Urban Bikeway Design Guide

WORKING PAPER

Designing for Small Things With Wheels

February 2023

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Designing for Small Things With Wheels

Updating the *Urban Bikeway Design Guide*

Designing for Small Things With Wheels is one of seven working papers being released by NACTO as part of the ongoing update to the NACTO *Urban Bikeway Design Guide*. The working papers will cover topics related to equitable planning, engagement, and implementation. The papers will help inform project delivery concerns and policy considerations that should accompany the design updates in the guide. NACTO will develop a complete update to the *Urban Bikeway Design Guide* in 2023 by synthesizing these working papers with state-of-the-practice design guidance.

Making Bikes Count: Effective Data Collection, Metrics, & Storytelling

Breaking the Cycle: Reevaluating the Laws that Prevent Safe & Inclusive Biking

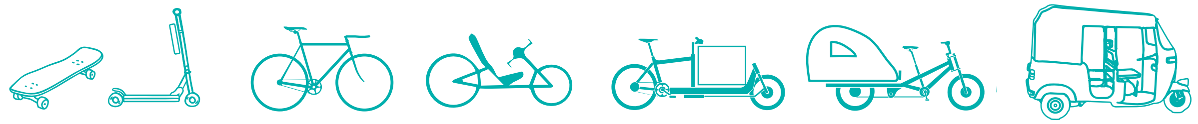
Shared Micromobility Permitting, Process, and Participation

Moving Together: Collaborating with Communities for More Equitable Outcomes

Designing for Small Things With Wheels

Material Success: Designing Durable Bikeways

Complete Connections: Building Equitable Bike Networks



Micromobility requires shifts in infrastructure design

The combination of more varied and faster speeds, a wider variety of device sizes, and more riders overall requires new thinking about street and bikeway design. To build better bikeways and meet All Ages & Abilities[1] street design standards, transportation practitioners are reassessing bikeway design principles and practice.

Over the past decade, biking and the use of shared micromobility has soared in North America—people in the U.S. have taken half a billion trips on shared bike and e-scooter systems since 2010,[2] and e-bike sales in the U.S. grew three-fold between 2019 and 2021.[3] This increase has come on an astonishingly wide variety of new devices. In addition to pedal bikes, e-bikes, e-scooters, cargo bikes, sit-down scooters, and powered skateboards are all increasingly common on North American city streets. These “small things with wheels” come in different sizes, move at a wide range of speeds, handle turns and surfaces differently, and attract people with varying degrees of skill and expertise.

Ensuring a safe, comfortable trip for everyone, regardless of device type, is essential for designing All Ages & Abilities bikeways. The broader range of speeds created by the increase in electric and electric-assist devices means that planners and engineers are reconsidering design criteria for bikeway widths to accommodate comfortable riding and passing. Rapid growth in cargo bikes and trikes for deliveries and family transportation means that many devices in a bikeway are wider, longer, and have larger turning radii than typical bikes. E-scooters have smaller wheels than bicycles and handle surfaces, bumps, grates, and gradients differently than devices with larger tires.

To safely accommodate and encourage these new uses and modes, planners and engineers are revisiting bikeway design practices, including passing widths, queueing lengths, turn radii, grade changes, and surface materials. This paper explores these and other design considerations to ensure that people using the evolving variety of small things with wheels can comfortably ride in urban bikeways.

Note for the reader:

This paper was developed with U.S. customary units for distance (i.e. the Imperial system). For practical international use, the metric units included parenthetically are rounded and do not represent exact conversions.

Strategies for designing for all ages, abilities, and micromobility options

In most cases, bike lanes are the best, safest, and most comfortable place for people using the wide array of (often electrified) small things with wheels. To ensure bikeway design is inclusive of all potential riders—regardless of which wheeled device they ride—designers need to accommodate more people using bikeways with higher speed and size differentials. Effective All Ages & Abilities design will increase comfort and safety for everyone. The new array of vehicle types, sizes, and speeds, requires updated design thinking in four key arenas:

LANE WIDTHS
Allocate extra width to accommodate wider devices and passing
PAGE 9 →

INTERSECTIONS
Create safe and maneuverable spaces at intersections and driveways
PAGE 18 →

SURFACES AND GRADIENTS
Provide smooth surfaces for devices with small wheels
PAGE 23 →

NETWORK LEGIBILITY
Make the best place to ride obvious
PAGE 27 →

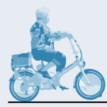
Source: Jonathan Maus/Bike Portland

Who is the “All Ages & Abilities” User?

To achieve growth in bicycling, bikeway design needs to meet the needs of a broader set of potential bicyclists. Many existing bicycle facility designs exclude most people who might otherwise ride, traditionally favoring very confident riders, who tend to be adult men. When selecting a bikeway design strategy, identify potential design users in keeping with both network goals and the potential to broaden the bicycling user base of a specific street.

Children

School-age children are an essential cycling demographic but face unique risks because they are smaller and thus less visible from the driver's seat than adults, and often have less ability to detect risks or negotiate conflicts.



Seniors

People aged 65 and over are the fastest growing population group in the US, and the only group with a growing number of car-free households.[12] Seniors can make more trips and have increased mobility if safe riding networks are available. Bikeways need to serve people with lower visual acuity and slower riding speeds.

Women

Women are consistently under-represented as a share of total bicyclists, but the share of women riding increases in correlation to better riding facilities.[13] Concerns about personal safety including and beyond traffic stress are often relevant. Safety in numbers has additional significance for female bicyclists.

