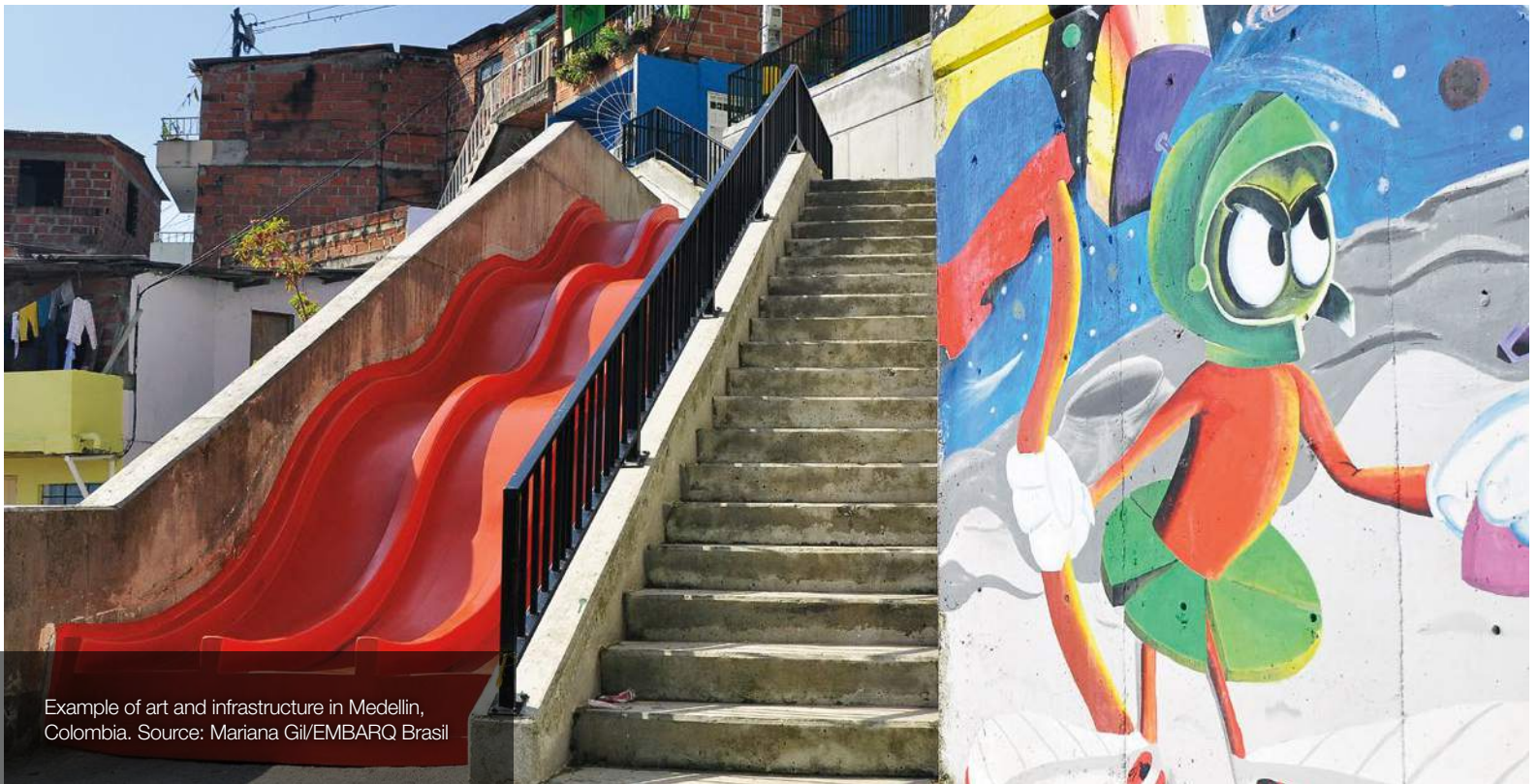
ART + INFRASTRUCTURE

Using art in urban spaces can help promote the community's identity. Contests involving local artists can be held to decide the themes used in the design of structures erected for bicycles and pedestrians.

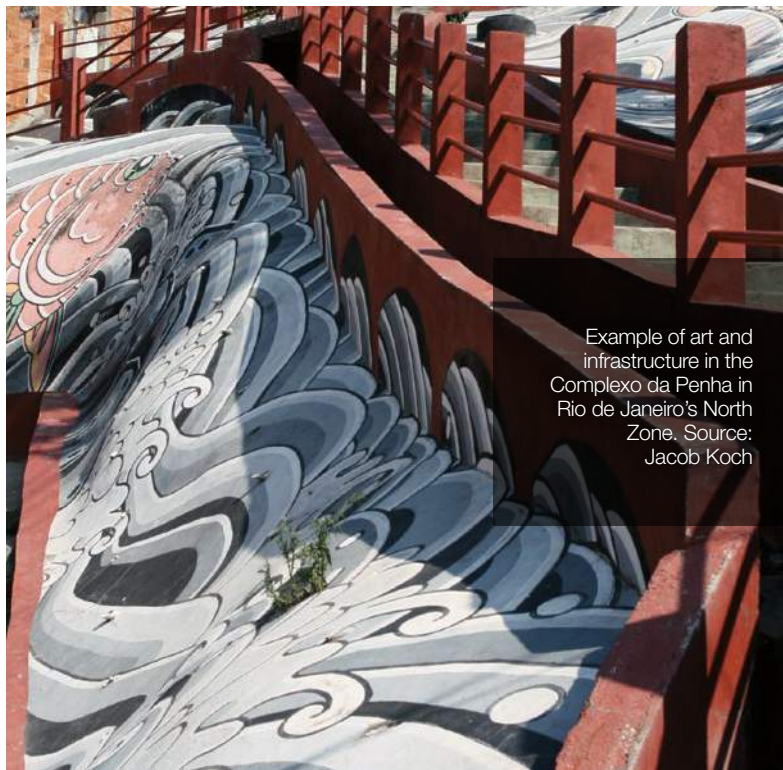
- Bicycle racks are usually designed to reflect the local identity.
- Mosaic art is great for recycling materials.

ADDITIONAL REFERENCES AND GUIDELINES

Intersection Repair - City Repair: www.cityrepair.org/how-to/placemaking/intersectionrepair



Example of art and infrastructure in Medellín, Colombia. Source: Mariana Gil/EMBARQ Brasil



Example of art and infrastructure in the Complexo da Penha in Rio de Janeiro's North Zone. Source: Jacob Koch



Example of mosaic steps in Rio, the Escadaria Selaron (Selaron Steps) connecting the Glória and Santa Teresa neighborhoods. Source: www.zarpante.wordpress.com



Art can also be used as a traffic calmer, as shown in this "Intersection Repair", part of the City Repair project in Portland, OR, USA. Source: Gubbins4ever

OPEN ROADS

On Sundays and holidays in Rio de Janeiro, cars are not allowed on at least one side of the many beach avenues (e.g. Leblon, Ipanema, Copacabana, Leme and Flamengo), which are opened for use by the general population. They use the space to rollerblade, jog, cycle and skateboard.

- These Open Roads programs can be expanded to connect and serve the surrounding communities.
- Connections between communities and Open Roads events must guide cyclists safely, especially those with less experience.
- Rent-a-Bike initiatives as part of the Open Roads program should be supported and expanded.





Cycling and bike rental during
Open Roads events along the
Avenida Infante D. Henrique,
Rio de Janeiro.
Source: Alta Planning + Design

BICYCLE MESSENGER COURIER SYSTEM

Bicycle messengers provide an important service using both sustainable transportation and local labor. Bike courier services are already common practice in Rio (Copacabana and Leblon neighborhoods) and can also be implemented in communities. This type of service has proved very successful in many high-density urban areas because bikes are often able to travel more efficiently than cars, and can be easily parked close to their point of delivery.

- This service could be expanded to communities, not only carrying the small items normally delivered by couriers, but also delivering larger items that can be carried in customized devices fitted on special delivery bicycles.
- If they are set up similarly to other delivery services, this program requires an organized entity or an individual to coordinate the deliveries between clients and couriers.



Freight bicycle in Santiago, Chile. Source: Bilobicles bag



Freight bicycles in Rio. Source: Source: Cityscape image

TRAFFIC CONTROL AND ENFORCEMENT

Vehicles traveling at high speed put cyclists in danger and inhibit cycling, therefore speed restriction enforcement actions are necessary. Traffic control and enforcement authorities must mandate low speed limits on roadways designated as bikeways and near schools, and be responsive to complaints from the community about excessive speed. Other enforcement initiatives for cyclists' safety include:

- Training programs given by the traffic control authority on how to cycle safely in traffic.
- Training programs given by the traffic control authority for drivers, especially motorcyclists, about how to drive safely and respect cyclists and pedestrians.
- Keeping bikeways clear of parked cars, trash and other obstructions.
- Ensuring a safe distance is kept between drivers and cyclists through traffic control and enforcement.

PROMOTING EQUALITY

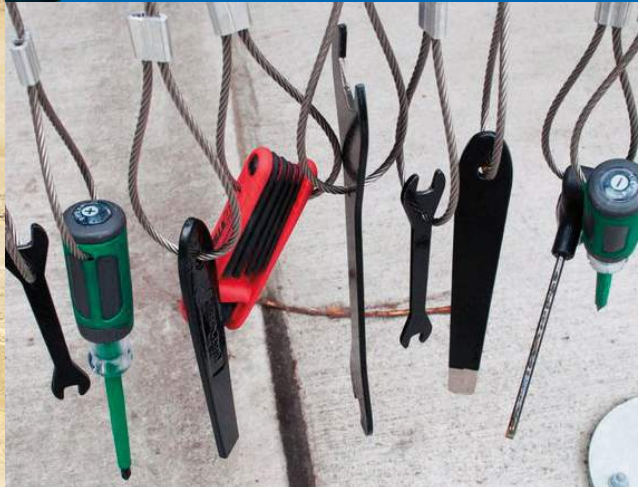
The bicycle can be a symbol of freedom and economic opportunity for community residents. There are many ways to improve social equality by integrating the bicycle into a sustainable mobility system.

- Given that bicycle safety and maintenance equipment are expensive for many people, repair stations can be installed with tools for the community's use. Signs explaining how to use repair tools is key to ensure they are used correctly.
- The stations should be set up where they are clearly visible in busy centers of local activity. They can be installed inside community buildings and be made available for the same business hours as the local commerce.
- The residents of the communities should also have access to services and facilities such as bike paths, bike lanes and Open Roads events in other parts of the city.
- Offering more bicycle parking stations at bus stops provides incentive for more people to use bicycles as a cheap means of transportation, and promotes greater equality in city mobility options.
- All bike infrastructure should be planned so that women, the elderly, and children can use it with comfort and security.



Bicycle repair tools for communal use.

Source: Alta Planning + Design



Source: Mariana Gil/EMBARQ Brasil



Source: Alta Planning + Design

BIKE SHARING

The current bike sharing system in Rio de Janeiro can be adapted to serve the communities using the same basic services provided in the rest of the city.

- There are several ways to allow people who do not own a credit card to pay for the bike sharing service. The system can include cell phones as a form of identification, or issue prepaid cards to buy bike credits.
- The bike sharing system can also be integrated with the city's public transportation travelcard.
- If necessary, low-technology alternatives can be developed in communities, where the bicycle fleets can be managed as a cooperative and maintained and shared by the people within the community. These systems can work along the lines of the bike sharing systems set up in China, where a team of attendants check-out the bikes to users who later return them to the system. This method is often called a "bicycle library" and works well in a specific area such as a neighborhood, college campus or some of Rio's communities.
- The racks currently used in Rio should be redesigned so that users can release and connect the bike without having to simultaneously lift the front of the bike. Some people find this lifting maneuver difficult, especially when holding other items or when the bike does not connect straight away.
- It is essential that the bike sharing equipment is standardized. Some of the bikes donated to a bike sharing system in Nicaragua during the 1980s had parts missing, and because the bikes were not all the same model, repair work became very difficult.



Bicycle sharing station in Rio de Janeiro. Source: Alta Planning + Design



CHAPTER 4

DESIGN



PRINCIPLES FOR DESIGNING **BIKE INFRASTRUCTURE IN COMMUNITIES**

The seven principles for developing bike paths and a bike infrastructure in Rio's favela communities were drawn up using a combination of the best international practices, and discussions involving municipal agencies, architecture firms and community leaders.



THE SEVEN PRINCIPLES

- 1.** An environment favorable to cycling must be safe. All cycling routes must be safe physically and be perceived as such by all users. A safe environment presents minimum conflict with external factors such as debris, trash, vehicle traffic and criminal activity. Safety also means clear, well-marked, paved routes with appropriate signage.
- 2.** The bike path network must be accessible. Routes and bridges must allow mobility of residents of all ages and cycling ability. The bike path network must therefore be designed to accommodate inexperienced cyclists (especially children and senior citizens).
- 3.** Improvements to the bike path network must be economical, arriving at the lowest cost-benefit ratio, accounting for implementation and maintenance costs, and reducing dependence on more expensive means of transportation.
- 4.** The bike path network should connect the places where people want to travel. The routes should be direct and continuous, with convenient connections, not only within the communities, but also at their interface with the rest of the city. Points such as houses, schools, commercial areas, public services, leisure areas and public transportation stops must be connected. A complete bicycle infrastructure network must seamlessly connect with existing and planned roadways.
- 5.** The cycling environment must be attractive and improve living conditions in the community. An effective plan should encourage use of urban spaces, promoting preservation of the landscape and other elements that add value to the region. These elements should be inviting and make people feel welcome in open spaces, offering benches, arts, plants, special paving, historical features and cultural references.

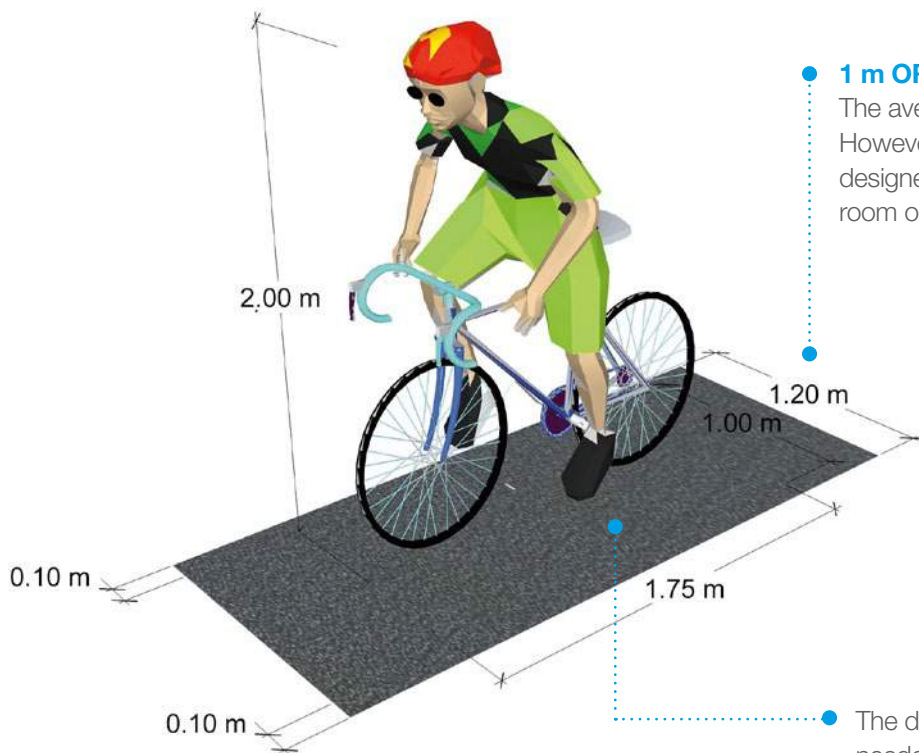
6. The design guidelines are flexible and should be consulted while applying professional judgment. This manual references the best practices in bike path infrastructure planning, as well as recommendations from specialists not consulted in the current guides. Detailed engineering analysis combined with the opinions of community members must be applied in all projects.

7. Designers should be aware of unintended consequences. A track around a community's perimeter might become a barrier if it is not part of a wider network. For the same reason, widening roads is not always the best choice. The human scale of the roads in communities provides a sense of belonging, and an environment with few cars that is safer for cyclists and pedestrians.

FLEXIBILITY IN THE USE OF GUIDES AND MANUALS

Detailed engineering analysis combined with the opinions of community members must be applied in all projects.

FIVE NEEDS OF CYCLISTS



● 1 m OR 1.2 m?

The average width of a cyclist is 1 meter. However, it is important that all infrastructure designed for cyclists allows 10 cm of wobble room on each side.

● The designer must be aware of the space needed for a cyclist to pedal and understand the bicycle as a means of transportation. It is strongly recommended that designers cycle and be fully familiar with the cycling environment and user needs.

1. ROAD SAFETY

Quality of the surface: cyclists are safer when focusing solely on road traffic, without distractions caused by poor quality surfaces.

Intersection design: most collisions involving cyclists occur at poorly signalized intersections that do not favor bicycle traffic.

Nighttime cycling: poor lighting and personal security concerns discourage cyclists.

Drainage: blocked and poorly located drains and manholes can cause serious accidents and create obstacles.

Debris: broken glass, built-up sand and mud, wet leaves and other debris on the bike path can cause accidents.

2. COHERENCE

Continuity of route: it is illogical to discontinue the bike path network near busy locations in order to accommodate vehicle flow as the main priority.

Intersections: areas where the bike path network approaches and crosses intersections should be clearly marked.

3. SHORTCUTS

Permeability: one of the advantages of cycling is the possibility of providing shortcuts, i.e., paths where it is not possible to build infrastructure for larger vehicles, but which allow bicycle traffic.

Traffic signals: sequencing of signals along the bike path network is important to minimize cyclists' waiting time at intersections.

Detours: cyclists accept short detours to maintain speed and avoid conflicts. Long detours are less likely to be used.

4. ATTRACTIONS

Shelters: some plants serve as wind breaks, provide shade and improve the appearance of the bike path network.

Maintenance: bike path surface should be well-maintained and clear of debris.

Lighting: adequately lighted bike path network to encourage nighttime use.

5. COMFORT

Width: provide adequate width to avoid conflicts.

Gradients: ensure slopes along the bike path network are not excessive.

Stops and delays: minimize the number of obstructions or detours that impact cyclist's speed.

Surface quality: maintain smooth and continuous surface.