People Riding Bike Share

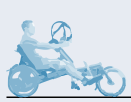
Bike share systems have greatly expanded the number and diversity of urban bicycle trips, with over 28 million US trips in 2016.[14] Riders often use bike share to link to other transit, or make spontaneous or one-way trips, placing a premium on comfortable and easily understandable bike infrastructure. Bike share users range widely in stress tolerance, but overwhelmingly prefer to ride in high-quality bikeways. All Ages & Abilities networks are essential to bike share system viability.

People of Color

While Black and Latinx bicyclists make up a rapidly growing segment of the riding population, a recent study found that fewer than 20% of adult Black and Latinx bicyclists and non-bicyclists feel comfortable in conventional bicycle lanes; fear of exposure to theft or assault or being a target for enforcement were cited as barriers to bicycling.[15] Long-standing dis-investment in street infrastructure means that these riders are disproportionately likely to be killed by a car than their white counterparts.[16]

Low-Income Riders

Low-income bicyclists make up half of all Census-reported commuter bicyclists, relying extensively on bicycles for basic transportation needs like getting to work.[17] In addition, basic infrastructure is often deficient in low-income neighborhoods, exacerbating safety concerns. An All Ages & Abilities bikeway is often needed to bring safe conditions to the major streets these bicyclists already use on a daily basis.



People with Disabilities

People with disabilities may use adaptive bicycles including tricycles and recumbent handcycles, which often operate at lower speeds, are lower to the ground, or have a wider envelope than other bicycles. High-comfort bicycling conditions provide mobility, health, and independence, often with a higher standard for bike infrastructure needed.

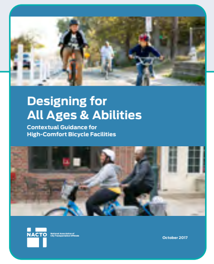
People Moving Goods or Cargo

Bicycles and tricycles outfitted to carry multiple passengers or cargo, or bicycles pulling trailers, increase the types of trips that can be made by bike, and are not well accommodated by bicycle facilities designed to minimal standards.

Confident Cyclists

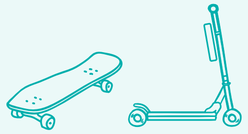
The small percentage of the bicycling population who are very experienced and comfortable riding in mixed motor vehicle traffic conditions are also accommodated by, and often prefer, All Ages & Abilities facilities, though they may still choose to ride in mixed traffic.

Source: NACTO, *Designing for All Ages & Abilities: Contextual Guidance for High Comfort Bicycle Facilities*.



Common devices in urban bikeways

The most common devices people ride in urban bikeways fit into one of four operational categories: mini devices, typical bikes, cargo bikes, and extra-large bikes. Devices that require a driver’s license and vehicle registration, such as mopeds, are not considered in this paper as a potential bikeway user.



MINI DEVICES

People riding electric and non-electric scooters, skateboards, rollerblades, and other devices are typically riding or rolling upright on small wheels. Many people who use wheelchairs and personal mobility devices also use bikeways.

In cities with shared e-scooters systems, people on e-scooters may be one of the most prevalent bikeway users.

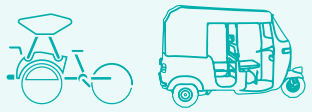
Electric options for **mini devices** are motor driven and typically limited to 8-15 mph (12-25 km/h).

TYPICAL BIKES

People riding electric and non-electric upright bikes and trikes as well as recumbent bikes, hand cycles, and any wheeled devices up to 2.5 feet (0.7 meters) wide. People riding typical bikes are common bikeway users and the typical bike is the conventional design vehicle for bikeways.

CARGO BIKES

People riding cargo bikes with or without a trailer as well as any wheeled device 2.5-3 feet (0.8-1 meter) wide are often carrying goods or passengers, commonly children.



EXTRA-LARGE BIKES

People riding large freight tricycles, pedicabs, and other devices wider than 3 feet (1 meter) and typically up to 4.5 feet (1.4 meters) may also use urban bikeways.

Common electric options for **typical bikes, cargo bikes, and extra-large bikes** include electric assistance for pedaling up to 20 mph (30 km/h); some e-bikes also have a throttle that can propel the device up to 20 mph, 25 mph, or 28 mph (30 km/h, 40 km/h, or 45 km/h) without pedaling.

How much faster are e-bikes?

While electric-assist bikes and pedal-only, non-electric bikes have similar top speeds, observed operating speeds for electric-assist bikes are typically higher and spread over a smaller range than pedal-only bikes. Urban e-bike operating speeds are typically 12-18 mph (20-30 km/h), while pedal-only bike speeds range from about 4-18 mph (6-30 km/h).[4,5] Designers should note that these speed differentials will require design strategies similar to those used when considering downhill and uphill needs.

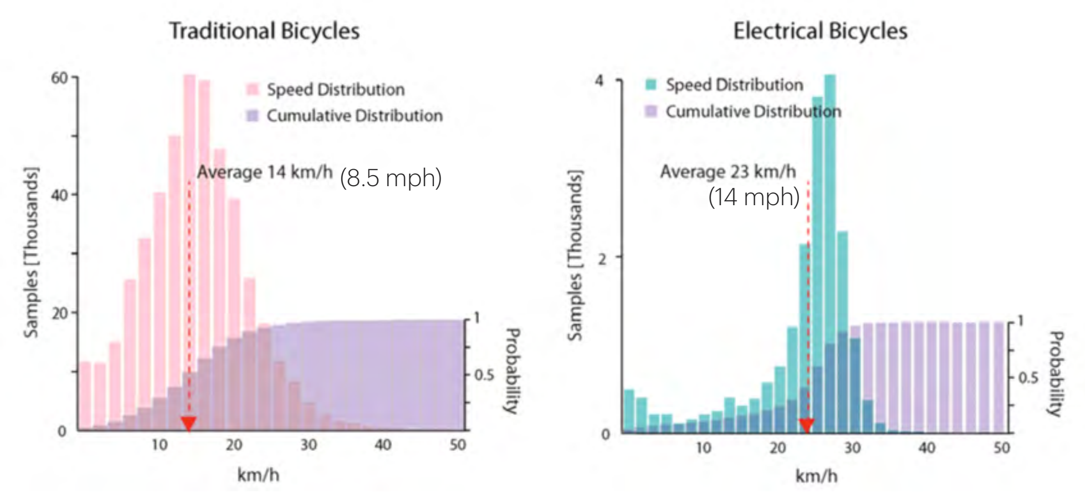


Image source: Dozza, Werneke & Mackenzie, 2013[6]

Designing for Small Things With Wheels

LANE WIDTHS

Allocate extra width to accommodate wider devices and passing

As bikeway use grows and people ride a wider mix of devices at different speeds, there is a growing need for space to pass or be passed by devices wider than a bicycle. Wider bikeways can more comfortably accommodate the increase in passing events and the increase in side-by-side riding that comes with higher bike volumes. A bikeway that is too narrow for its particular mix of volume, devices, and speeds can become uncomfortable due to close-passing, even if it meets minimum width standards. Wider protected bike lanes are especially important for children and caregivers, side-by-side riders, people using adaptive devices, and people moving goods.

To determine the width of the bikeway, start with identifying the widest device that people will *frequently* ride in the bikeway—this is the design bike—and the widest device that people will *occasionally* ride in the bikeway—this is the control bike. Once the design bike and control bike are identified, follow this step-by-step method for determining the desired bikeable width:

STEP 1 **Calculate the control bike *riding space* -** the width needed for comfortable riding by the control bike

STEP 2 **Calculate the design bike *passing space* -** the width needed for comfortable passing by the design bike

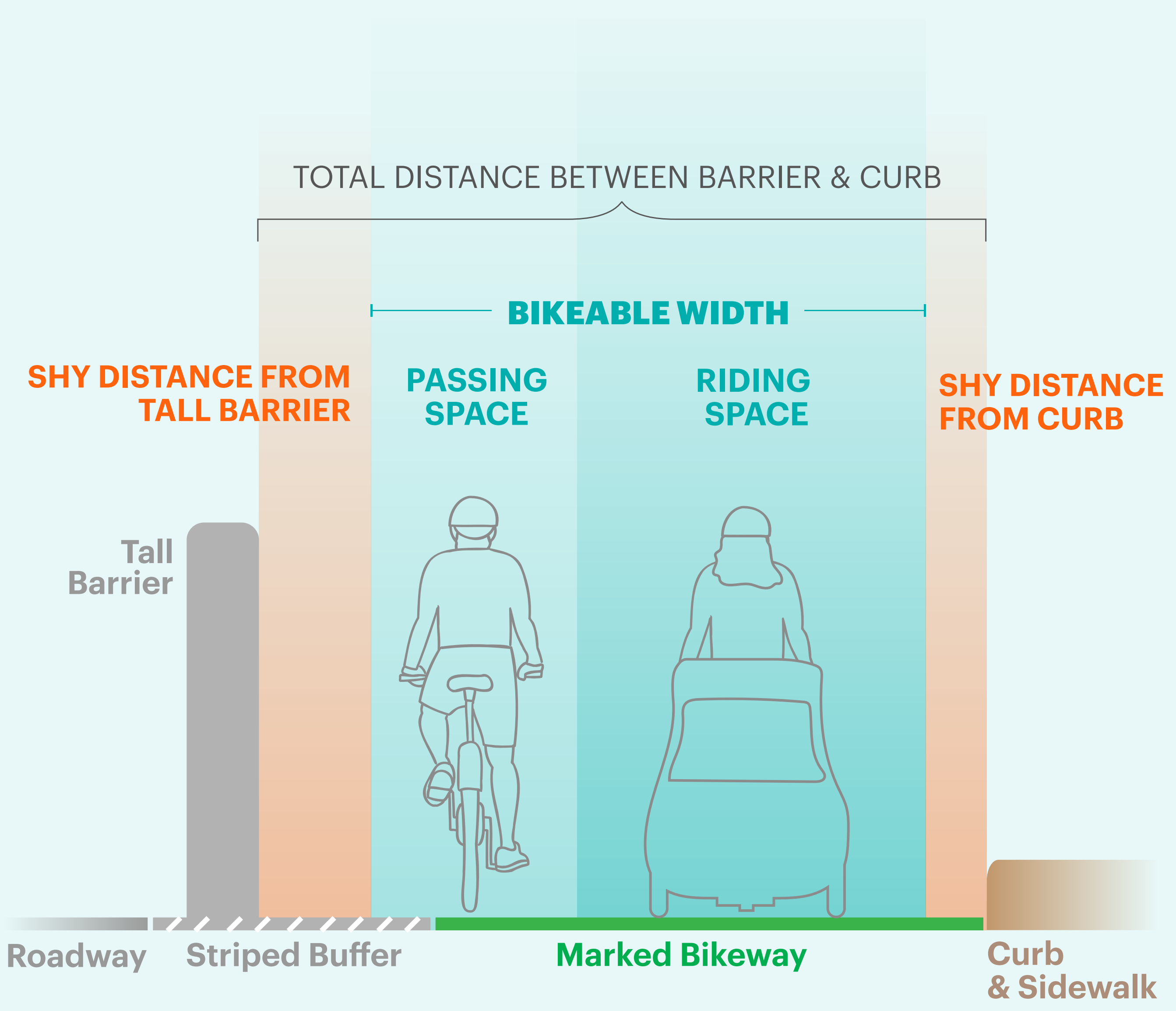
STEP 3

A **Determine the desired bikeable width for one-way bikeways -** add control bike riding space to design bike passing space

OR

B **Determine the desired bikeable width for two-way bikeways -** double the control bike riding space, and designate additional width for side-by-side riding along busy two-way bikeways

The following pages include a detailed explanation of each step.