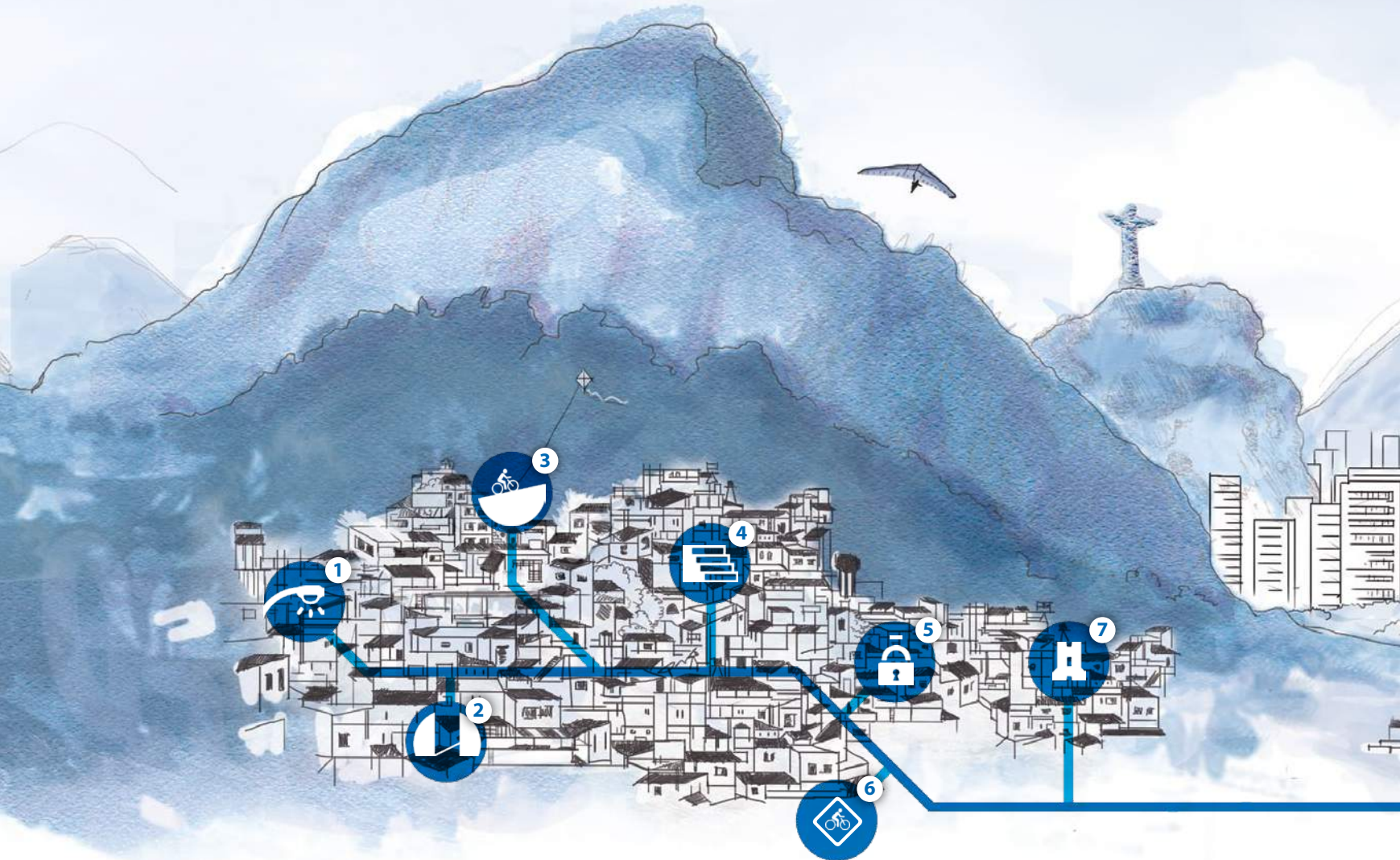
Shelter: minimize exposure to bad weather.

ADDITIONAL REFERENCES AND GUIDELINES

Irish National Cycling Manual: www.cyclemanual.ie

ELEMENTS OF THE BIKE PATH SYSTEM

The variations in land incline in Rio de Janeiro's communities have a significant impact on the challenges and opportunities to stimulating bike usage. The individual characteristics of each community must be taken into account when planning the cycling infrastructure. Regardless of whether it is flat, hilly or a mixture of both, planning for continuity of the bike path network and the interface with the city at large is essential for complete connection across the city.



1. Lighting - **p. 50**
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3. Steep roads - **p. 56**
4. Staircases - **p. 61**
5. Short-term parking - **p. 64**
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13. Long-term bicycle parking - **p. 102**
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15. Bicycle access to public transportation - **p. 108**





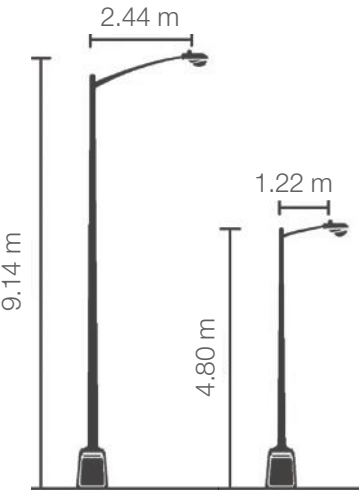
1. LIGHTING

Appropriate lighting in terms of adequacy, positioning and quality can significantly improve an urban nighttime experience. To be more effective, lighting must be consistent, adequately spaced and visible, providing appropriate light intensity. Lighting options for the pedestrian and cyclist scale include LED, mercury vapor, metal halide vapor, incandescent and high pressure sodium lighting, which is generally cheaper. Brazil also has great potential for solar lighting.

Some important points to consider when designing lighting for pedestrian and bike paths:

- Ensure that routes and crossings are adequately lit.
- Consider adding more lighting in areas with a higher volume of pedestrians and cyclists and at major intersections.
- Install lighting on both sides of major roadways.
- Use uniform light intensity between post along the same road.
- Use directed lighting to prevent light pollution.

Examples of standard public lampposts and street lamps for pedestrians and cyclists.



ADDITIONAL REFERENCES AND GUIDELINES

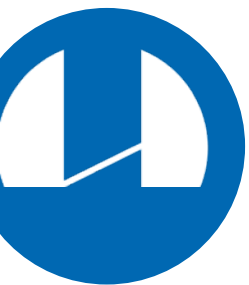
Irish National Cycling Manual:
www.cyclemanual.ie

RECOMMENDED MEASUREMENT BETWEEN THE POLE HEIGHT AND SPACING

LAMP TYPE	POLE HEIGHT	MAXIMUM SPACING BETWEEN POLES	COMMENTS
70 W high pressure sodium vapor lamp	6-8 meters	34 meters	Normally used in residential areas
150 W high pressure sodium vapor lamp	6-8 meters	34 meters	Mixed-use areas
250 W high pressure sodium vapor lamp	8-12 meters	40 meters	Standard for transit routes and city center
400 W metal vapor lamp	8-12 meters	One on each side of the roadway, at the pedestrian crossway	Used at crosswalks



Amsterdam: Pedestrian and cyclist-scale lighting. Source: Shutterstock



2. ALLEYS

Some roadways may be too narrow to implement cycling infrastructure where priority is given to pedestrian traffic. Alleys can be used to link different stretches of bikeways, but cyclists are often obliged to get off their bikes in order to move along these narrow roads. To encourage bike usage in alleys they require maintenance and periodic reconstruction.

Flooding is a frequent problem in alleys, because many were built without a connection to the city's sewer and storm water system. One sustainable solution to this problem (where soil conditions are appropriate) is to allow storm water to infiltrate into the subsoil through permeable pavements. In addition to permeable asphalt, concrete and paver blocks, permeable pavements can also be installed using a variety of recycled materials.

ADDITIONAL REFERENCES AND GUIDELINES

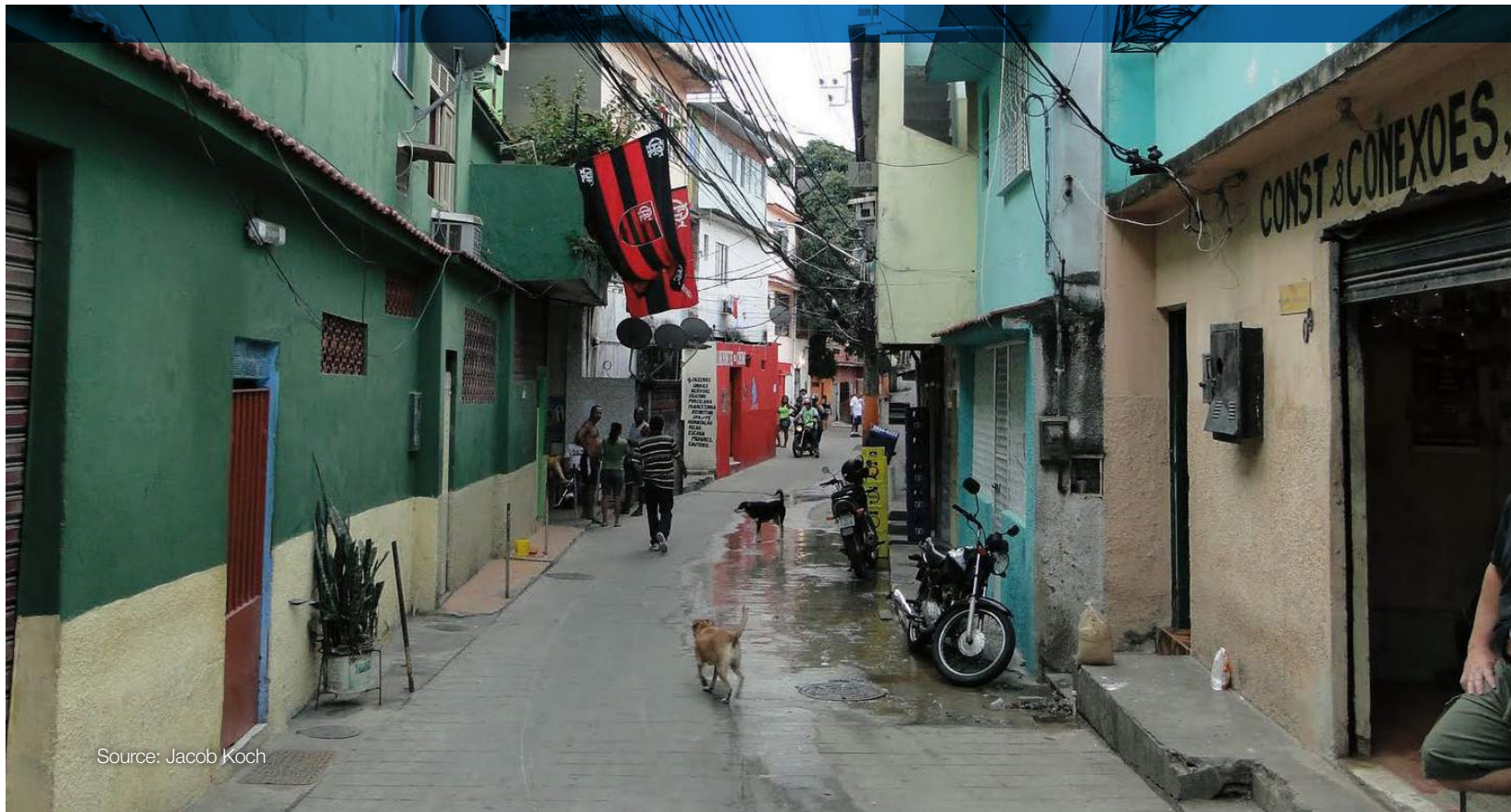
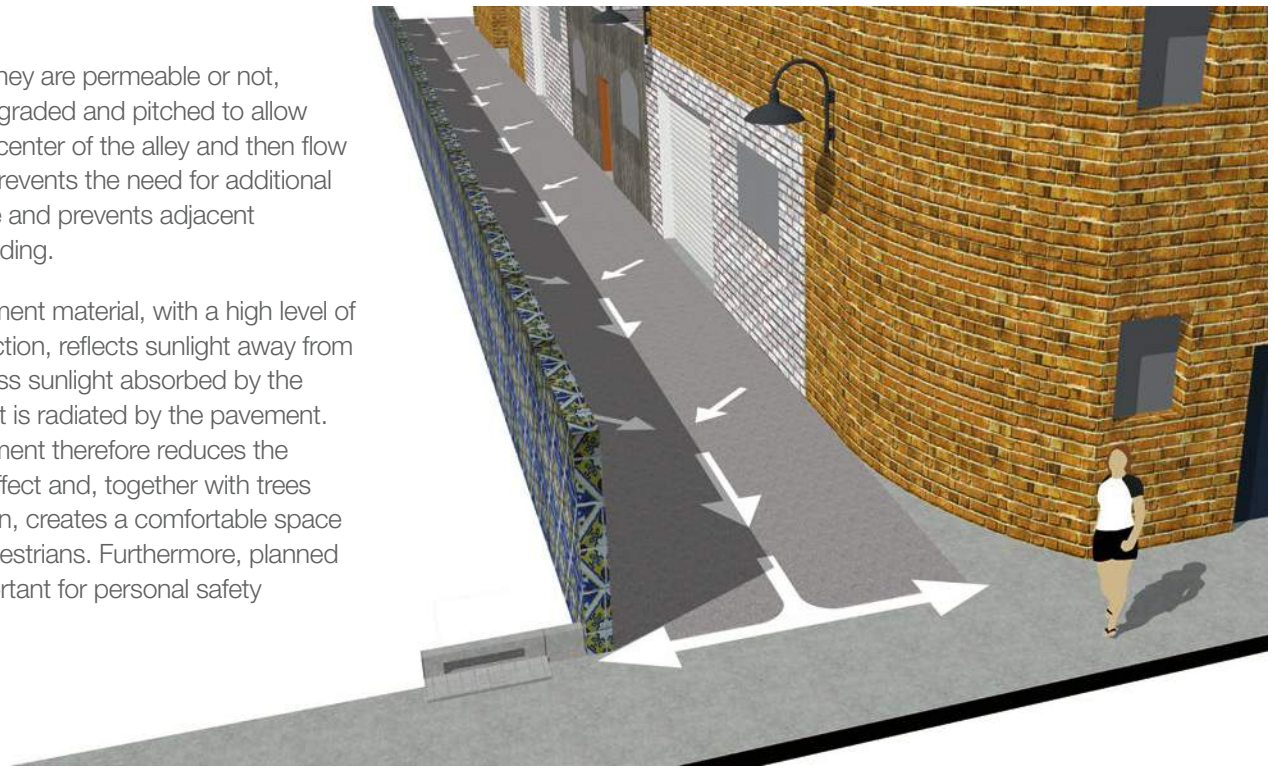
*The Chicago Green Alley
Handbook.* Department of
Transportation.



Source: Alta Planning + Design

All alleys, whether they are permeable or not, should be properly graded and pitched to allow water to run to the center of the alley and then flow to the street. This prevents the need for additional sewer infrastructure and prevents adjacent properties from flooding.

Light colored pavement material, with a high level of solar radiation reflection, reflects sunlight away from the surface. With less sunlight absorbed by the pavement, less heat is radiated by the pavement. Light colored pavement therefore reduces the urban heat island effect and, together with trees and other vegetation, creates a comfortable space for cyclists and pedestrians. Furthermore, planned lighting is very important for personal safety in alleys.



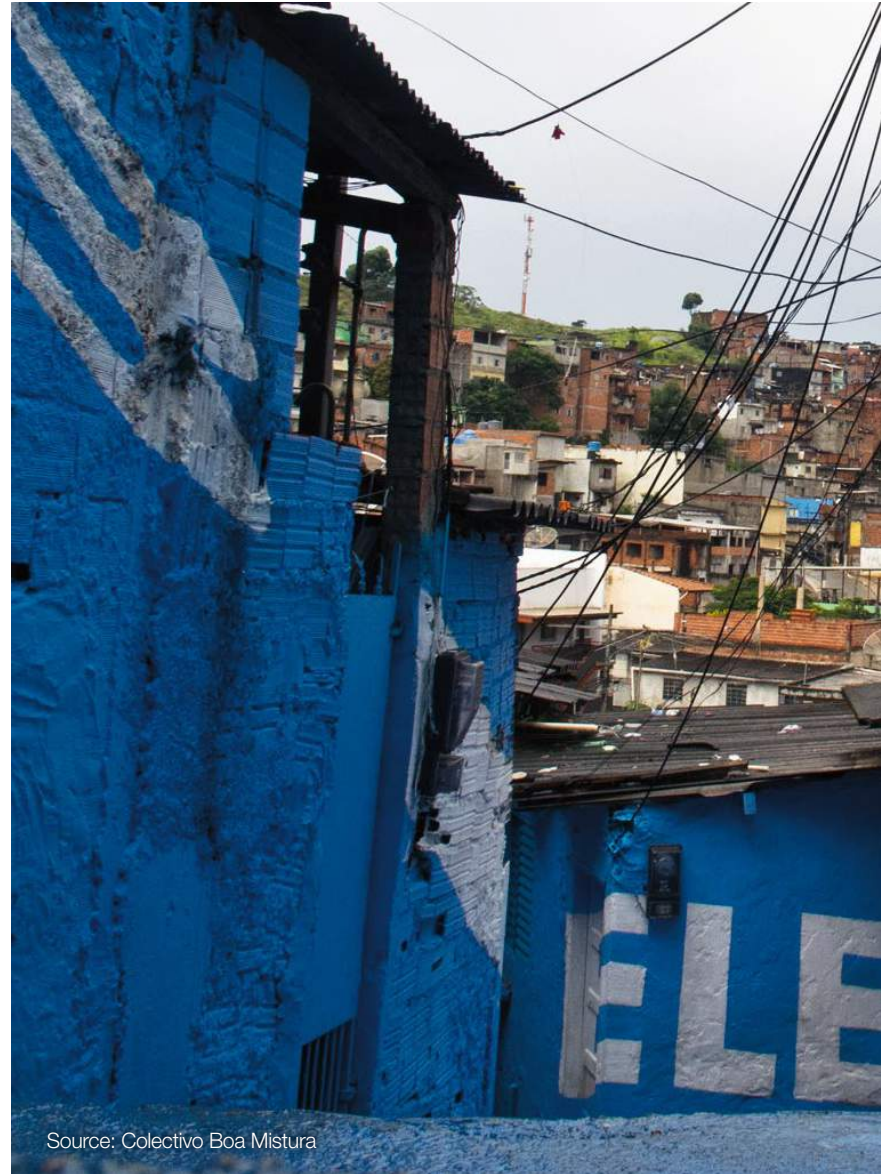
Source: Jacob Koch

ART IN THE ALLEYS

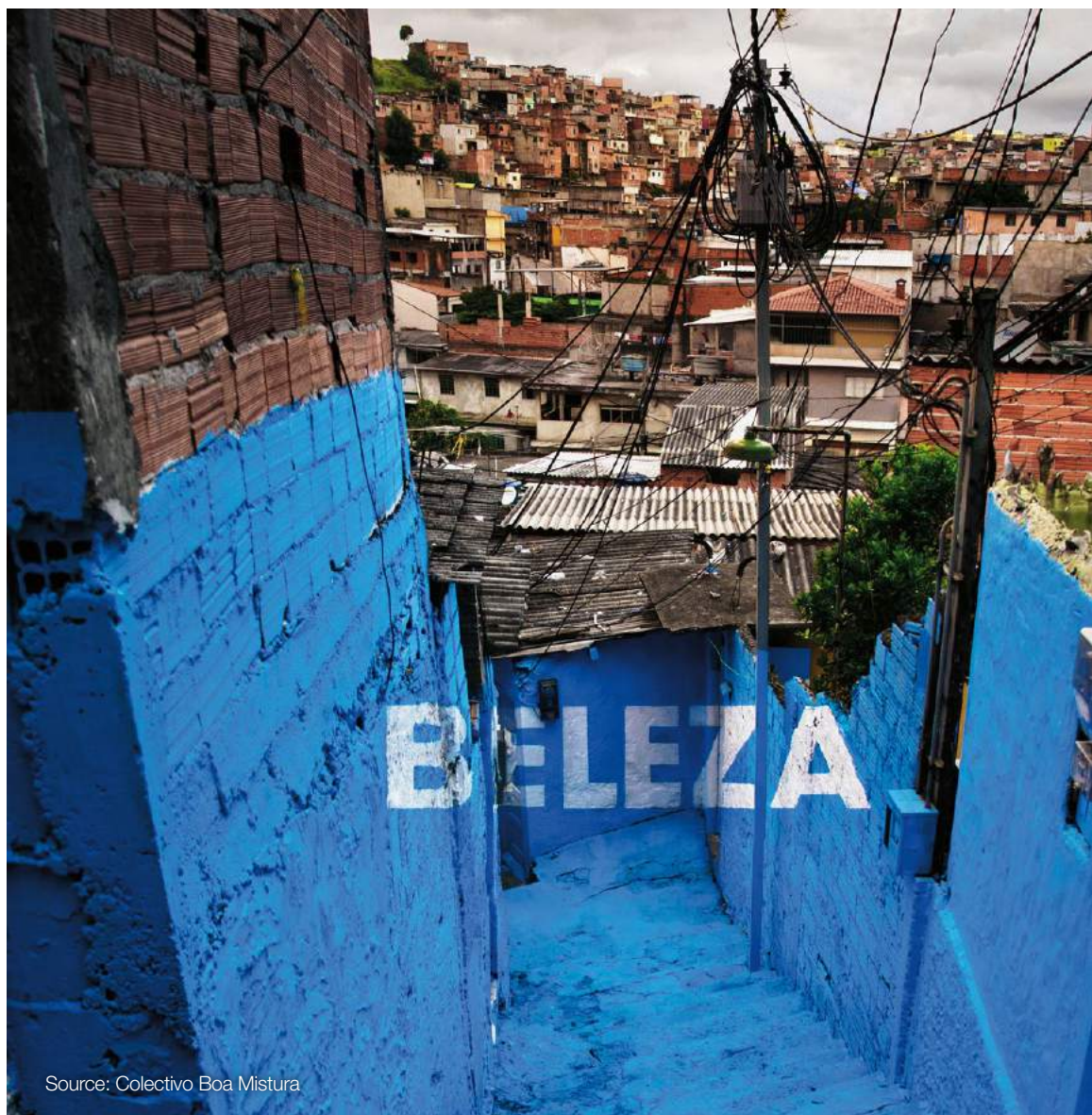
The "Luz nas vielas" (Light in the Alleys) project, implemented by the group of Spanish street artists Boa Mistura, used creativity and art to bring color to the alleys of the Brasilândia community in São Paulo. Five artists selected alleys in the neighborhood and painted the walls, doors and windows with the help of the local residents. Words like 'love', 'kindness', 'pride' and 'beauty' were painted in white over the bright colors. They used a technique that only allows the words to be read from a certain distance and angle. They appear distorted when viewed from close-up.

ADDITIONAL REFERENCES AND GUIDELINES

Luz nas vielas Project – Colectivo Boa Mistura:
www.boamistura.com



Source: Colectivo Boa Mistura



Source: Colectivo Boa Mistura

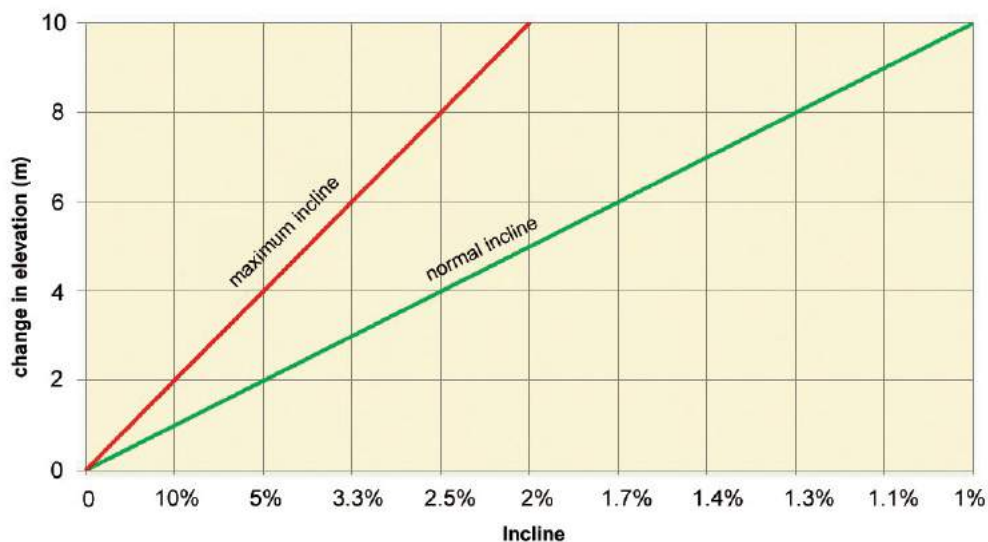


3. STEEP ROADS

In communities built on steep, hilly areas, access by motor vehicles is mostly restricted to the major public roads. Despite not having intense motor vehicle traffic, roads with steep slopes discourage many potential cyclists. Secure bicycle parking facilities installed at the foot of the hills can help stimulate bike usage.

BICYCLE RAMPS

Special attention should be given to ramps along bikeways because cyclists are highly sensitive to this type of obstacle. The Bike path Planning Manual (GEIPOT) provides a graph with the normal incline and the maximum permitted incline on bikeways.



Examples of application
of the ramp graph:

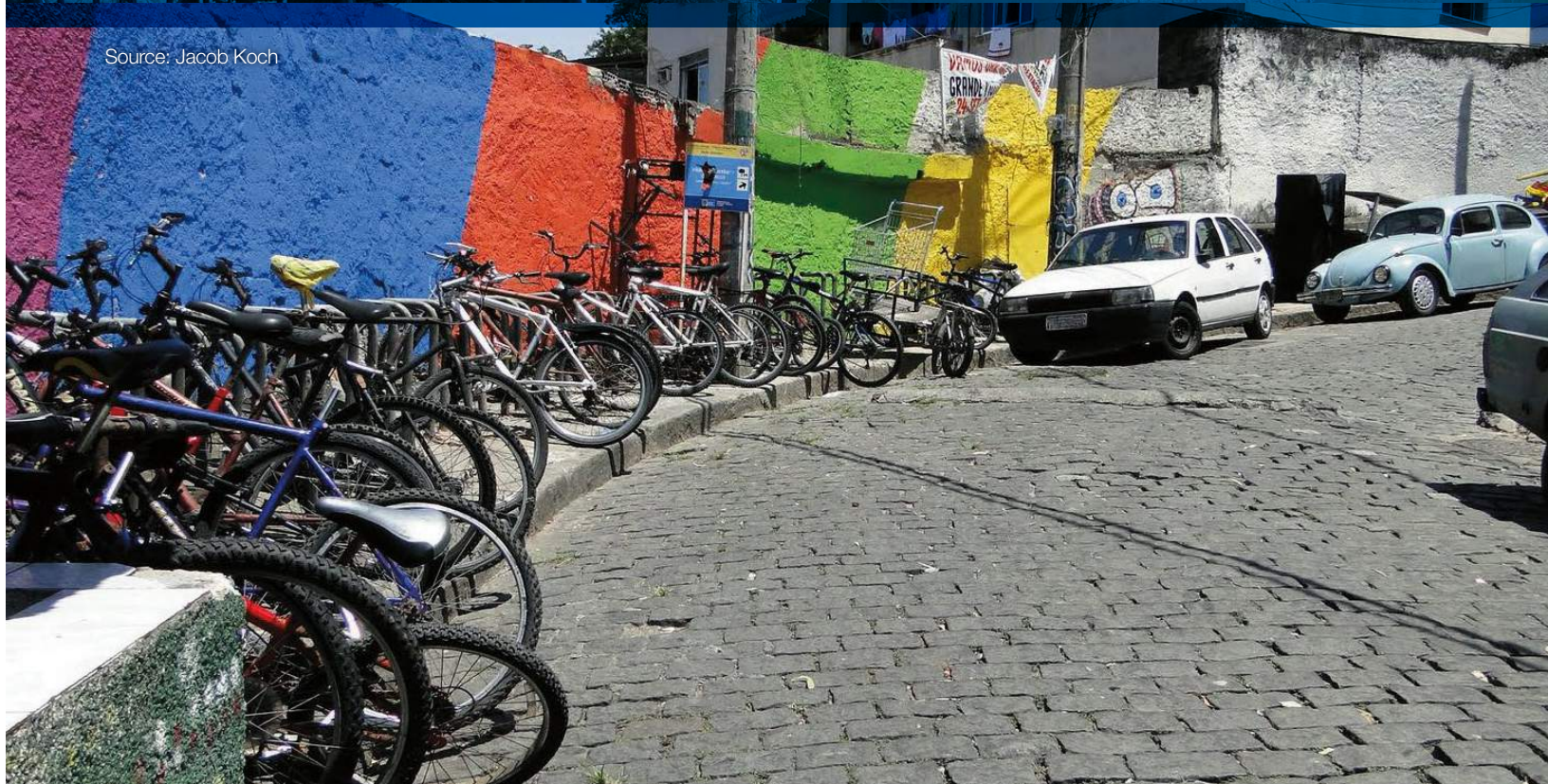
SLOPE TO OVERCOME	INCLINE	
	Normal	Maximum
2 m	5%	10%
4 m	2.5%	5%
6 m	1.7%	3.3%

Graph showing ramps with incline and maximum incline according to the slope.
Source: GEIPOT

Source: Jacob Koch



Source: Jacob Koch



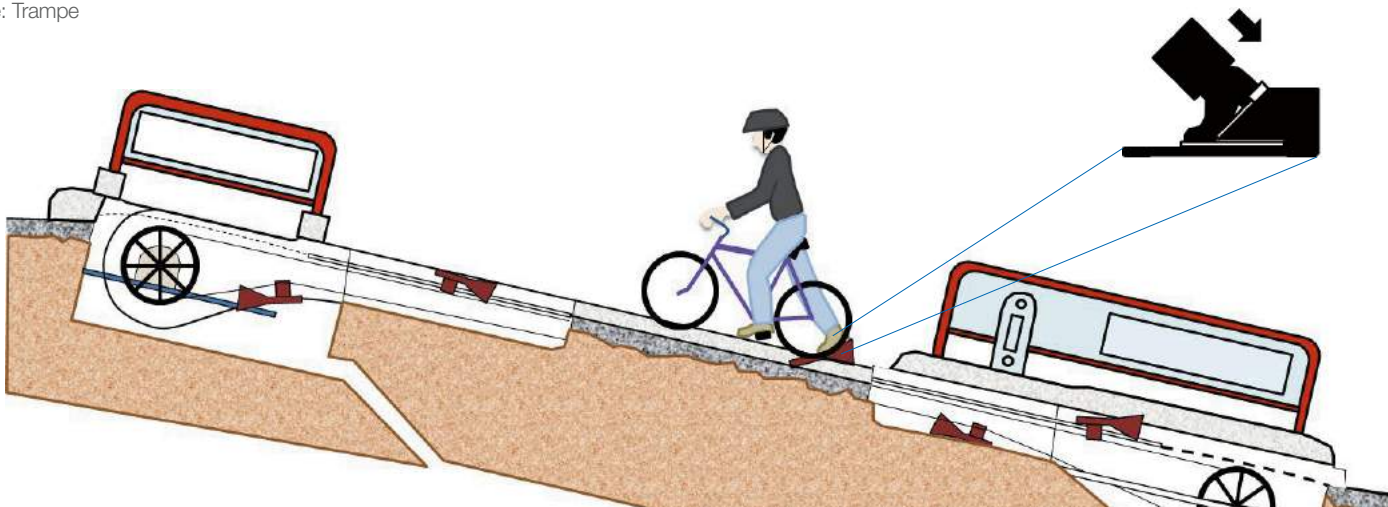
BICYCLE LIFTS

Bicycle lifts (also called “Trampe” or “CycloCable”) are a way for people to climb steep hills with the help of a device very much like an escalator. Users place one foot on the lift’s footplate, which pushes them uphill while they remain seated on their bicycles. This system has been used by cyclists for over 15 years in Trondheim, Norway, where hilly roads are a constant challenge for cyclists.

Design guidelines issued by Design Management AS, the original designer of the bicycle lift:

- Hills with a gradient between 1:10 and 1:5 are ideal for a bicycle lift. Moreover, the device can be installed on roads with or without car traffic. On two-way roads with intense traffic, the lift’s track should be marked with paint at least 1 meter wide.
- The lift can also be installed off traditional roadways, at shortcuts between two land levels for example.
- The lift’s tracks can be installed over slight bends (horizontal and vertical), with a radius of not less than 25 meters.

Source: Trampe



DISCUSSION

User fee: the 'Trampe' initially operated in Trondheim by using electronic cards to charge fees, but today it operates free of charge.

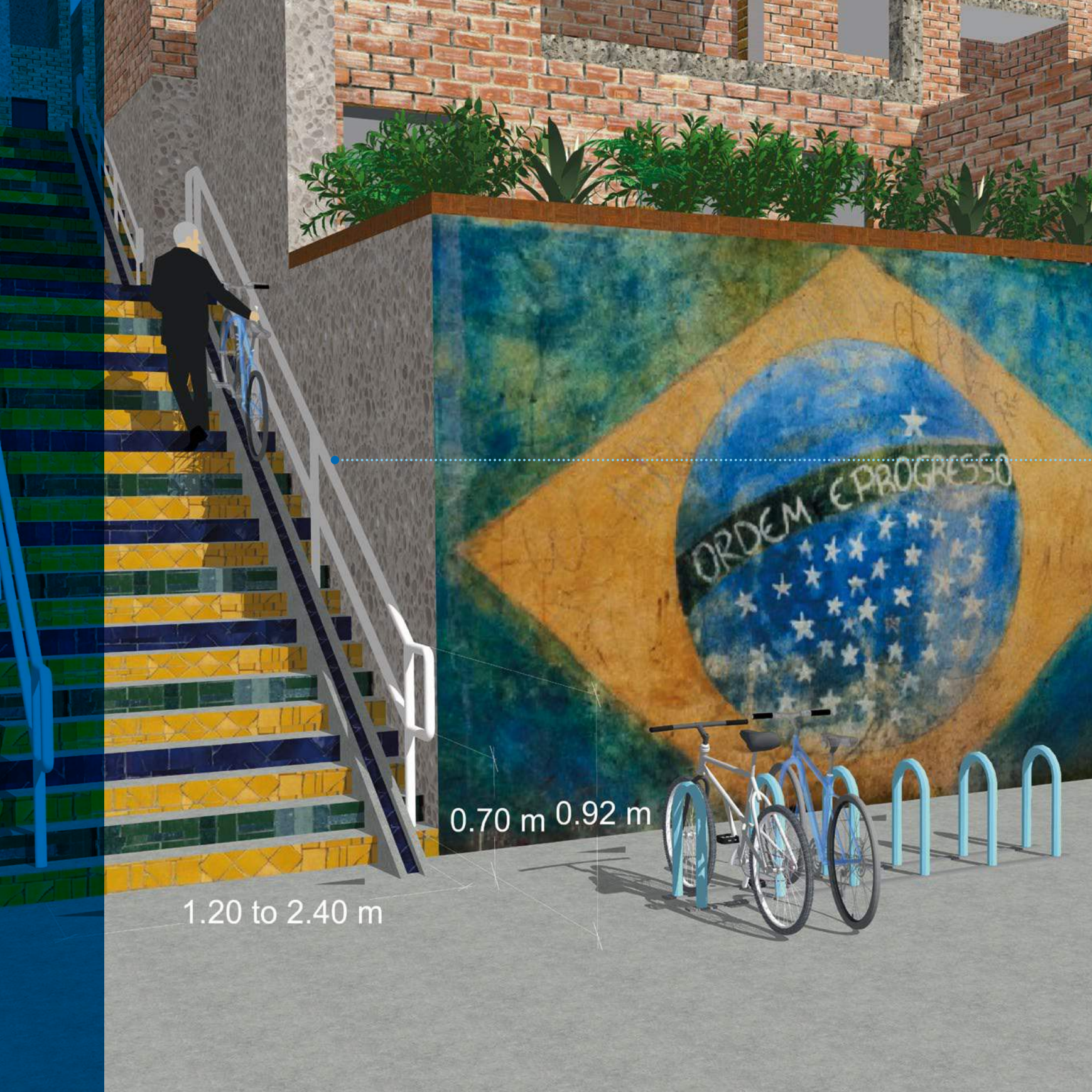
The bicycle lift is patented. Design Management AS entered into a Licensing agreement with POMAGALSKI SA (POMA). POMA manufactures cable-driven lift systems and installed the cableway that runs over the Complexo do Alemão favela in Rio de Janeiro.

ADDITIONAL REFERENCES AND GUIDELINES

For images, videos, instructions, technology and references, access the Design Management AS website at: www.trampe.no



Source: Jarle Wanvik



1.20 to 2.40 m

0.70 m 0.92 m



4. STAIRCASES

As with steep roads, long-term bike parking at the foot of staircases provides an alternative for cyclists who live at the top of a hill. The ability to carry a bicycle up many steps depends on an individual's physical condition. Stairways facilitate bike usage through installation of channels so cyclists can transport their bikes up and down steps more easily.

- In accordance with ABNT 9050, an intermediate handrail must be installed on stairs wider than 2.4 m. Handrails should be continuous. If they need to be interrupted on landings, there must be a gap of at least 80 cm between the end of the first segment and the start of the second.

As a rule of thumb, channels on both sides reduce conflicts between bicycles traveling up and downhill, but on narrow stairs it is not unusual to find channels on just one side to reduce the risk of injuries from trips and falls.

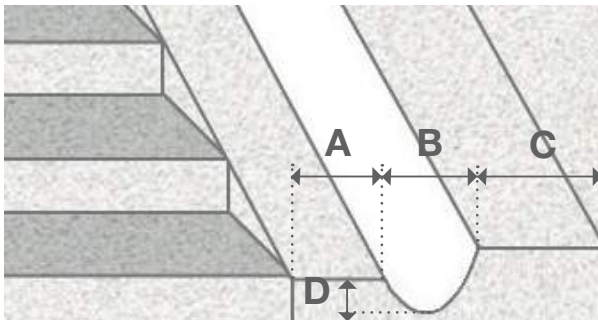


U-shaped concrete channel.
Source: www.planitmetro.com

CONCRETE CHANNEL

According to the *CROW Design Manual for Bicycle Traffic*, the U-shaped concrete channel is the best option. There should be a clearance of at least 20 cm between the bicycle ramp channel and the side wall of the steps to ensure that the pedals do not hit the wall. Another option is to use an L-section closer to the side-wall. This method is less attractive to cyclists because the bicycle must be kept at an angle, which hinders their climb.

Concrete ramps can be used by other devices with wheels. One ramp for bikes and two ramps for baby strollers and shopping carts, for example.



Detail of U-shaped concrete channel, with measurements.