Design bikeways to have enough bikeable width for all expected users to operate comfortably and to be passed comfortably by faster riders. Bikeable width is the distance between barriers, minus any shy distance from each barrier. Passing space and riding space should both fit within the bikeable width without overlapping.

For details on calculating bikeable width, see page 16.

Calculate riding space and passing space

STEP 1 **Calculate the control bike riding space**

To comfortably use a bikeway, people need the space around their body to remain clear of other people and objects. This width is called ***riding space.*** A person's preferred riding space will vary depending on the width and stability of their device, how fast they're riding, and their overall level of comfort. A comfortable riding space is typically 1.5-2.5 feet (0.5-0.8 meters) wider than the device width and allows users to deviate slightly while riding. For example, a cargo bike or personal tricycle may be 3 feet (0.9 meters) wide, but the rider needs a total of 4.5-5.5 feet (1.4-1.7 meters) to comfortably use a bikeway.

STEP 2 **Calculate the design bike passing space**

Passing space is the width a faster rider needs to overtake slower riders without entering the slower rider's riding space. When a faster rider overtakes a slower rider, they typically assume a temporarily narrower space, or passing space, that is only 0.5 feet (0.2 meters) wider than the device they are riding.

Calculating riding space for the control bike and passing space for the design bike:

	Comfortable *riding space* for one-way biking Device width plus 1.5-2.5 ft (0.5-0.8 m)	***Passing space* for the faster rider during a passing event** Device width plus 0.5 ft (0.2 m)
Typical bike Device width is up to 2.5 ft (0.7 m)	4-5 ft (1.2-1.5 m)	3 ft (0.9 m)
Cargo bike Device width is up to 3 ft (0.9 m)	4.5-5.5 ft (1.4-1.7 m)	3.5 ft (1.1 m)
Extra-large bike Device width is up to 4.5 ft (1.4 m)	6-7 ft (1.9-2.2 m)	5 ft (1.6 m)

STEP 3A **Determine the desired bikeable width for one-way bikeways**

Calculate the bikeable width needed for passing on a one-way bikeway by adding the passing space for a design bike (representing the faster rider passing) and the riding space for a control bike (representing the slower rider being passed).

[**Recommended bikeable width** = Design bike's passing space + Control bike's riding space]

For example, a person riding a typical bike passing a cargo bike should have 3 feet (0.9 meters) of space *outside* the cargo bike's comfortable riding space (4.5-5.5 feet or 1.4-1.7 meters) to accommodate comfortable passing, resulting in a desired bikeable width of 7.5-8.5 feet (2.3-2.6 meters).

Bikeable width needed for passing on a one-way bikeway:

	Control bike riding space representing the slower rider being passed		
Design bike passing space representing the faster rider passing	**Typical bike** Riding space is 4-5 ft (1.2-1.5 m)	**Cargo bike** Riding space is 4.5-5.5 ft (1.4-1.7 m)	**Extra-large bike** Riding space is 6.5-7.5 ft (1.9-2.2 m)
Typical bike passing Passing space is 3 ft (0.9 m)	7-8 ft (2.1-2.4 m)	7.5-8.5 ft (2.3-2.6 m)	9.5-10.5 ft (2.8-3.1 m)
Cargo bike passing Passing space is 3.5 ft (1.1 m)		8-9 ft (2.5-2.8 m)	10-11 ft (3.0-3.3 m)
Extra-large bike passing Passing space is 5 ft (1.6 m)			11.5-12.5 ft (3.5-3.8 m)

VANCOUVER
Source: City of Vancouver


CHICAGO
Source: CDOT

Along all facilities, look for opportunities to provide and designate wider ***passing areas***. Uphill passing opportunities can be especially beneficial along facilities where people use devices with and without electric assistance. To designate passing areas, use lane markings to direct slower users to the right and ensure sufficient space is available for passing. Without lane markings, people may ride in the center of the bikeway, making passing more difficult.

STEP 3B

Determine the desired bikeable width for two-way bikeways

A comfortable riding space for two-way biking allows all users to maintain their own riding space within their own directional lane. To calculate the bikeable width for two-way biking, double the comfortable riding space for the control bike.

Along a two-way bikeway, faster riders can pass slower riders by changing lanes during a gap in the opposing flow. However, on busy two-way bikeways, gaps in the opposing flow may be infrequent enough that faster riders choose to overtake slower riders while bikes are passing in both directions. Designate an additional 3 feet (0.9 meter) to accommodate passing along busy bikeways and create space for side-by-side riding.