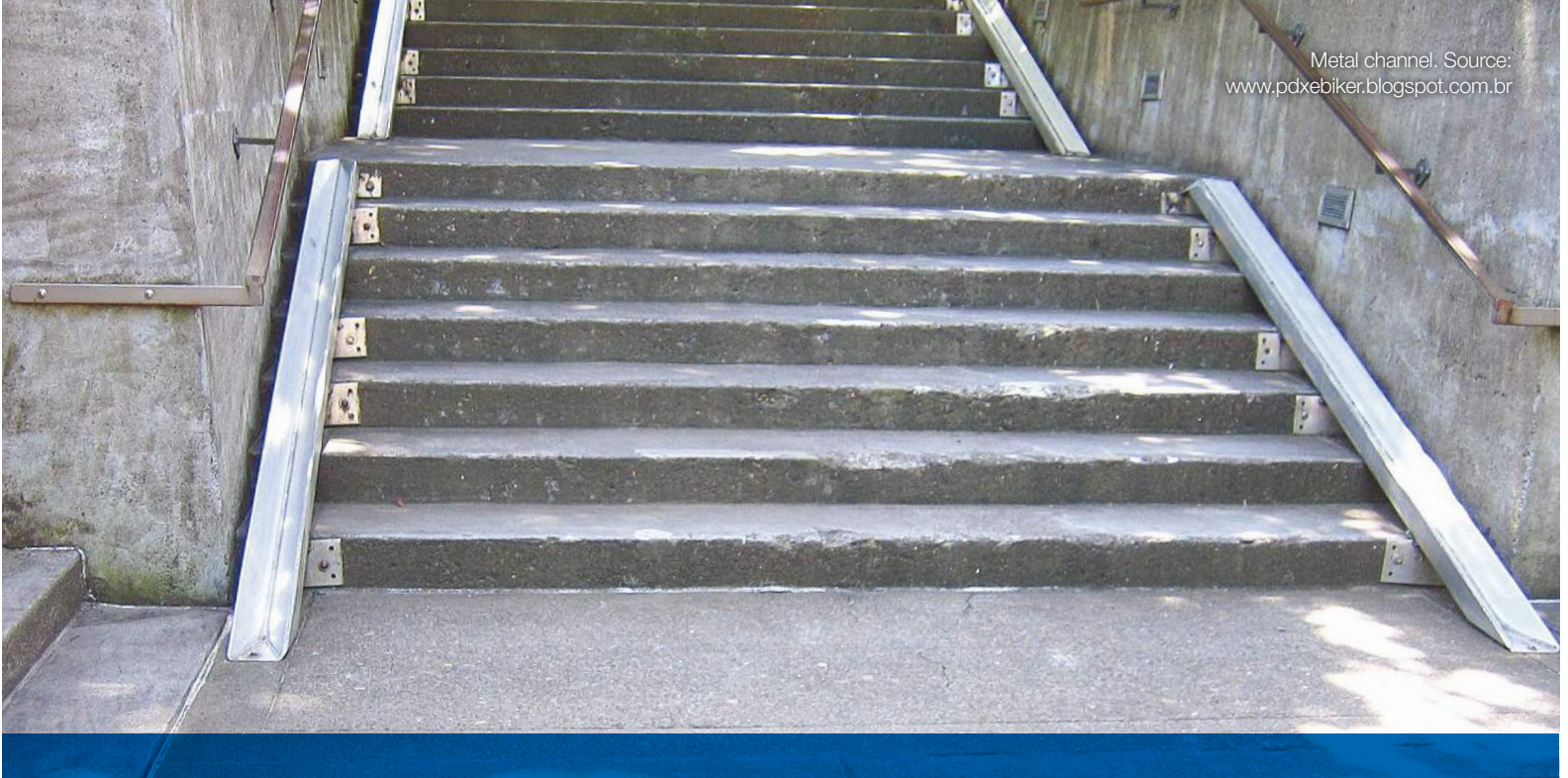
- A** = 3-5 cm
- B** = 8-12 cm
- C** = 20 cm
- D** = 3-4 cm



L-shaped concrete channel.
Source: www.planitmetro.com



Source: Shutterstock



Detail of metal channel, with measurements.

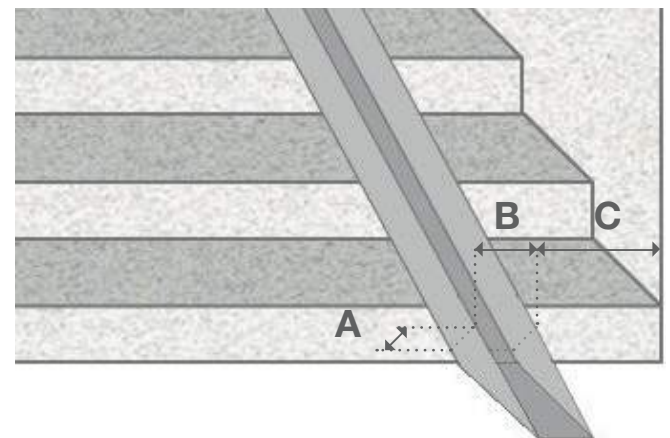
A = 5 cm

B = 10-20 cm

C = 20 cm

METAL CHANNELS

Metal parts are generally installed in existing concrete staircases or metal staircases. When using metal parts, it is essential to provide a surface that creates friction with the bike tires so users can move up and down the ramp without slipping.





5. SHORT-TERM PARKING

Short-term bicycle parking facilities are typically used for two hours or less. These facilities are required near commercial establishments, or, for example, for use by visitors to commercial buildings and parks. The manufacture, installation and maintenance of the bike racks can be done by the residents of the communities.

*In the same space
used by **7 cars**,
a bike rack can
comfortably hold
80 bicycles
with space for
future expansion.*



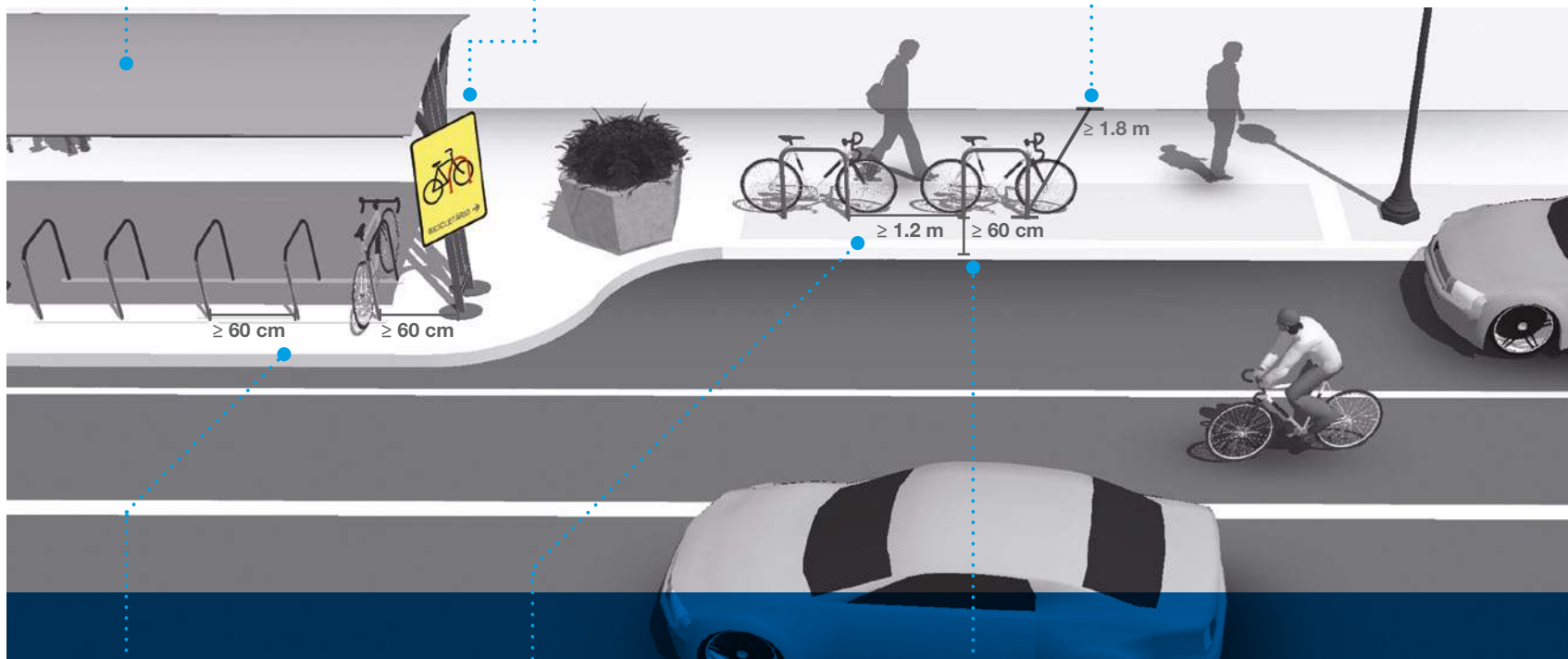


Bike rack installed at the foot of the hill,
Santa Marta Community, Rio de Janeiro.
Source: Jacob Koch

Roofs protect bike racks against inclement weather.

Bike rack and bike station signage.

There should be a distance of at least 1.80 m between the bike rack and buildings.



Minimum distance between racks is 60 cm, although 80 cm is recommended for better convenience for cyclists.

The minimum distance between two bike racks so that bicycles can be kept in line is 1.2 m.

Minimum distance of 60 cm between the racks and the curb to prevent collisions between bikes and car doors being opened.

LOCATION OF BIKE RACKS

SPECIFIC CHARACTERISTICS

To determine the right location for the parking facility, some characteristics of the area where it will be installed should be considered.

RESIDENTIAL AREAS

- Convenience is essential in areas where bicycles are frequently used. It is important to observe where people park their bikes in order to find the most appropriate place to install bike racks.
- Shared parking spaces can be installed to accommodate the bikes of residents living in a cluster of houses, such as a small condominium community.

ON-STREET BIKE RACKS

- Should be clearly visible to cyclists on adjacent paths and pedestrian traffic.
- They should be installed in areas where cyclists are most likely to travel.
- The distance between the rack and the cyclist's final destination should not exceed 50 meters.
- The racks can be covered or uncovered, although they are more cyclist-friendly when they protect bikes from inclement weather.
- Parking facilities should be installed close enough to pedestrian areas, bus-stops, taxi stands, police stations, parks, popular stores, bars, etc., so they are constantly visible to pedestrians.

COMMERCIAL DISTRICTS

- Bike parking facilities can be combined with other services, such as bike rental and repair points, shopping malls, etc.
- Parking facilities in commercial districts usually demand greater capacity than in other areas.
- Parking facilities may require infrastructure for cyclist assistance services if the number of users is very high.

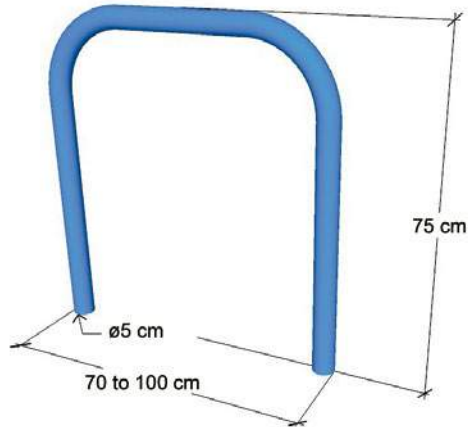
BIKE RACK MATERIALS

- Racks should be made of a durable, tamper-proof material that cannot be cut.
- Use of galvanized steel with a paint or scratch-proof finish is recommended to protect against rusting.
- If re-using materials, it is important that the rack is not misshapen or deformed.

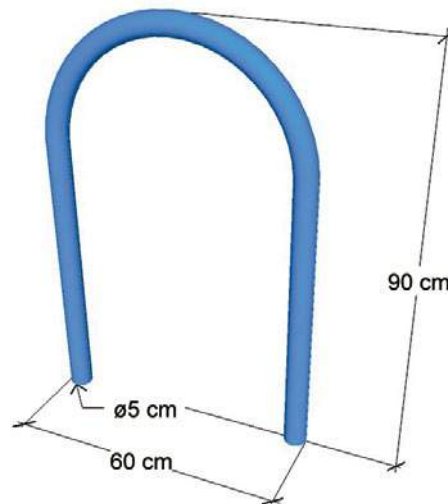
RACK SHAPES AND DIMENSIONS

Bike racks must have supports that:

- support the bike in at least two places, preventing it from tipping over;
- allow the frame and one or both wheels to be secured with a U-lock.



Sheffield Model

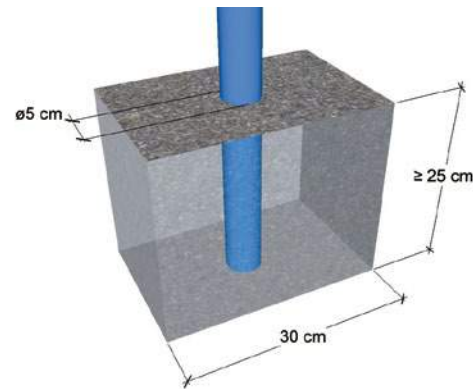


Inverted "U" Model

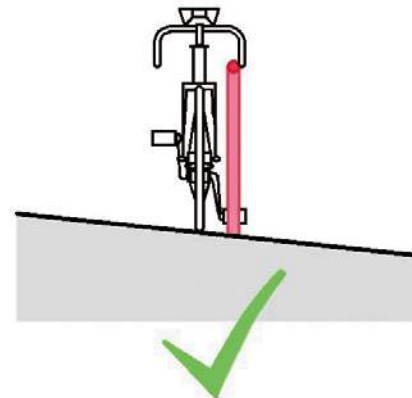
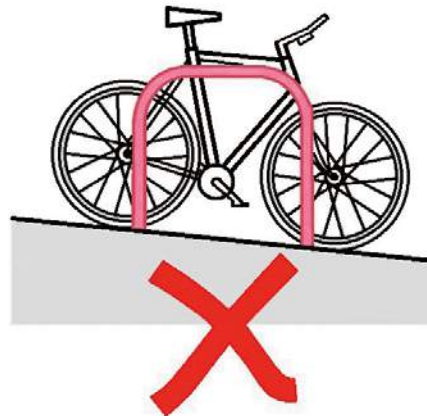
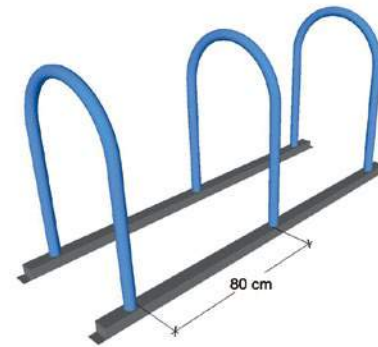
INSTALLATION OPTIONS

The rack must be securely embedded within the foundation. Racks should only be anchor-bolted when installing clusters of racks linked to a welded bar.

Option 1 – Embedded within foundation (recommended).



Option 2 – Anchor Bolted
(only for clusters of racks installed in secure areas with a high volume of pedestrian traffic).



Source: *Bicycle parking guide*. EMBARQ Brasil.

ADDITIONAL REFERENCES AND GUIDELINES

EMBARQ Brasil (2011) Bicycle parking guidelines.

Irish National Cycling Manual: www.cyclemanual.ie

CUSTOMIZED DESIGNS

A modern, innovative design or on-rack advertising can be used to attract attention to the area where the racks are installed. When creating customized models, it is important to pay attention to the dimensions necessary to lock the bicycle correctly.

There are many examples of distinctive and creative formats around the world.



Source: Mariana Gil/EMBARQ Brasil



Source: Mariana Gil/EMBARQ Brasil



Source: www.pqliving.com



Source: Shutterstock



Source: Shutterstock



Source: Daniela Facchini/EMBARQ Brasil

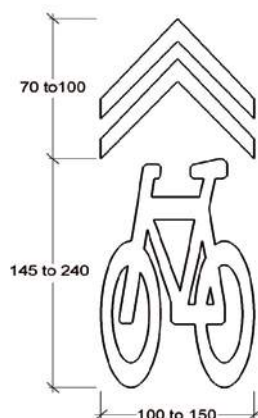
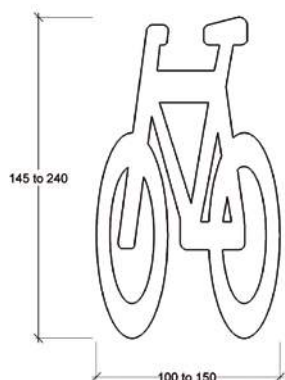


6. SIGNAGE

HORIZONTAL SIGNAGE

Horizontal signage provides information so users can adopt appropriate behavior, in order to improve traffic safety and flow. To capture messages from horizontal signage, drivers and cyclists do not need to divert their attention from the road. It can be used to reinforce vertical signage and complemented with auxiliary devices.

Cycling-related horizontal signage regulated by the Rio de Janeiro Municipal Environment Department (measurements in centimeters):



- Indicates the direction of bicycle flow on bike paths and bike lanes.

Signage points:

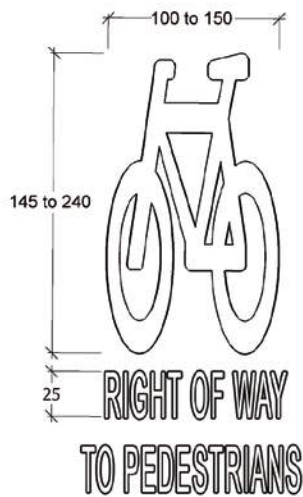
- start of the path;
- before and after intersections;
- after bends;
- every 25 m.

- Known as the *sharrow*, this road marking indicates roadways shared between bicycles and motor vehicles.

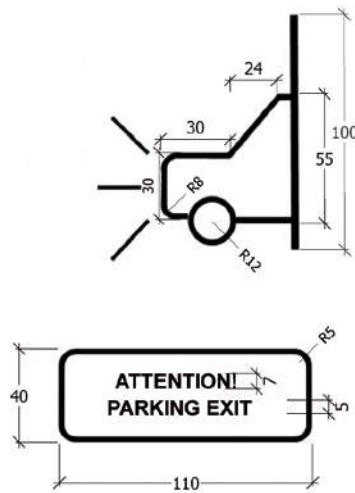
Signage points:

- start of the shared lane;
- before and after intersections;
- after bends;
- every 30 m or less.

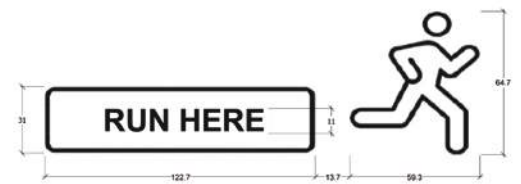
It is also used at intersections to inform drivers about the direction of bicycle flow.



- Indicates lanes shared between cyclists and pedestrians.



- Indicates entrances to parking facilities and lots.



- Indicates an area designated for jogging.

VERTICAL SIGNAGE

As with horizontal signage, vertical signage is used to improve safety and traffic flow by providing information, so that users can adopt appropriate behavior.

REGULATORY SIGNS OF THE BRAZILIAN TRAFFIC CODE RELEVANT TO CYCLING:



Bicycle traffic only



Bicycle traffic prohibited



Cyclists keep right



Cyclists keep left



Cyclists keep left,
pedestrians keep right



Cyclists keep right,
pedestrians keep left

**BRAZILIAN TRAFFIC CODE WARNING SIGNS
RELEVANT TO CYCLING:**



Bike traffic



Signalized cyclist
crossing

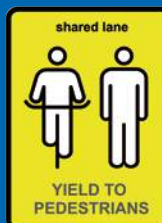


Traffic shared by cyclists
and pedestrians



Pedestrian: bicycles go
both ways

**STANDARD SIGNS OF RIO DE JANEIRO RELEVANT
TO CYCLING:**





GUIDING CYCLISTS USING AUXILIARY DEVICES

In addition to horizontal and vertical signage, a directional system for bike traffic is comprised of auxiliary devices to guide cyclists to their destination along the preferred bicycle routes. Signs are usually positioned at decision making points: typically at intersections of two or more routes and at other key locations that lead to bikeways.

There are three types of auxiliary devices:

CONFIRMATION SIGNS

Inform cyclists that they are on a designated bike track or lane, and alert car drivers about the bike path. These can include destinations and information about distance and journey time, but do not contain arrows. Markings on the asphalt can also serve as confirmation that cyclists are on the right route.

Sign installation in the city: they must be positioned after bends or detours to confirm directions to destinations.

- Off-road bikeways (in parks, for example): every 500 meters or 1 km.
- Along-the-road bikeways: every two or three blocks unless other signs such as turning or decision making signs are used in this interval.



TURN SIGNS

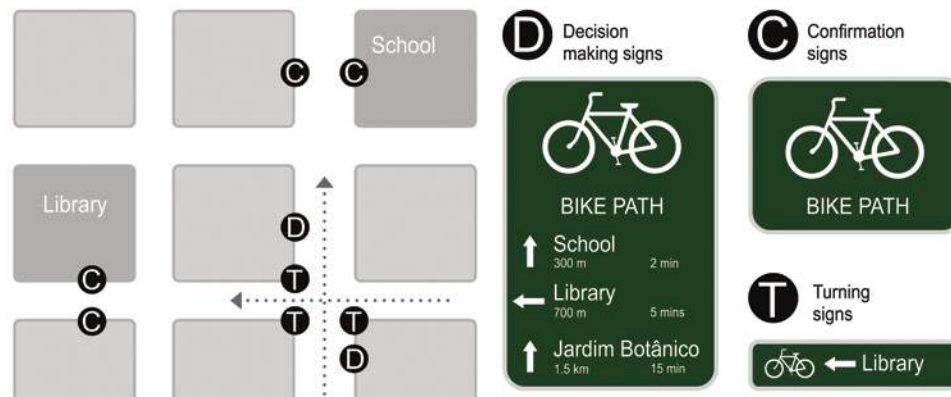
Inform cyclists about bike path turns from one track to another, using arrows to indicate the route that should be followed. They can also be indicated using markings on the asphalt.

Signage installation in the city: they must be positioned close to intersections where bikeways turn onto another path, or when the track on which the cyclist is riding ceases to be a bike path, for example.

DECISION MAKING SIGNS

Mark the junction of two or more bikeways. Inform cyclists about bike routes to access key destinations. Distances and journey times are recommended.

Sign installation in the city: close to intersections, before a junction with another bike path, or along the route to indicate nearby locations such as tourism spots, government buildings, beaches, etc.



Example of signage positioning.

DISCUSSION

Signage is particularly useful to indicate the best routes to enter, exit and travel inside the community, by highlighting locations such as parks and community centers. It can be useful to categorize destinations that should be indicated by signage on bike paths. The position of each destination on this list defines the distance that will separate the destination to the related sign. For example, if a bus-stop is categorized as being more important than a park, the directional signs that lead to the bus-stop will be positioned in a radius of up to 8 km from the stop, while the signs leading to the park will be positioned within a radius of only 3 km.

MATERIALS AND MAINTENANCE

Orientation signs require similar maintenance as other signs and must be replaced periodically, due to general wear and tear. A signage plan should be put into practice to facilitate replacements and upgrades.



ADDITIONAL REFERENCES AND GUIDELINES

FHWA (2009) *Manual on Uniform Traffic Control Devices*.

NACTO (2012) *Urban Bikeway Design Guide*.

AASHTO (2012) *Guide for the Development of Bicycle Facilities*.



7. SECONDARY ROADS

Busy side roads can serve as a good alternative for cyclists, especially when traffic reduction treatments that favor cycling and discourage car traffic are implemented. Roads with a width of 5 m or less may be shared.

- Parking possibilities can be considered in the shared space.
- Intermittent parking along the road narrows the space for other vehicles.
- Contran (National Traffic Council) resolution No. 39/98 provides for two types of speed bumps:

Type 1 – width equal to the road, maintaining the surface drainage conditions; 1.5 m in length and up to 8 cm in height.

Type 2 – width equal to the road, maintaining the surface drainage conditions; 3.7 meters long and up to 10 cm high.

ADDITIONAL REFERENCES AND GUIDELINES

National Traffic Council – CONTRAN Resolution 39/98: standards and criteria for installing transverse bumps and rumble lines on public roadways governed by art. 94, sole paragraph, of the Brazilian Traffic Code.









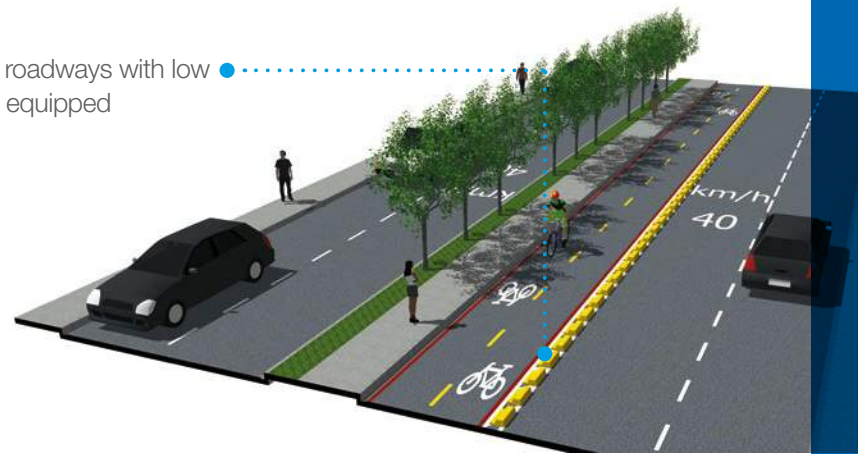
8. WIDE ROADS

Wider roads allow vehicles to travel at higher speeds. A lack of markings on the asphalt also reduces the visibility of upcoming turns. However, wide roads permit extensive re-planning.

Median strips with infrastructure for pedestrians and cyclists create space along the roadway for recreation and transform roads into places where less experienced cyclists can ride safely. Areas for safe crossing must be provided between the side curbs and the median strip.

These facilities should only be considered on roadways with low motor vehicle traffic volume or when they are equipped with speed reduction mechanisms.

Unpaved surfaces are difficult for some cyclists to traverse. Damp surfaces and mud create more challenges and make some roads unusable for cycling. A good practice for such cases is to prioritize paving for pedestrians and bicycles, as shown in the Bogota case.



Source: Enrique Peñalosa



THE CASE OF BOGOTA, COLOMBIA

Prioritizing investment in infrastructure for pedestrians and cyclists has proved a great success in Bogotá. The images show spaces created for walking and cycling in the city. In the first image, the space dedicated to pedestrians and cyclists is consolidated, while the roads for automobile transit were intentionally left unpaved as a speed reduction measure.

This redefinition of public space also has important social implications because it shows prioritization of public space for the majority of the population and not for a minority who owns a motorized vehicle.

Source: Enrique Peñalosa



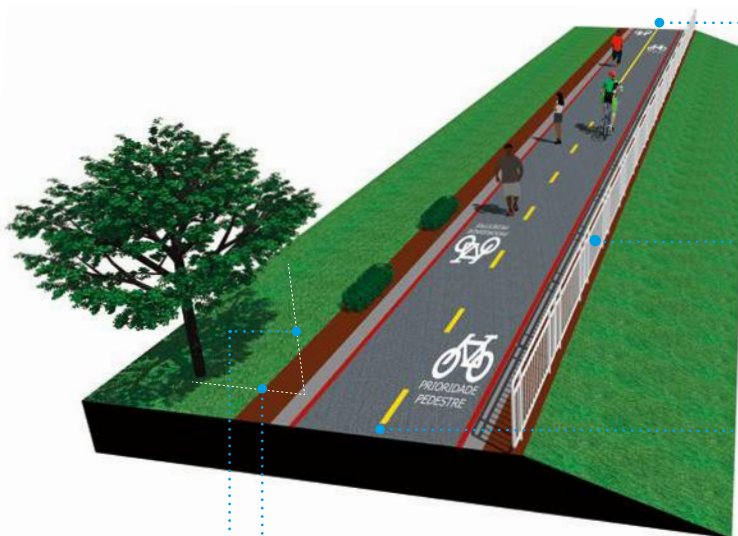
Source: Jacob Koch



9. GREENWAYS AND TRAILS

Greenways and trails can give cyclists and pedestrians access along infrastructure corridors (water channeling, sewage and electricity lines), watercourses and high speed roadways, creating a linear green space for recreation and transportation. Paths can be created using the natural surface of the land, and through ecological stormwater management to reduce initial costs. A uniform surface is necessary to ensure long-term use of the bike path system.

Polluted rivers and watercourses present common challenges and opportunities in cities around the world. Some streams are seen as threats due to sewage, garbage build-up, the possibility of contracting contagious diseases and other injuries resulting from flooding. Over the long-term, after targeted clean up efforts, these waterways can become a great asset to the communities: offering trails, fishing, natural beauty, etc.



START/END POINTS

The path should start at points where the connection with the bike path system is accessible, preferably at a controlled intersection at the beginning of a dead-end street.

FENCES

Fences should be used when the adjacent slope is greater than 3:1. Fence height should be 1.05 m above the trail surface.

DELIMITER MARKINGS

When delimiter markings are necessary use a central dotted line 10 cm wide. Unbroken central lines can be painted at narrow corners or corners with no visibility, and close to cross-roads.

SIDE CLEARANCE

There should be a clearance of 60 cm or more on both sides of the path. An additional side clearance of 30 cm is recommended for installing signage and other equipment.

UPPER CLEARANCE

Suspended obstructions must have minimum clearance of 2.5 m although 3 m is recommended.

MATERIAL AND MAINTENANCE

Experiences in other locations reveals that a combination of support from city hall with maintenance, and an ongoing sense of ownership by the community, are essential for the long-term success of greenways and trails.

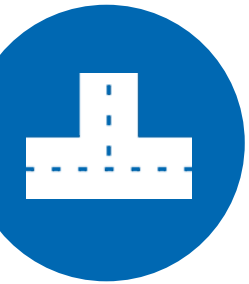
ADDITIONAL REFERENCES AND GUIDELINES

AASHTO (2012) *Guide for the Development of Bicycle Facilities*.

FHWA (2009) *Manual on Uniform Traffic Control Devices*.

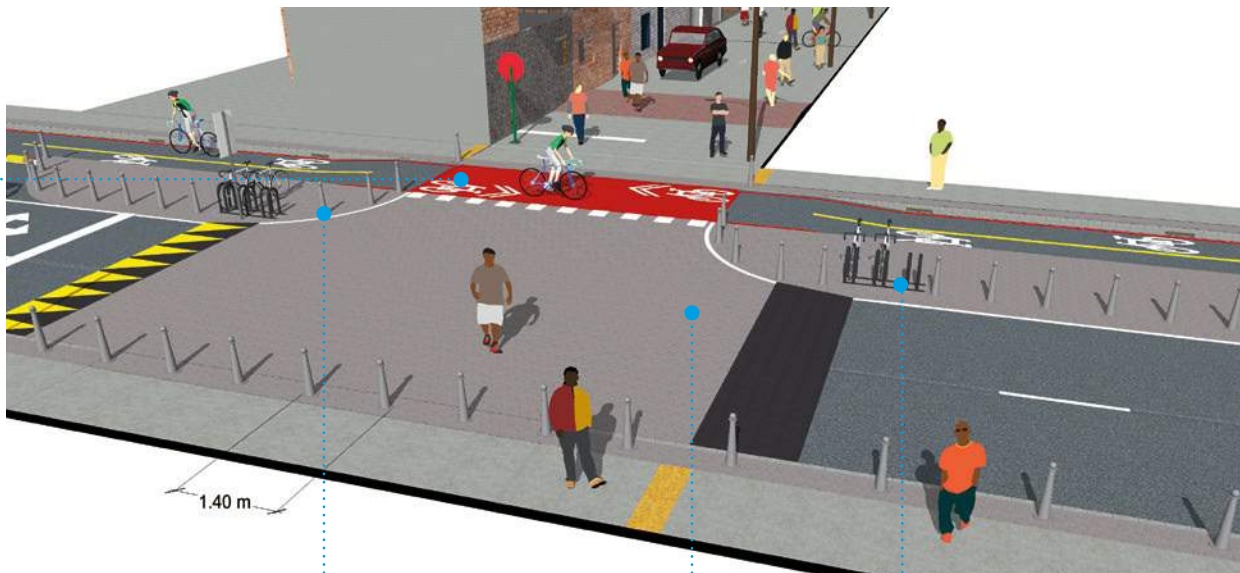
Flink, C. (1993) *Greenways: a guide to planning design and development*.

Ministry of Cities and Department of Transport and Urban Mobility (2007) *Reference guide for developing an: Urban Bicycle Mobility Plan. Guide 1. Brasília, DF*.

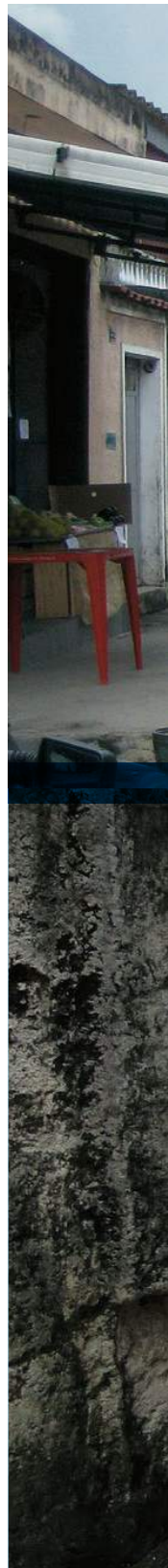


10. INTERSECTIONS AT COMMUNITY ACCESS POINTS

Community access roads, where there is usually a higher volume of motorized vehicles, have great potential for implementing a variety of bikeways and better access to public transportation.



- The intersection should be highlighted with markings on the asphalt: red paint, “elephant’s feet” markings and signage indicating the direction of bike flow. On raised levels, the bike path surface should be comprised of interlocking red concrete paver blocks, with compressive strength of 35 or 50 MPa.
- Bollards are positioned where motor vehicles tend to encroach into the sidewalk and park. This is a tendency on roadways with no parking lanes. The ideal spacing between bollards is 2 m, narrowing to 1.4 m where cars are able to maneuver over the sidewalk.
- Raised levels reduce motor vehicle speed and create a better cycling environment.
- Important destinations should have bike racks.





Source: Jacob Koch



Source: Jacob Koch



Source: Shutterstock

1



11. EXCLUSIVE AND SHARED LANES

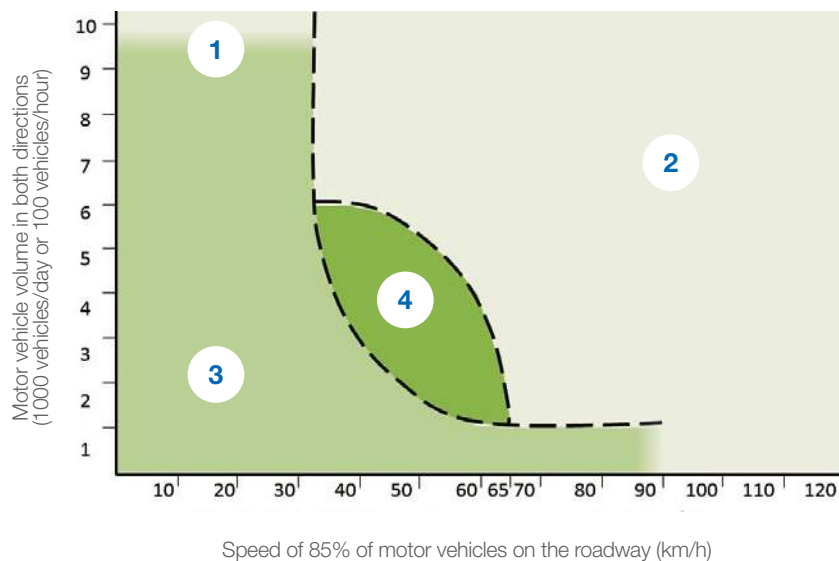
CHOOSING INFRASTRUCTURE FOR BICYCLES

The graph below, produced by the National Transportation Agency for Scotland, suggests infrastructure types according to the speed/volume characteristics of a roadway.



Source: My Transportation Blog

2



1. CONGESTED AREAS

Become unsuitable for cyclists on the roadway.

2. BIKE PATHS

Speeds in excess of 60 km/h make cycling unsuitable on the roadway, depending on the related conditions. In some areas like Copacabana beach, the space required for a bike path may require removal of one or more motor vehicle lanes.

3. SHARED LANES

The most common type of space for bicycles. This provides continuity to other infrastructure (usually bike lanes), or indicates preferred routes through high traffic corridors. Measures to reduce vehicle speed or volume are recommended.

4. BIKE LANES

Monitoring and enforcement is usually required to ensure motor vehicles do not park in the bike lane.



ONE-WAY VS. TWO-WAY

One-way bike paths and bike lanes are preferable because communication between cyclists, pedestrians and drivers of motorized vehicles is clearer.

Two-way bike paths are complicated for a driver turning at an intersection. A cyclist can travel at high speeds, reaching up to 30 km/h, and appear from behind cars parked along the curb just as the driver is checking the bicycle traffic coming in the opposite direction. In vehicles where the driver has low side visibility, such as trucks and vans, right-turning becomes particularly dangerous. In this situation, the driver must give way to cyclists traveling in both directions as well as pedestrians.

Furthermore, the right of way rules create doubt for cyclists when they are at an intersection with two two-way bike paths. In cases where many cyclists are approaching the intersection, they may have to wait for a chance to cross.

Since cyclists are vulnerable to detours, two-way bike paths are a possible solution in roadway systems with a lot of one-way streets. However, care must be taken to design safe intersections. When reduced speeds cannot be assured, intersections must be signalized. Bike routes where cyclists are obliged to give way to automobiles to guarantee their safety are considered low service level.

BIKE LANES

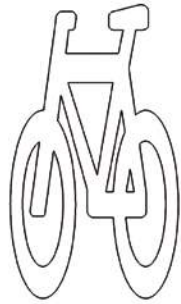
One-way bike lanes are at least 1.2 m (recommended: 1.5 m), and are located on the right-hand side of the roadway. They can be installed at curb-level, distinguishing them from other traffic flow by painting and raised markers. Two-way bike lanes are only permitted at curb-level, they must be well signaled and measure at least 2.4 m (recommended: 2.5 m).