Bikeable width needed for passing on a two-way bikeway:

Control bike:	**Bikeable width needed for comfortable two-way operations** Double the one-way riding space	**Along busy bikeways accommodate passing and side-by-side riding** Two-way operations plus 3 ft (0.9 m)
Typical bike One-way riding space is 4-5 ft (1.2-1.5 m)	8-10 ft (2.4-3 m)	11-13 ft (3.3-3.9 m)
Cargo bike One-way riding space is 4.5-5.5 ft (1.4-1.7 m)	9-11 ft (2.8-3.4 m)	12-14 ft (3.7-4.3 m)
Extra-large bike One-way riding space is 6-7 ft (1.9-2.2 m)	12-14 ft (3.8-4.4 m	15-17 ft (4.7-5.3 m)

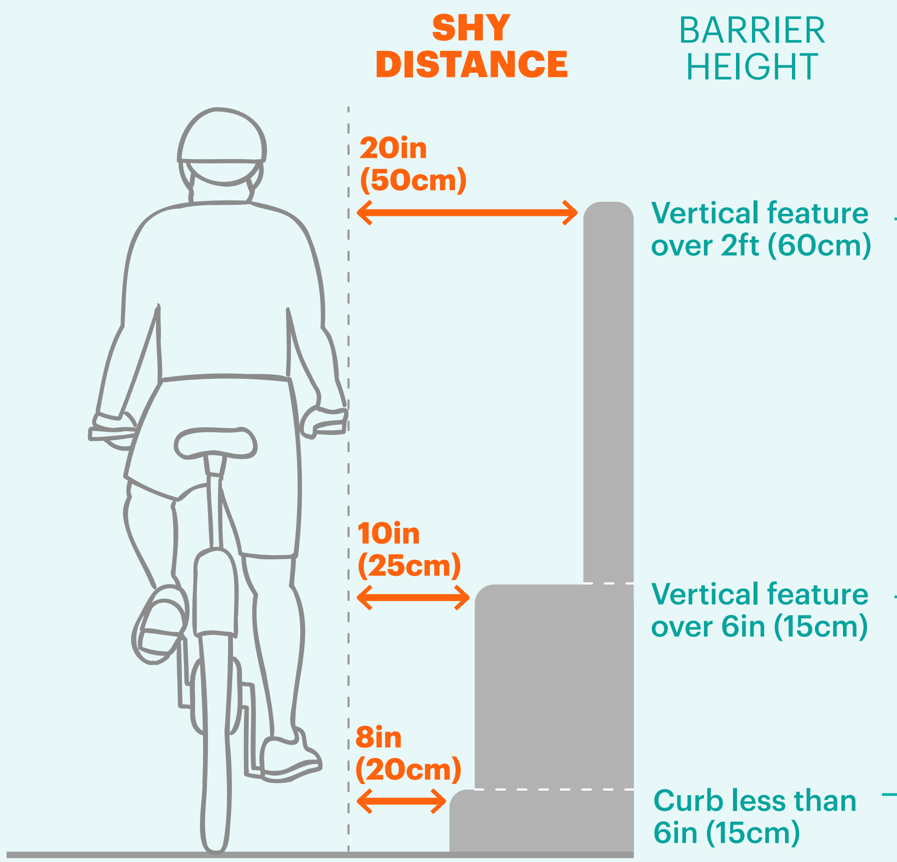
Designing for Small Things With Wheels

Understanding bikeable width

The marked width of a bikeway on paper is not always the same as the bikeable width that riders experience. The ***bikeable width*** is the usable space of a bikeway and excludes the space that is unrideable because it is too close to a wall, post, curb, or gutter.

The unrideable surface next to a vertical object is called the ***shy distance*** and is not part of the bikeable width. The bikeable width of a bikeway is calculated as the distance between two vertical objects *minus* the shy distance from each vertical object.

The amount of shy distance is impacted by the height of an object and the speeds expected along the bikeway.



Adapted from *Cycle Infrastructure Design* Table 5-3.[7]

Some bikeways include physically constrained portions where the bikeable width may not accommodate passing. When width is limited, designers can maximize bikeable width by locating physical objects as far as reasonable from the bikeway and by designing beveled curbs to reduce conflicts. In these areas, designers should also look to reallocate space from motor vehicles (e.g., reducing lane widths or reducing the number of lanes) to ensure that pedestrians and people using the bikeway have sufficient space.

Type of object	Typical shy distance
Tall vertical barriers or other objects taller than 2 feet (60 centimeters) are high enough to conflict with handlebars.	The bikeable surface begins **20 inches (50 centimeters)** away from a tall vertical object.
Vertical curbs of 6 inches (15 centimeters) high or more can catch a pedal or the side of a trailer or scooter.	The bikeable surface begins **10 inches (25 centimeters)** away from a vertical curb.
Half-height curb profiles less than 6 inches (15 centimeters) and beveled curbs reduce the likelihood of a pedal strike.	The bikeable surface begins **8 inches (20 centimeters)** away from a half-height curb and **6 inches (15 centimeters)** from a beveled curb.
Gutter pans create an uneven surface where they meet the roadway surface, potentially destabilizing wheels.	The bikeable surface begins **1-2 inches (2-5 centimeters)** away from the edge of the gutter pan.

Increase shy distance when higher speeds are expected. Higher operating speeds (e.g., downhills or a desire to accommodate electric powered devices or fast riders at full speed) may warrant an additional **3-6 inches (7.5-15 centimeters)** of additional shy distance.