Source: www.saidaciclovia.tumblr.com

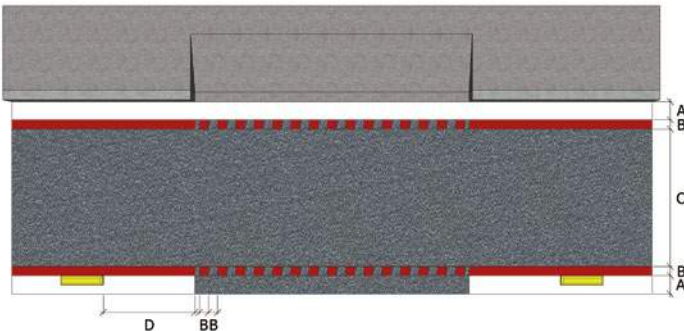
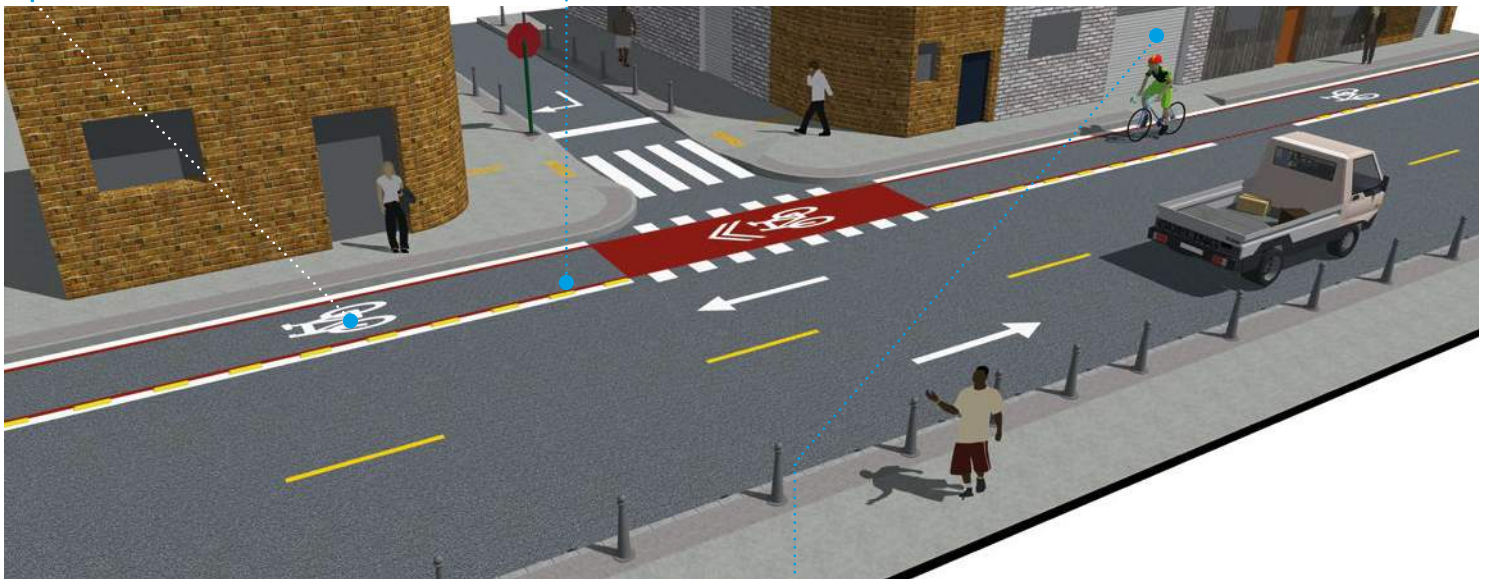


Source: Carolina Pires



Horizontal Signage

- Segregators to signal bike lanes at street level can be seen in Rio de Janeiro neighborhoods. This separation may not be enough to prevent drivers from parking and interrupting the flow of bicycle traffic.



- Motor vehicle entrances must be signaled with paint. The durability of the reflectors (cats-eyes) in areas of constant automotive traffic is generally low.

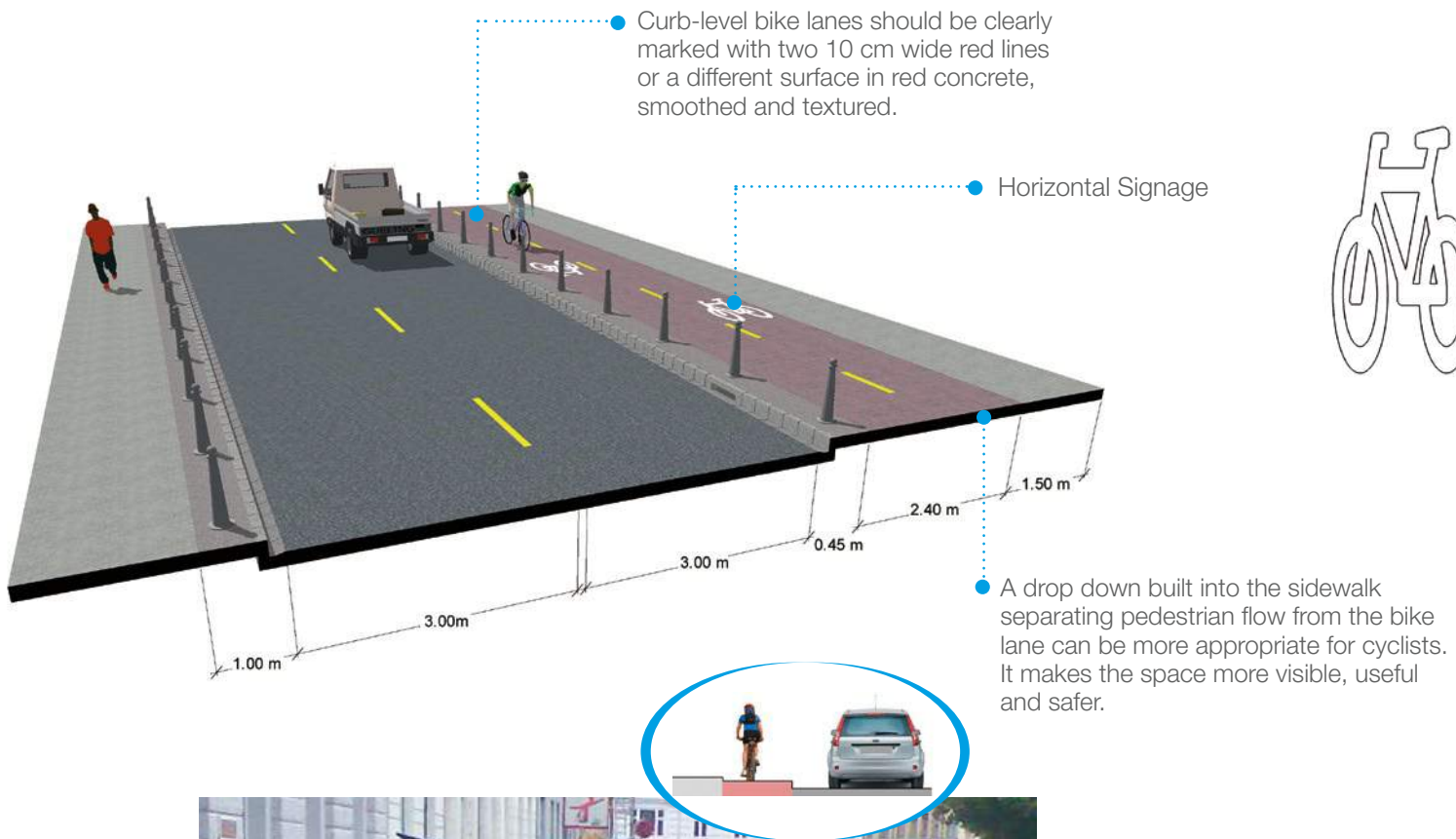
A = 20 cm

B = 10 cm

C ≥ 1.20 m

D = 1.00 m

Research carried out in Amsterdam and Copenhagen, two cities where bike transit is high, show that people do not like to ride on curb-level bike lanes. They usually prefer to share the road with vehicles rather than deal with unpredictable pedestrian movements.



Source: Irish National Cycling Manual

BIKE PATHS

Bike paths can be one-way or the two-way design although the two-way is more common in Brazil. The recommended width of bike paths depends on the bicycle flow:

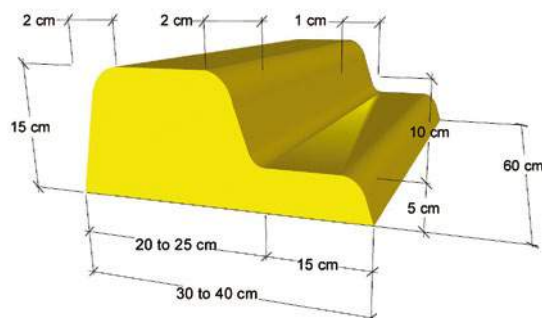
FLOW (bicycles/hour)	WIDTH OF THE ONE-WAY BIKE PATH (m)	WIDTH OF THE TWO-WAY BIKE PATH (m)
< 1000	from 1.20 to 2.50	from 2.40 to 3.00
from 1000 to 2500	from 2.50 to 3.20	from 3.00 to 4.00
from 2500 to 5000	from 3.20 to 4.00	from 4.00 to 6.00
> 5000	from 4.00 to 6.00	> 6.00

ADDITIONAL REFERENCES AND GUIDELINES

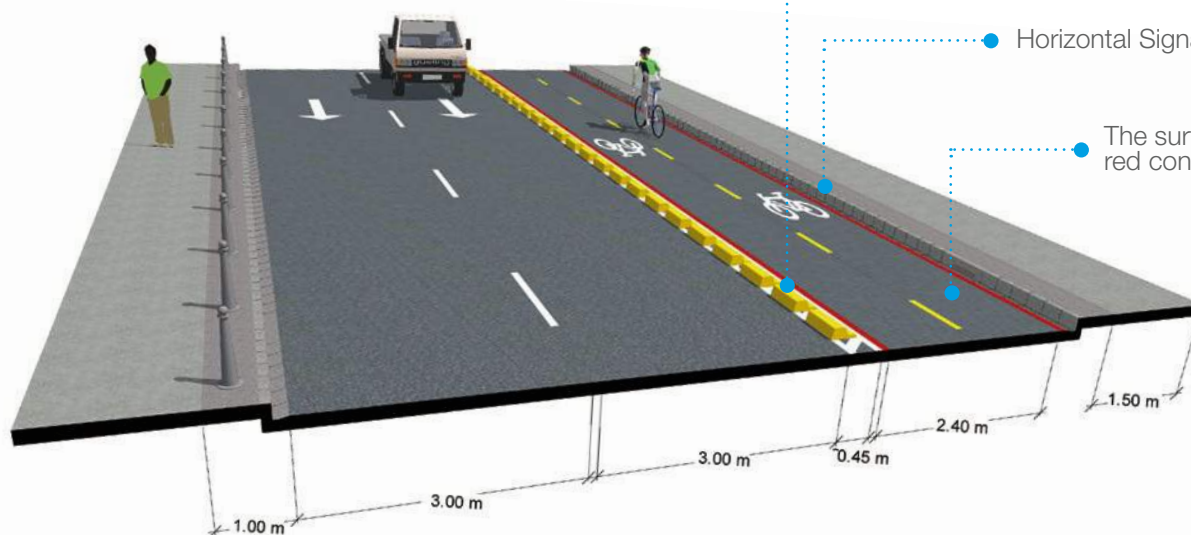
The Ministry of Cities (2007) Coleção Bicicleta Brasil. Brazilian Bicycle Mobility Program. Reference guides for developing an Urban Bicycle Mobility Plan. Department of Transportation and Urban Mobility.

Ministry of Cities (2007) Brazilian Traffic Signage Manual. Volume IV. Horizontal Signage. National Traffic Council. DENATRAN.

Rio de Janeiro City Hall (2014) Guides for execution of bike path projects. Municipal Environment Department.



An L-shaped concrete block is a good way to segregate the bike path. It prevents encroachment by cars and facilitates drainage, by allowing storm water to run-off between the blocks.



Horizontal Signage

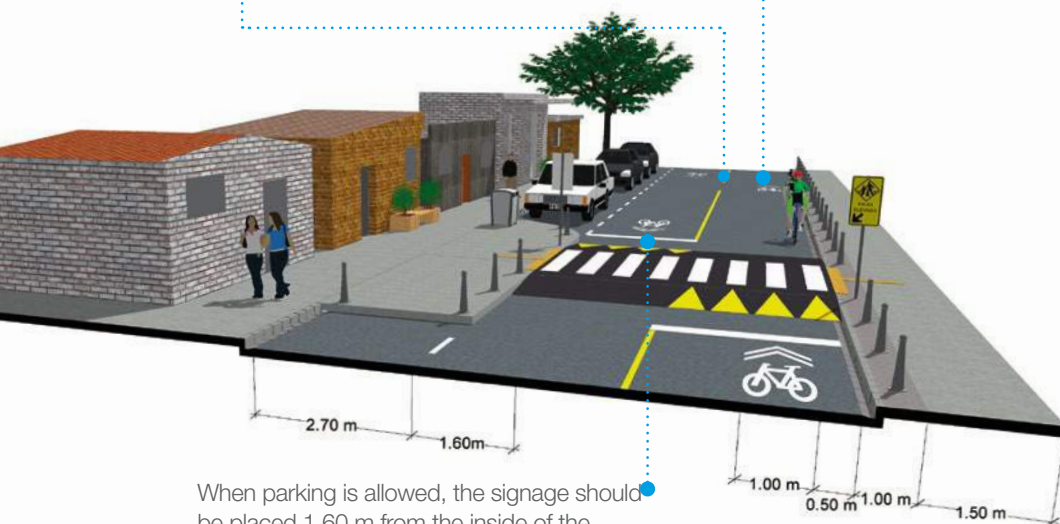
The surface can be asphalt or red concrete.

SHARED SPACES

Spaces shared between bicycles and motorized vehicles: roadways with a low motor vehicle volume and speed restricted to less than 40 km/h are generally safer for cyclists. To ensure low speed, traffic calming measures and horizontal signage should be provided to warn drivers about the presence of cyclists.

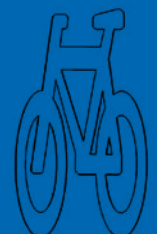
- Where roadways lack sufficient width to implement a segregated lane for bicycles, and vehicle volume is not high, a shared lane can be created using signage and by installing traffic restrictors.

- Horizontal signage for shared spaces installed 50 cm from the curb every 30 m, at most.



When parking is allowed, the signage should be placed 1.60 m from the inside of the white line demarcating the parking area.

Lanes shared between pedestrians and cyclists should only be used when spaces cannot be designated for each type of user. This is acceptable in segments of the bike path in order to complement it.



RIGHT OF WAY
TO PEDESTRIANS



Source: Mariana Gil/EMBARQ Brasil

RELATED URBAN ELEMENTS

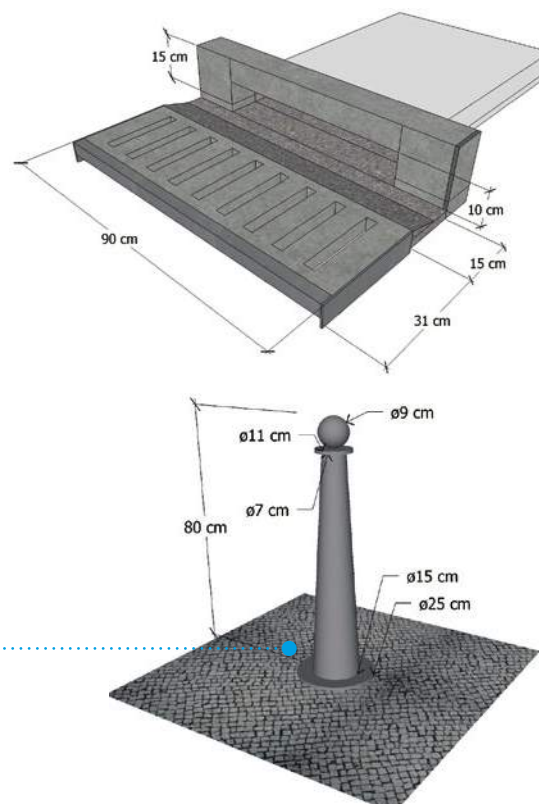
DRAINS

The position of bars on drains is important for cyclists' safety. If drains cannot be built outside bicycle routes, the gaps between bars should be at a right angle to the bike flow and should not measure more than 5 cm.

BOLLARDS

Bollards are installed on sidewalks to prevent vehicles from parking on the curb, blocking flow of pedestrians and cyclists. Usually made of cast iron and finished with grey powder paint, they should be visible and equipped involving reflectors.

The "frade" (friar) bollard found in Rio de Janeiro has rounded edges, which reduces the severity of accidents involving cyclists and pedestrians.





12. BIKEWAY ROUTES AT INTERSECTIONS

Surface painted markings indicate the preferred route for cyclists at intersections. They provide a clear border between the different traffic flows and guide cyclists along a direct route through the intersection.

Although segregated bike lanes and bike paths where pedestrians and cars are not permitted are safe and comfortable for cyclists, they can cause problems at intersections if the geometric design is not carefully assessed. A number of measures can be applied to resolve conflicts at intersections, such as prohibiting left turns or prohibiting pedestrians from crossing at intersections. Signage at intersections should also be designed to prevent conflicts by signaling and directing the various legal traffic flows.

In Denmark, a country with many cyclists and a well-developed bike path system, the most common accident between cars and cyclists occurs at right-turns by motorized vehicles. When approaching an intersection (or entrance to a parking facility), cyclists and drivers move in parallel to each other, each in their designated lane. However, when cars make a right-turn at an intersection, drivers can quite easily fail to see a cyclist, who has the right of way. In particular this happens when the vehicle's sides are closed off, as in the case of trucks and vans, where drivers rely exclusively on their rear-view mirrors to see cyclists before turning. Conflicts like this should never come as a surprise to the road users and should always be perceived in advance.

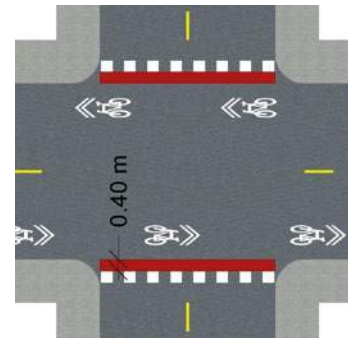


Bike Path Stuart Angel Jones, Av. Pasteur, Rio de Janeiro. Source: Alta Planning + Design

SIGNAGE AT INTERSECTIONS

At intersections between bike paths or bike lanes with roadways, surface painting can be used to increase visibility and reduce interference.

In addition to red paint, “elephant’s feet” markings are common in Rio de Janeiro. They are comprised of white squares with sides 40 cm wide, spaced 40 cm from each other. The *sharrow* should also be used to indicate the bike direction of the bike flow.



Crossings between shared spaces and public roadways must be signaled by painting an unbroken 40 cm wide red line, adjacent to the “elephant’s feet” and *sharrows*.

NON-SIGNALIZED INTERSECTIONS

For cyclists’ safety, motor vehicles must maintain low speeds at intersections. Raised crosswalks can be used to reduce speed at intersections with signals. However, in such cases, it is important to ensure that drivers approaching the intersection are able to perceive the cyclists’ intention to cross in advance in order to avoid accidents. Lanes dedicated to car parking remove cyclists from drivers’ line of sight.

Roundabouts also ensure low speeds. ●



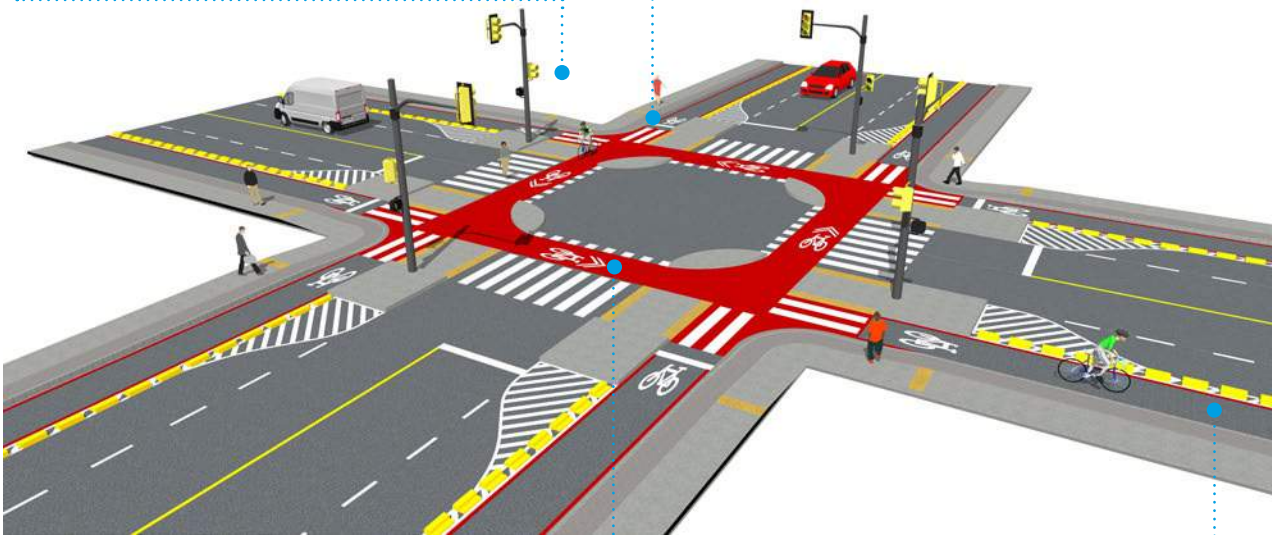
Bike path at a roundabout in the Netherlands. Source: www.carfreeinbigd.com

SIGNALIZED INTERSECTIONS

Special attention should be given when implementing two-way bike tracks at intersections. Alternate stop lines should be considered: the stop line for cars should be 5 meters before the stop line for bikes. Separate signals for cyclists are also recommended, providing 2 or 4 seconds in advance at the green light for cyclists.

- If bike traffic signals are introduced, the system can be programmed to allow right and/or left turns without conflicts.

- Alternate stop lines should be considered: the stop line for cars should be 5 meters before the stop line for bikes. This increases visibility and ensures right-turning drivers can see the cyclist.



- In addition to the “elephant’s feet” markings, it’s important to have signage indicating the direction of traffic flow to warn drivers.

- In the case of roads with parking lanes, the position most recommended for the bike path is between the sidewalk and the parking lane. This situation can only be implemented if the road is wide enough to guarantee the safety of cyclists and drivers getting in and out of vehicles.

- Bicycles are vehicles, even when on the sidewalk level. The crosswalk should be painted over the bike lane to warn cyclists to give way to pedestrians.

- The drop down corner is one solution when the bike lane is at sidewalk level, meeting the accessibility requirements. It must be safe for pedestrians and cyclists and signaled with tactile warning strips.



Stationary vehicles near corners can reduce visibility and present an accident risk. Right-turning cars cannot see crossing cyclists. There must be no stationary, off-loading vehicles or bus-stops on the approach to the intersection. The distance between the crossing and the start of the parking lane should be sufficient to allow visibility.



- Ending parking lanes well before corners prevents obstructing the flow of pedestrians and cyclists by parked vehicles. Source: O Globo



Driver visibility when **there are cars** parked on corners.



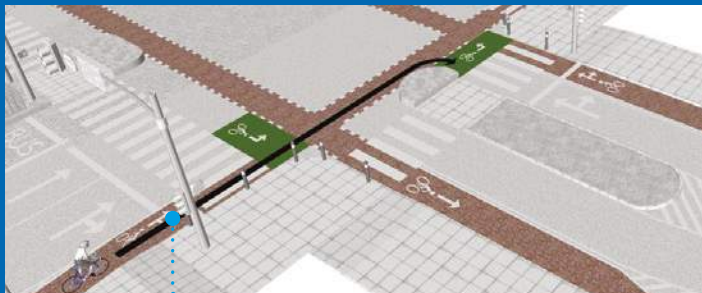
Driver visibility when **there are no cars** parked on corners.

HOW TO SAFELY HANDLE LEFT TURNS

The biggest safety concern at an intersection, when both sides of the road have bike infrastructure, is how to deal with left-turns by cyclists. According to NACTO, designers have several options, including areas in front of the vehicles (*bike boxes*) and waiting areas for two-stage turning. Use of two-stage turning areas is recommended. Cyclists who want to turn left should first cross through the intersection and then wait for the green light for the cross-street vehicles in the assigned area (*queue box*).

This is the international best practice and is also the option that minimizes conflicts between cyclists and other road users. Depending on the local context and prior experience with this type of solution, it can be a new and relatively uncommon configuration. The advantages of using it should be carefully weighed against the need for education and legislation in order to ensure cyclists use the *boxes* correctly.

If cyclists are not informed about how to use this infrastructure, introducing it may not necessarily bring any safety benefits. Other options to accommodate left-turns for cyclists should be considered.



- First stage of the left-turn. Cyclists should move forward during the green phase, stop in the (*queue box*) on their right and wait.



- Second stage of the left-turn. When the light changes to green for cross-street vehicles, cyclists can proceed straight across the intersection with the rest of the traffic. In these cases, it is extremely important to have a repeat traffic light after the intersection. Cyclists waiting to turn cannot see the traffic light located before the intersection and depend exclusively on the repeat light.

DISCUSSION

Additional markings such as borders, share lane signage or colored bike paths in conflict areas are strategies currently in use in Rio de Janeiro.

The agencies responsible for implementing markings at crossings must standardize designs to prevent confusion.

Special attention must be given when planning crossings, in order to minimize extremely dangerous conflicts between bicycles and right-turning vehicles.

ADDITIONAL REFERENCES AND GUIDELINES

MUTCD (2009) Section 3B.08: "dotted line intersections"

FHWA (2009) Manual on Uniform Traffic Control Devices.

NACTO (2012) Urban Bikeway Design Guide.

Rio de Janeiro City Hall (2014) Guides for execution of bike path projects. Municipal Environment Department.

Duduta, N., Adriaola, C.; Wass, C.; Hidalgo, D.; Lindau, L. A. (2012) Traffic safety on bus corridors. (Study report).

MATERIALS AND MAINTENANCE

Because the effectiveness of markings at crossings depends entirely on visibility, maintenance must have a high priority status. The standard material in Rio de Janeiro is white (elephant's feet) and red (center), executed using thermoplastic road marking paint.



13. LONG-TERM BICYCLE PARKING

Long-term parking facilities must provide a space with a higher degree of security than regular bike racks, allowing cyclists to leave their bikes for the entire day, overnight or for even longer periods. These parking areas can be accessed through an attendant on duty 24-hours and provide bike parking for 50 bicycles or more. Heightened safety measures or greater provision of police surveillance can create an additional transportation option for people concerned about theft and vulnerability.

Ideal locations include bus-stops, train stations and points of entry to communities with steep slopes (where residents cannot easily pedal uphill). Essential characteristics include:

- CC-TV monitoring.
- Double-decker racks and spaces for freight bicycles.
- Repair workshops.
- Vending machines dispensing tires' air chambers and other repair products.
- Racks – to allow cyclists to park and lock their bicycles.
- Secure access for users.





● Example of long-term bicycle parking stations in a private car parking lot.
Source: www.mobfloripa.com.br

● Double-decker racks make better use of vertical space and maximize parking capacity.
Source: Portland State University

DISCUSSION

Although long-term bicycle parking stations are more expensive than short-term facilities, they offer greater security. Despite some cyclists willingness to pay a fee to ensure their bicycles are securely parked, long-term bicycle parking should be free in areas where car parking is free.

ADDITIONAL REFERENCES AND GUIDELINES

APBP (2010) Bicycle Parking Guide 2nd Edition

AASHTO (2012) Guide for the Development of Bicycle Facilities.

MATERIALS AND MAINTENANCE

Regularly inspect the moving parts and security systems. Periodically change keys and access codes to prevent access by unauthorized users.



LONG-TERM PARKING INTEGRATED WITH PUBLIC TRANSPORTATION

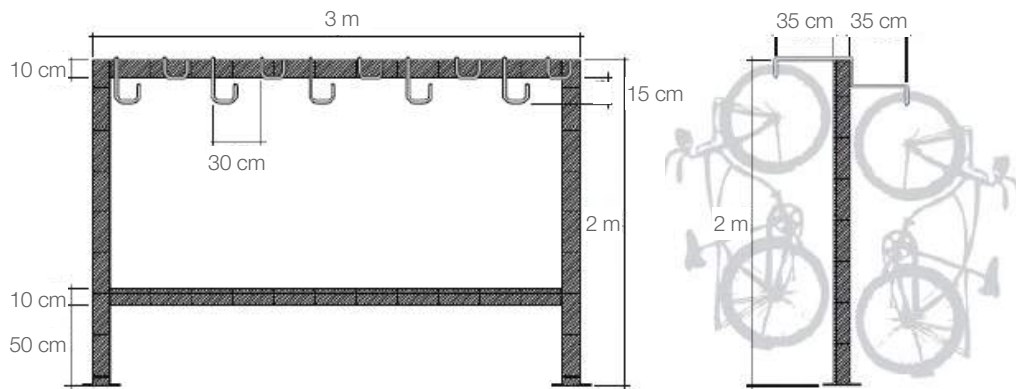
THE CASE OF BOGOTA

Investment in Bogota is directed towards maximum integration between high capacity buses and bicycles. A modern bicycle parking station with controlled access, good lighting and a ticketing system integrated with the public transportation system has been built in the Colombian capital.

THE CASE OF MAUÁ, IN SÃO PAULO

ASCOBIKE, the Mauá Cyclists Association Bicycle Parking Station in the state of São Paulo, is a well-known bicycle station in Brazil. It is located at the Companhia de Trens Metropolitanos (Subway Trains Company) station and is open 24/7.

It offers many services to members, including workshops, bicycle loans, racks, coffee, water and bathrooms. Members pay R\$ 10 per month and other users pay R\$1 per day to use the facilities.



Model of the racks used in Mauá, São Paulo. Source: ITDP + ASCOBIKE

ADDITIONAL REFERENCES AND GUIDELINES

ASCOBIKE: www.ascobike.org.br



Internal layout of the bicycle parking station integrated with the BRT Transmilenio in Bogota. Source: www.skyscrapercity.com



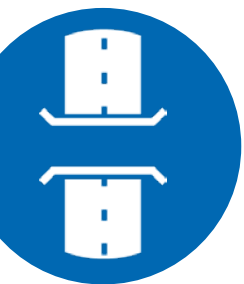
Bike parking station reception in Bogota. Source: www.designtrust.org



Mauá bicycle parking station entrance. Source: ASCOBIKE



Internal layout of the Mauá bicycle parking station. Source: ASCOBIKE



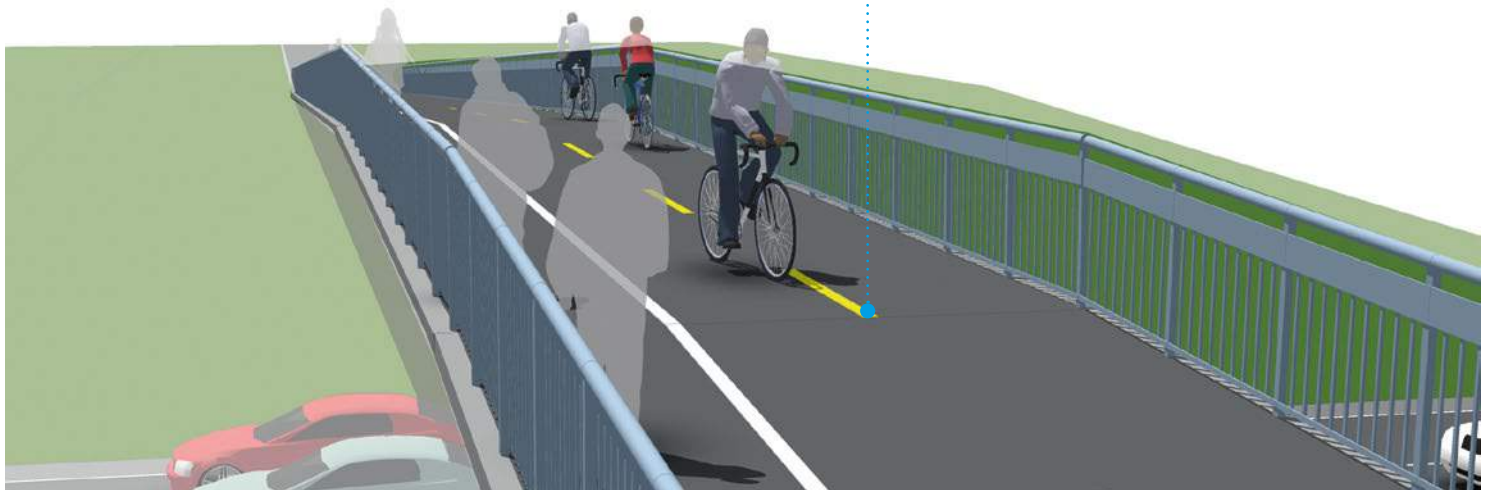
14. PEDESTRIAN AND CYCLIST OVERPASSES

Pedestrian/Cyclist overpasses are essential connections for crossing critical points such as waterways, wide traffic corridors and other barriers when arriving or leaving the communities, providing access to public transportation and other important destinations.

- Low fences can be unsafe for cyclists. According to the Brazilian National Standards Organization's, ABNT 9050, the fence must have a minimum height of 1.05 m.
- Overpasses for pedestrians and cyclists dismounted from their bikes should be at least 1.2 m wide.
- Overpasses with steps do not favor cycling. Ramps for pedestrians and bikes and staircases designed for bikes should be provided whenever possible.



Where cyclists can ride over, the minimum width is 2.4 m (preferably 4.2 m), with a 1.5 m lane exclusively for pedestrians. There must be an unbroken line separating cyclists and pedestrians, even when the remainder of the section does not.



DISCUSSION

In accordance with ABNT 9050: ramps must be installed at the edges of overpasses (not just stairs) so cyclists, person with carts and persons with reduced mobility can access the overpass. According to Brazilian standards, one ramp with a gradient of 5% (1:20) is recommended but steeper inclines are also permitted: between 6.25% and 8.33% (maximum). Landings must be installed to prevent ramps from exceeding 50 m in length.

ADDITIONAL REFERENCES AND GUIDELINES

AASHTO (2012) Guide for the Development of Bicycle Facilities

AASHTO (2004) Guide for the Planning, Design and Operation of Pedestrian Facilities.

DNIT (2010) Urban crossings design manual. Publication IPR – 740. Rio de Janeiro: Brazilian Department of Infrastructure and Transport: Brasil, Ministry of Transportation.

ABNT (2004) ABNT NBR 9050 Accessibility to urban buildings, street furniture, spaces and equipment.

MATERIALS AND MAINTENANCE

Possible problems with vandalism.

There may be a need to install a device that blocks access by motorcycles.



Metal device installed at the entrance to a bridge in Rome preventing motorcycle transit, by limiting the gap to allow passage of pedestrians and cyclists only.

Source: Luis Antonio Lindau/EMBARQ Brasil



15. BICYCLE ACCESS TO PUBLIC TRANSPORTATION

Typically, there are two additional journeys associated with public transportation: one journey to the bus stop and a second journey from the bus-stop to the final destination. Providing bicycle access to public transportation and space for bicycles on buses, subways and trains increases the viability of both public and bicycle transportation, especially when the distances between the journey start and end points are very long.

- Maps at the main stops and stations show nearby bicycle routes.

- The route from the bicycle parking facilities to the stops/stations must be visible and well lit.

- Provide direct and convenient access to stations from bikeways and sidewalks using signs and road markings.



- Provide secure long-term parking facilities such as lockers with padlocks close to bus stops, etc. Parking facilities should be easy to use and well maintained. Signs should show where the parking facility is located, and rules and instructions for use, when needed.

Bicycle lockers near a BRT Orange Line station in Los Angeles, USA.

Source: Mariana Gil/EMBARQ Brasil



THE CASE OF FUNCHAL

The steep hills of Funchal, the Portuguese city on Madeira Island, discourage its residents from cycling around the city. To overcome this physical barrier, the public transportation operator implemented a program called Bus & Bike, where cyclists can lock their bikes and climb to the hilltops by bus.

Launched in September, 2010, the Bus & Bike program is the basis of the city's concept of sustainable mobility. It offers cyclists a choice of five lines that cross the city and connect hilly sections with flat sections.

THE MAIN GOALS OF THIS PROGRAM ARE:

- To integrate bicycle and bus routes, thereby promoting sustainable mobility options.
- To create a friendlier and healthier urban environment.
- To dismiss the myth that the bicycle is not an appropriate means of transportation for daily life.
- To reduce the intensity of private transportation by making the bicycle more attractive to tourists and residents.

ADDITIONAL REFERENCES AND GUIDELINES

Civitas Mimosa. Cleaner and better transportation in cities:
www.civitas-mimosa.eu

Funchal's western and central coastal area is flat and appropriate for cycling, but the city's mountainous areas make many people think twice before using their bikes. This changed with the development of Bus & Bike. To encourage cyclists to use buses, there is no additional fee for users who want to take their bikes with them and instructions are displayed on the buses to help new users.

THE KEY RESULTS OF THIS SYSTEM ARE:

- 70% increase in the level of bicycle use – people are cycling more often and intend to maintain their current level or even increase it in the future.
- 56 bikes transported on public transportation in one year – this result is much lower than predicted but there is evidence indicating that some public transportation users are considering using Bus & Bike service in the future.

It is important to point out that Funchal launched Bus & Bike at a time when cycling levels and development were very low. Since changes in transportation habits generally occur over the long term, significant changes are unlikely to be achieved within the first two years after implementation. Therefore, the slow but positive trends related to changes in bike usage should be considered positive and promising steps towards the development of a city that favors cycling.

THE BIKE LANE AND CONFLICTS WITH BUS STOPS

The preferred solution to avoiding conflicts between cyclists and bus stops is to install small bicycle paths running behind the bus stops in order to prevent collisions between cyclists and passengers getting on or off buses.