INTERSECTIONS

Create safe and maneuverable spaces at intersections and driveways

Protected and dedicated intersections are a major tool for promoting comfortable and safe interactions between and among all roadway users. To accommodate the expanding range of device profiles in bikeways, cities need to:

- ⇨ Design enough space for people to wait at intersections
- ⇨ Allow turning maneuvers and lane shifts at appropriate operating speeds
- ⇨ Ensure visibility of all bikeway users at intersections and driveways

Protected intersections:

- Reduce motor vehicle turn speeds
- Create dedicated spaces for people using bikeways
- Shorten pedestrian crossing distances

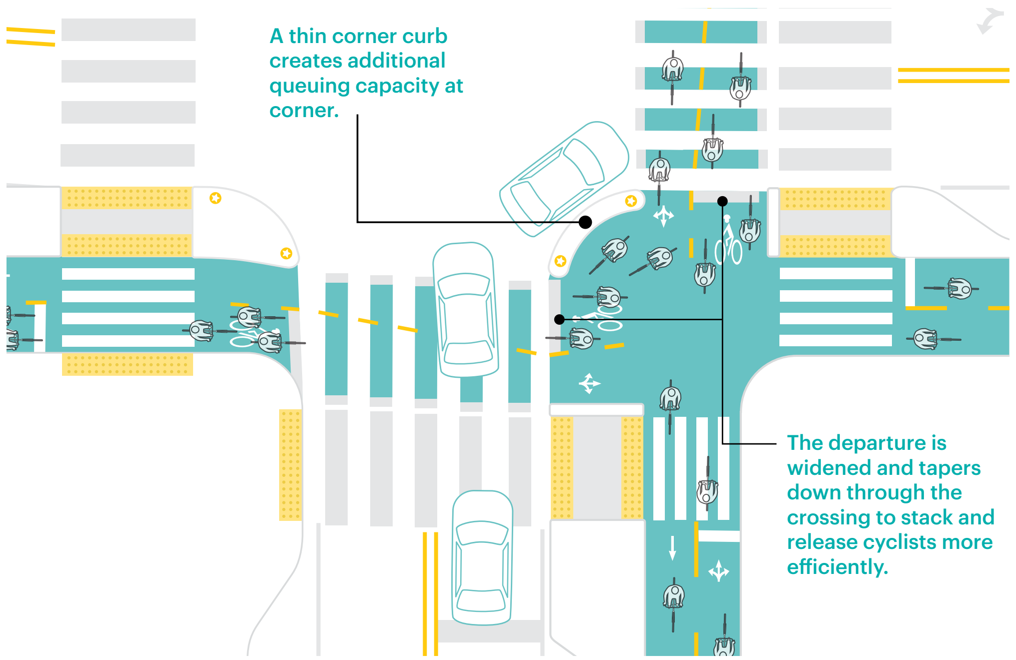
Reconfiguring and redesigning intersections for safer biking and walking changes the way pedestrians use the intersection. Special care should be taken to accommodate the pedestrian direction of travel, accessibility of any ramp changes, and overall legibility for pedestrians who are blind. For applied guidance, see: *Planning and Designing Streets to be Safer and More Accessible for People with Vision Disabilities.*[8]

For detailed information on bikeway intersection design, see Don't Give Up at the Intersection.

Design enough space for people to wait at intersections

Protected intersections physically separate queueing bikeway users from motor vehicle lanes, are the site of interaction with pedestrians, and are an especially sensitive location subject to crowding. Queueing areas at intersections should reflect the anticipated use of the intersection. Cargo bikes, pedicabs, adaptive bikes and other vehicle types are not only wider, but often much longer than e-scooters and typical bikes. Protected or dedicated queueing space is especially critical for ensuring a bikeway intersection is attractive and comfortable for small groups, such as a bike with a child trailer or an adult riding alongside a child. Without an obvious safe place to wait, people may spill into a crosswalk or be forced to wait very close to motor vehicle traffic.

Protected corners can be designed to maximize width available for side-by-side queueing and two-stage turns. Narrow the corner curb and make the cross-bike wider on the intersection approach than the receiving side to maximize the available queueing and maneuvering space.



Source: Don't Give Up at the Intersection page 16

At protected intersections with limited queueing space, use design features to keep riders waiting to cross the street from being forced into motor vehicle lanes or pedestrian areas. Enhance the attractiveness of linear queueing with longer bike signal phases, footrests or curbs, and few—if any—grade changes or curves in the approaching bikeway.

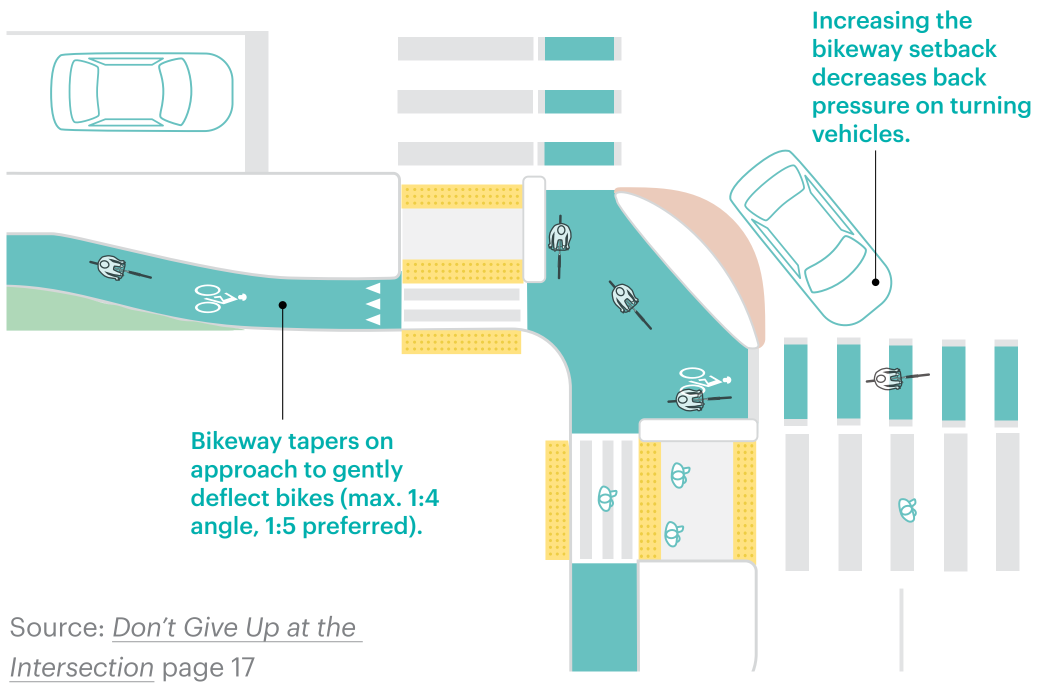
At non-protected intersections, allow for additional or overflow queueing space at intersection approaches to allow faster users to filter to the front of the lane to pass. Create additional space by widening bikeways at the intersections or designating areas as bike boxes.[9]

Allow turning maneuvers and lane shifts at appropriate operating speeds

Turning radii at intersections need to be maneuverable by all devices operating in the bikeway. Beginner e-scooter riders may find it difficult to turn safely at their minimum turn radius and cargo bikes and tandem bikes in particular have wide turn radii. Cargo bikes have a minimum inner turn radius of 5 feet (1.5 meters) and a sweeping radius of at least 9 feet (2.7 meters). Tandem bikes have an inner radius of 7.5 feet (2.3 meters) and a sweeping radius of at least 10.5 feet (3.2 meters).[10] If possible, the inside radius of horizontal curves should be at least 10 feet (3 meters) to accommodate typical bikes and wider-turning devices at low speeds.[11, 12]

Horizontal tapers and ***lane shifts*** are important features of bend out designs at intersections and where bikeways need to shift around a curb extension or create room for a parking lane. Design horizontal lane shifts and tapers so that people using the design bike (i.e. the device with the widest turn radius that people will *frequently* ride in the bikeway) can maneuver completely within the established bike lane at a typical or desired operating speed. A control bike (i.e. the device with the widest turn radius that will *occasionally* ride in the bikeway) can be accommodated using buffer areas outside the designated bike lane itself.

Gradual tapers of at least 1:5 will allow most users to continue at their typical operating speeds. In high-pedestrian contexts, short blocks, and other locations planned for low bikeway speeds, a 1:3 taper may be appropriate on one-way bikeways.



Source: *Don't Give Up at the Intersection* page 17

On two-way bikeways, test the path of two opposing bikes with trailers to confirm they can pass one another without encroaching into one another's riding space. To create space for two devices to proceed simultaneously, make the lateral shift more gradual or make the bikeway wider as it shifts.

Ensure any horizontal tapers are well lit and have retroreflective markings to help with visibility at night. Vertical deflection like raised crosswalks or raised transit boarding areas can help moderate bikeway speeds approaching busy pedestrian areas but avoid starting a horizontal taper and a grade change simultaneously, as three-wheeled devices can become unstable when making this maneuver even at low speeds.

See *Design grade changes sensitively* on page 25 for more details designing vertical deflection across bikeways.

Ensure visibility of all bikeway users at intersections and driveways

At all intersections and driveways, turning drivers need to be able to see approaching users in the bikeway in time to slow, yield, or stop completely. However, the distance needed varies based on motor vehicle speed, driver expectations, and bikeway speeds. People riding powered-devices in the bikeway create the potential for faster speeds, which necessitate longer sight distances so turning drivers can see approaching riders in time to slow, yield, or stop completely.

For all bikeways, but especially when bikeways are separated by parking or other high-profile objects:

- Ensure that all users are visible at intersections and use design strategies to meaningfully slow conflicting motor vehicle turning movements with speed bumps and humps, raised bikeway crossings, or smaller motor vehicle turn radii.
- Improve visibility at intersections by placing visually permeable items like bike racks, sign posts, and shared micromobility stations within approximately 20-30 feet (6-9 meters) of street crossings and 10 feet (3 meters) of driveway crossings.[13]
- Review parking setbacks to create visibility of, and for, children and people using lower-profile devices like sit-down scooters and recumbent bicycles, and ensure clear stopping-sight distances are compatible with faster bikeway speeds.

On very short blocks or blocks with driveways, consider removal of all parking adjacent to the bikeway to improve user visibility. This choice may be a difficult one, but will result in the highest visibility and stopping sight distance.

VANCOUVER, BC

Source: Province of British Columbia

SURFACES & GRADIENTS

Provide smooth surfaces for devices with small wheels

Devices like skateboards and scooters often have small and solid or dense wheels, usually under 10 inches (25 centimeters) in diameter that will not absorb the shock of uneven surfaces. For many riders with small wheels, even slight maneuvers to avoid debris can cause the user to fall, tip over, or lose control of the device. Trash, gravel, snow, ice, and other roadway debris become a major challenge for these smaller-wheeled devices and a considerable nuisance for users with larger wheels.

To provide a smooth surface for all user, cities need to:

- Design a smooth but not slick surface
- Design grade changes sensitively
- Maintain bikeways to a higher standard

FORT COLLINS

Source: City of Fort Collins

Design a smooth but not slick surface

An ideal bikeway has good traction in all weather conditions. Consider resurfacing the roadway when implementing protected bike lanes. Brick or cobblestone streets and open metal decking on bridges can be particularly slippery, hazardous, and uncomfortable for all users, but especially those with small and narrow wheels. In these locations, replace the bikeway surface with a smoother material.