MAIN CONFLICTS:

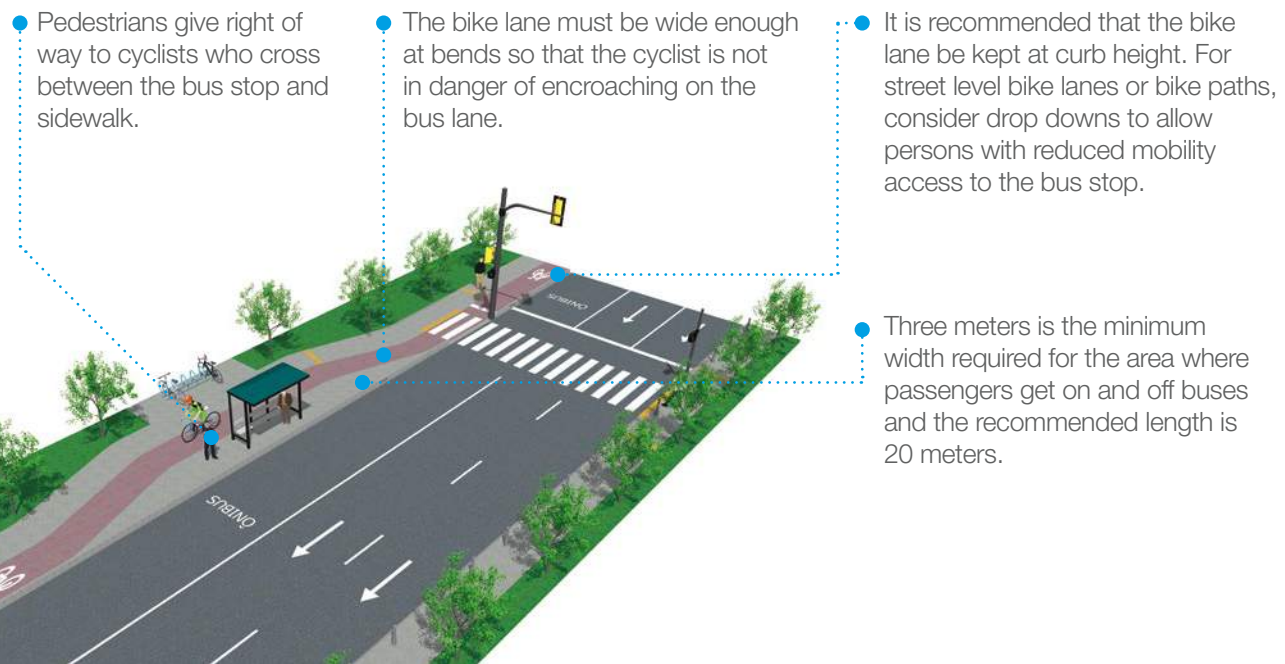
- Passengers waiting at a bus stop might cross or wait on the edge of the bicycle lane.
- Bus shelters can obstruct a cyclist's view and make conflict prevention more difficult.

It must be acknowledged that it is not always possible to provide conflict-free access for all users. However, it is important to ensure easy access to bus stops for all persons with reduced mobility. When choosing the design, it is important to consider whether the cyclist flow will be prioritized, or whether they must give the right of way to pedestrians.

Regardless of the chosen design, the cyclist-friendly bus stop must meet at least the following requirements:

- The design must meet ABNT 9050 requirements.
- Areas where bicycles can be securely parked must be provided at bus-stops where there is a demand, or in areas where this demand can be developed.

RIGHT OF WAY FOR CYCLISTS



RIGHT OF WAY FOR PEDESTRIANS

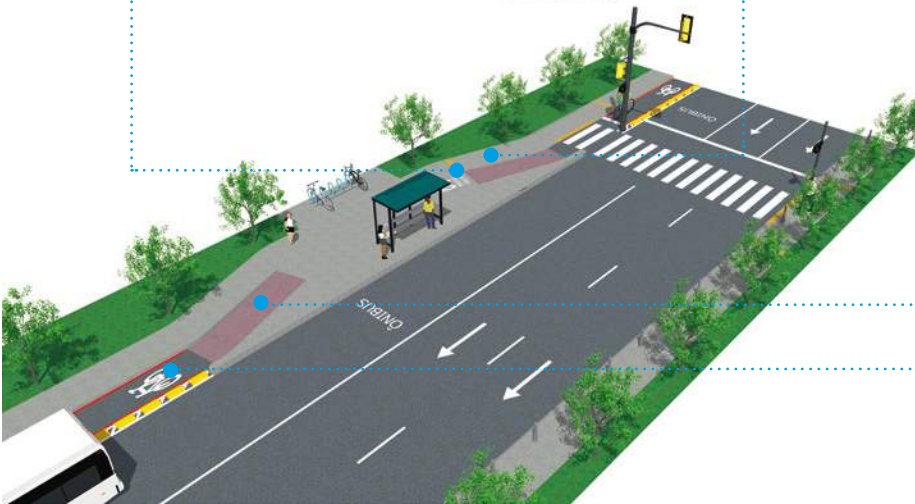
- Cyclists must give way to pedestrians crossing between the bus stop and the crosswalk. Signage:



- It is important that the design and the markings ensure that cyclists reduce their speed and give way to pedestrians crossing shared spaces.

- Street level bike path. This option of priority for pedestrians can also be implemented with curb-level bike lanes.

- Ramp



DISCUSSION

Bringing bike routes to public transportation helps to combine bus, train and subway routes with the “door-to-door” cycling service. The route can impose huge obstacles on cycling, including distance, hills, busy roadways, nighttime cycling, inclement weather and poor surfaces.

High visibility crossings and mid-block crossings are appropriate to provide safe access to bus stops for pedestrians and cyclists, in particular high demand bus stops. If a bus stop is situated mid-block, appropriate crossing treatments should be provided based on the level of traffic flow. All users must cross the road to access or leave the bus stop.

ADDITIONAL REFERENCES AND GUIDELINES

Rio de Janeiro City Hall (2014) Guide for execution of bike path projects.
Municipal Environment Department.

Irish National Cycling Manual: www.cyclemanual.ie



CHAPTER 5

IMPLEMENTATION



OVERVIEW

Cycling is just one element of the communities' complex mobility network. However, it offers an economically realistic form of transportation and recreation. The approach to upgrade cycling conditions requires a variety of alternatives, including upgrades to infrastructure and cycling support programs, such as education and incentive programs.

Potential projects and programs to increase cycling in the communities can only be developed in collaboration with local residents and organizations. This includes not just listening to what the residents want and need but also incorporating their suggestions in the implementation (even in small measures), so that residents know they are being heard and their involvement is being taken seriously. Participation is important to establish a sense of ownership, which is essential for the investments to be adequately looked after and maintained. Workshops and gatherings of members of the community can be organized to develop and fine tune ideas and identify local volunteers for the programs.

The bikeways infrastructure requires a network of facilities similar to those built for automobiles and public transportation. A local network should improve internal access within each community. Connections between communities and the formal city are needed to promote access to work posts and other services. A bike path plan should provide guidance on providing the necessary infrastructure at both community and city level.



MANAGEMENT

Several government departments and organizations in Rio de Janeiro are responsible for public projects, which include water, transportation, housing, schools and other services. Areas designated for programs that involve education, traffic control and enforcement, employment training, public health and the environment are also included in issues that can be part of a broader cycling program. Integrating the resources of these different entities can provide support to improve cycling in communities.

Collaboration and partnerships can promote meaningful opportunities. For example, constructing a bike path can create local job opportunities in metallurgy, organization and management of small businesses and manufacturing and sale of cycling clothing and accessories, etc. Some of these initiatives can be taken to larger local industries, creating an opportunity to manufacture products for domestic and international markets. With limited resources it is important to consider cycling's potential, in addition to simply riding bikes, including broader community initiatives in relation to health, safety, environment, economy and quality of life.

It is possible that many improvements in cycling will be created when integrating the efforts of existing projects. A movement launched in the United States called *complete streets* is expanding to encompass policies that include walking, cycling, public transportation and other improvements within large scale public projects. Initiatives like this can create new solutions for cycling as a component of projects that are already being funded.



MAINTENANCE

The Municipal Conservation Department (SECONSERVA) is responsible for preservation of the city of Rio de Janeiro's public spaces; it carries out necessary maintenance and oversees public lighting and cleaning. However, local organizations and residents can also get involved in the maintenance and management of the bike path infrastructure.



For example, using local manpower to manage secure parking facilities and bike path cleaning.

CONNECTION WITH THE FORMAL CITY

For a city to be bicycle-friendly it must provide connections that allow cyclists to travel safely between neighborhoods. While the majority of bike infrastructure inside communities can be installed on low-speed roadways, outside of the communities high-speed roadways and high traffic volumes must be considered. It is important that these spaces do not serve as barriers between the communities. Bikeways with suitable design can be installed along paths and waterways to ensure connectivity throughout the city. It is essential that the infrastructure is complemented by signage, maps and guides to support non-motorized routes.



In communities like Santa Margarida, cycling provides and promotes sustainable transportation. Safe connections with the broader city encourage people to use their bicycles outside their immediate neighborhood. Source: Image from the Catalytic Communities' short film: "Favela as a sustainable model"; www.catcomm.org.

COLLABORATION WITH LOCAL RESIDENTS

This includes not just listening to what the residents want and need, but also incorporating their suggestions into the implementation so that residents know they are being heard, and their involvement is being taken seriously.

FUNDING

Initiatives to improve cycling in communities can benefit from a wide variety of public and private funding, as well as assistance from NGOs. There are opportunities for self-sustaining 'organic' local projects in the neighborhoods, right up to large scale projects financed by infrastructure programs or investment from private sources. Examples include banks that support bike sharing systems and health authorities that invest in cycling promotion initiatives. The private sector may also be interested in building specific projects.

SEQUENCING

There is a lot of interest in building a bike path system in Rio with long-term planning, improvements and continued maintenance. This involves identifying priority projects, mobilizing resources and implementing these initiatives. The Morar Carioca program has been doing this: a phased approach, prioritizing pilot-projects that test new concepts. Larger projects, such as bike paths along the oceanfront, should be developed in parallel with short-term efforts, such as safe cycling education programs and installation of bicycle parking stations. As mobility within the neighborhoods is improved, the connections between the communities and the rest of the city become essential. With this method of sequencing, the entire city becomes safer, healthier and more egalitarian.

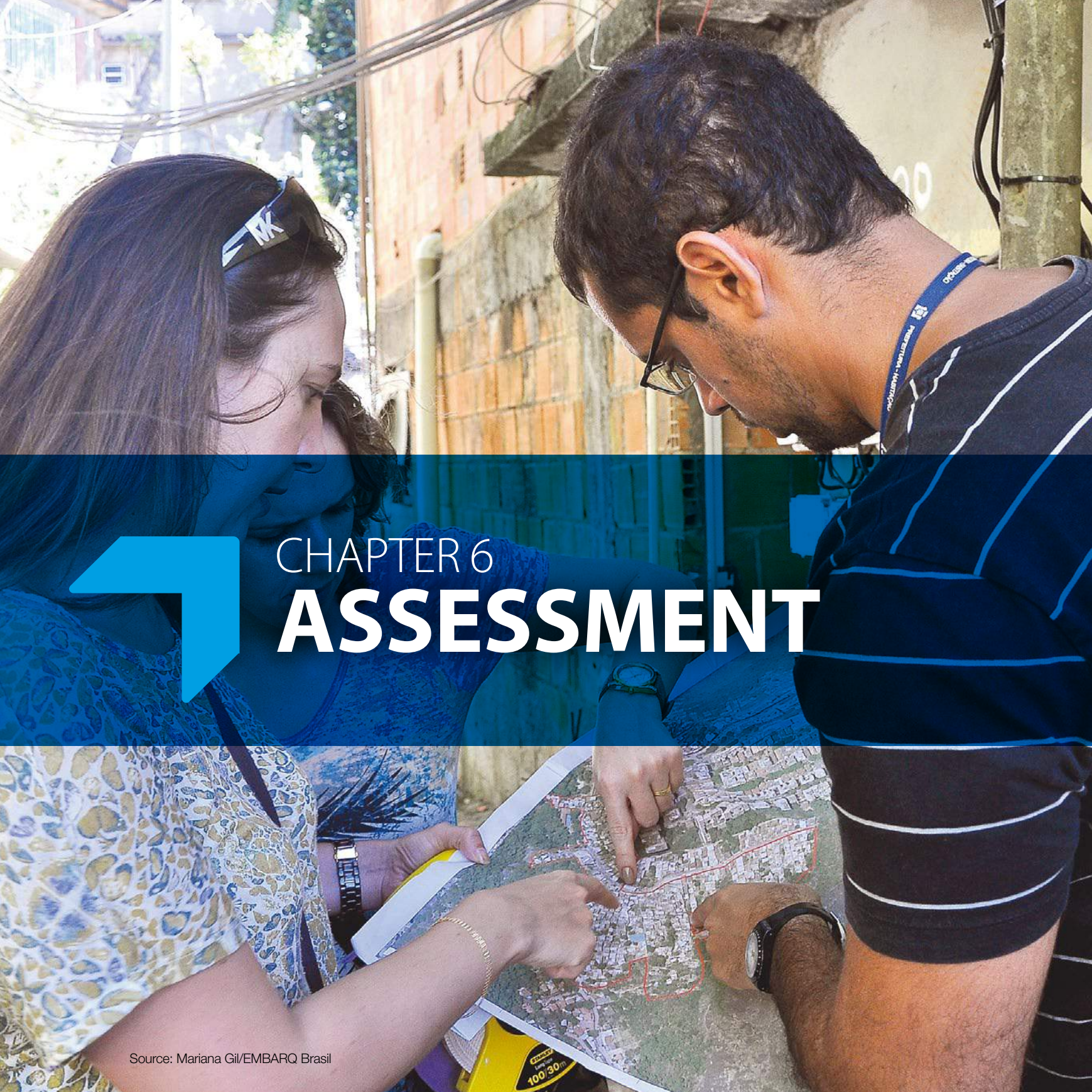
PLANNING THE STAGES

There is a lot of interest in building a bike path system in Rio with long-term planning, improvements and continued maintenance. As mobility within the neighborhoods is improved, the connections between the communities and the greater city become essential.





Source: Alta Planning + Design



CHAPTER 6

ASSESSMENT



MEASURING RESULTS

The Health Economic Assessment Tool (HEAT) helps designers conduct an economic assessment of the health benefits of walking or cycling by estimating the value of reduced mortality that results from specific amounts of these activities.

Examples of HEAT application:

- To produce a cost-benefit ratio (and help attract investment) by comparing the cost of implementing interventions against a value HEAT attaches to the level of infrastructure use by pedestrians and cyclists.
- To measure the reduced mortality compared to past and/or current levels of cycling or walking.
- To illustrate the economic consequences of a possible change in the levels of walking and cycling.

ADDITIONAL REFERENCES AND GUIDELINES

www.euro.who.int/HEAT



COMPARATIVE ANALYSIS: **BEST PRACTICES**

The growing opportunities for cycling in communities result in quantifiable benefits. As people start cycling more often, individuals and communities all over Rio de Janeiro can enjoy the new economic, health and environmental benefits. These benefits have been carefully projected and measured over many years in cities and countries known for their quality of life. Rio de Janeiro, in its communities, has been achieving some progress in this respect, with this manual serving as a starting point, a reference point and a tool for tracking future progress.



BENEFITS

It is recommended that an analysis of benefits be carried out to demonstrate the actual return on the initial investment in cycling programs and infrastructure, helping to attract continued economic development in communities. An annual estimate of travel modes (by bike, on foot or by car, for example), should be combined with the distance traveled using each mode, providing an estimate of the total number of kilometers walked or cycled. Many benefits can then be quantified, including improvements in public health, reduced carbon emissions and increased access to mobility.

Continued efforts to track increases in the levels of cycling and to quantify the resulting benefits are valuable tools to demonstrate the value of cycling projects in communities. A broad comparative analysis can track progress related to the goal of improving the quality of life of the residents of Rio de Janeiro's communities. This will provide quantitative data on the individuals and the benefits achieved. An annual report can both highlight the projects' successes and identify opportunities for improvement.



FOSTER ECONOMIC DEVELOPMENT IN COMMUNITIES

It is recommended that an analysis of benefits be carried out to demonstrate the actual initial investment return in cycling programs and infrastructure, helping to attract continued economic development in communities.



THE EFFECTS OF **ORGANIZED AND WELL-BUILT INFRASTRUCTURE**

CASE STUDY: SUSTAINED IMPLEMENTATION AND EVALUATION OF PEDESTRIAN SAFETY MEASURES IN NEW YORK CITY

New York City is known for improvements in pedestrian safety in particular, and road safety in general. A major factor in the declining pedestrian fatality rate in the city is the continued implementation of safety measures and evaluation of their performance. The annual pedestrian fatality rate fell from 5.8 deaths per 100,000 people to 2.0 per 100,000 people in the 2000–2009 decade.

To develop a pedestrian safety strategy, more than 7,000 severe and fatal pedestrian injury crashes in New York City were analyzed to identify the causes, risk factors and spatial distribution of these crashes.

THE ANALYSIS REVEALED THE FOLLOWING:

- Pedestrians were ten times more likely to die than motor vehicle occupants in the event of a crash.
- Driver inattention was cited in nearly 36% of crashes resulting in deaths or serious injury.
- 27% of crashes that killed or seriously injured pedestrians occurred as a result of driver failure to yield while turning at an intersection.
- High speed and limited field of vision were cited as risk factors in 21% of fatal and serious pedestrian crashes.
- 8% of all fatal pedestrian crashes involved drivers who had been drinking. However, this may be an underestimate since data suggest that drivers leave the scene in about 21% of the fatal and serious injury crashes.
- 80% of crashes that killed or seriously injured pedestrians were caused by male drivers.
- Most residents of New York City did not know that the speed limit in the city is 30 km/h.
- 47% of pedestrian fatalities occurred on major two-way streets in Manhattan, where the two largest business districts are located.
- 74% of pedestrian accidents occurred at intersections, with 47% of pedestrian fatalities and severe injuries occurring at intersections with signs.
- 79% of the crashes that killed or seriously injured pedestrians involved private vehicles as opposed to taxis, trucks and buses.

- Elderly pedestrians (over 65 years old) accounted for 38% of all pedestrian fatalities and 28% of severe injuries.
- Manhattan had four times as many pedestrians killed or severely injured per mile of street compared to other parts of the city.
- 43% of pedestrians killed in Manhattan lived in another borough or outside of New York City.
- 40% of pedestrian crashes occurred in the late afternoon and/or early evening.
- Late night pedestrian crashes were nearly twice as deadly as other time periods.

The New York City Department of Transportation formulated a pedestrian safety action plan involving other key agencies, such as the New York City Police Department, New York City Department of Health and Mental Hygiene, and New York State Department of Motor Vehicles. The action plan focuses on a combination of highly targeted engineering, enforcement and education/public information measures. Implementation began immediately, starting with strengthening already existing actions. Many measures set out in the plan that have already been implemented include:

- annual re-planning of 30 kilometers of roads with high accident rates;
- installation of pedestrian countdown signals at 1,500 intersections;
- implementing 30 km/h speed limits in school areas;
- implementing 30 km/h speed limits in residential areas;
- conducting public information campaigns and speed limit enforcement along major roadways and intersections where drivers normally fail to yield.

In addition to pedestrian safety measures, there are a number of other measures being implemented in order to reduce road traffic injuries and fatalities in general.

An evaluation of 13 recent safety measures implemented in New York City included pedestrian interventions, such as all pedestrian phase at traffic signals, high visibility crossings, increasing pedestrian crossing time, split-phase timing, pedestrian fencing, road diet (reduction in the number of travel lanes, with added turning lanes), speed bumps and speed limit reduction. Split-phase timing, traffic light installations, high-visibility crossings, all pedestrian phase and increasing pedestrian crossing time were found to reduce pedestrian and total crashes by 25–51%. Measures with lesser effect were posted speed limit reduction signs, and middle block pedestrian fencing.

BEFORE



AFTER



ADDITIONAL REFERENCES AND GUIDELINES

World Health Organization (2013) Pedestrian Safety: a road-safety manual for decision makers and practitioners.





**MORAR
CARIOCA**

Plano
Municipal
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