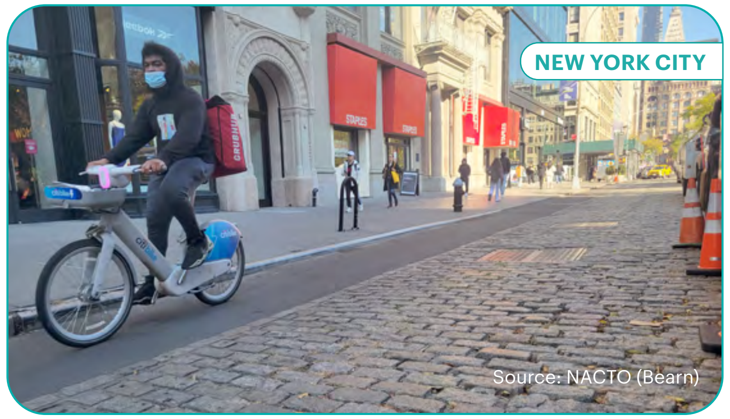
For large markings such as green color on bikeways, use a high friction material such as methyl methacrylate (MMA), polymer resin with color aggregate, or a high-friction (as opposed to conventional) thermoplastic or epoxy. Before selecting a standard or citywide treatment, test materials locally for compatibility with smaller wheeled users in wet conditions.

Where practical, avoid designing curves or lateral shifts on low-traction surfaces.

Added plating creates a more comfortable surface.

Open metal decking can be slippery.

The City of Milwaukee added anti-skid bridge plates to all of their bridges with open metal decking to create a safer and more comfortable surface for people biking.



To create a smoother riding area, the New York City Department of Transportation installed an asphalt bikeway along a block with cobblestones.

Design grade changes sensitively

Vertical speed management devices are less comfortable for bike riders and particularly people riding e-scooters and devices that do not have handlebars or mechanical brakes. On streets like bike boulevards, where bikes and e-scooters often go over speed humps, use speed cushions or speed humps with bicycle cut throughs to allow people riding bikes and scooters to continue at-grade. If speed humps need to extend across the entire width of a roadway, consider using sinusoidal speed humps to soften the vertical deflection and improve comfort.[14]

Use a gentle slope wherever the bikeway slopes up or down (e.g., at a raised intersection, transit boarding area, or a transition from street to sidewalk grade) aiming for a 1:20 or gentler slope where practical. Even an ADA-compliant slope (1:12), can jolt people riding bikes, e-scooters, or other devices.[15]

Avoid abrupt changes in grade where changes in direction also occur. Three-wheeled devices such as tricycles and bikes with child trailers can be ridden on a wide range of cross-slopes, but need a more level surface in order to turn without becoming unmaneuverable or tipping.[16]

Ramps connecting two bikeways at different grades (e.g., connecting an off-street bikeway to an overpass or pedestrian bridge) should maintain visibility around corners, be gentle in slope, have minimal grade breaks to soften vertical transitions for users with small wheels, and be wide enough to accommodate the turning movements of larger bikes, especially at switchbacks and around corners.

Maintain bikeways to a higher standard

Utility patches, stormwater grates, utility covers, and other repairs along bikeways should be held to a high standard and inspected following installation. A smooth final surface is required where a utility cut crosses the bikeway or runs along it. If a perfectly smooth final surface is not feasible, lips should be limited to ½ inch (1.2 centimeter).[17]

Develop proactive maintenance practices to ensure that bikeway surfaces are maintained to a higher degree. Relatively minor potholes, longitudinal cracks and seams, and other roadway defects can pose a hazard for smaller-wheeled devices.

It is sometimes efficient to resurface only part of the roadway, but narrow strips of asphalt are usually more difficult to maintain in the long term. If only resurfacing the bikeway, consider how the bikeway and remaining asphalt roadway surface can be maintained in the future.

Develop proactive maintenance practices to ensure that bikeway surfaces are maintained to a higher degree.

Effective snow clearance or removal practices that keep the bikeway surface ice-free and clear of snow will allow a wider range of devices to be used year-round. Some surface materials are better at reducing icing; for example, permeable asphalt is less likely to ice and become slippery than regular asphalt and can be considered for new construction of raised bikeways.

Source: ATLDOT

Designing for Small Things With Wheels

NETWORK LEGIBILITY

Make the best place to ride obvious

Providing easily-identified facilities that work for people riding side-by-side, using shared e-scooters, or riding e-cargo bikes will help guide riders into the bikeway and away from the sidewalk. People rely on a combination of formal information and obvious connections when deciding where to ride. Including additional elements like comprehensive wayfinding and intuitive, comfortable, and safe transitions between facilities improves the function of the bike network and of the sidewalk network.

Signs and markings are not a substitute for good design, but help set expectations for how to use the bikeway. They are helpful for clarifying the variety of ways people can use the bikeway and emphasizing that newly popular device types—like e-scooters and e-bikes—are welcome. When bikeways are designed for all ages, abilities, and micromobility options, people on bikes and scooters will prefer to ride in the well-designed bikeways instead of competing for space on a sidewalk.

Source: Alta Planning + Design

In areas separated from motor vehicle lanes, e-scooter stencils are used to indicate to e-scooter riders where to travel. Scooter symbols on signs or markings are considered experimental under the 2009 U.S. Manual on Uniform Traffic Control Devices (MUTCD), so jurisdiction-by-jurisdiction decisions are made about whether to include them in mixed traffic conditions or to limit their application to separated bikeways.

Notes

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