

**City of Houston**

**Design Manual**

**Chapter 17**

**BICYCLE, TRANSIT AND PEDESTRIAN DESIGN  
REQUIREMENTS**

## Chapter 17

**BICYCLE, TRANSIT AND PEDESTRIAN DESIGN REQUIREMENTS**

## 17.01 CHAPTER INCLUDES

- A. Geometric design guidelines for bicycle, pedestrian, and transit facilities.

## 17.02 REFERENCES

- A. Bicycle Master Plan (Houston Bike Plan), current edition
- B. Bicycle Parking Guidelines, Association of Pedestrian and Bicycle Professionals (APBP), current edition
- C. Designing for All Ages and Abilities - Contextual Guidance for High-Comfort Bicycle Facilities, NACTO, current edition
- D. Designing Walkable Urban Thoroughfares: A Context Sensitive Approach, ITE, current edition
- E. Houston Complete Streets and Transportation Plan
- F. Implementing Context Sensitive Design on Multimodal Thoroughfares, ITE, current edition
- G. A Policy on Geometric Design of Highways and Streets ("The Green Book"), AASHTO, current edition
- H. Guide for the Development of Bicycle Facilities, AASHTO, current edition
- I. Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations, FHWA, current edition
- J. Parks Master Plan, current edition
- K. Roadside Design Guide, AASHTO, current edition
- L. Scenic Houston Streetscape Resource Guide
- M. Separated Bike Lane Planning and Design Guide, Federal Highway Administration Bicycle and Pedestrian Program, current edition
- N. Texas Manual on Uniform Traffic Control Devices (TMUTCD), TXDOT, current edition
- O. Transit Street Design Guide, NACTO, current edition

- P. Trail Sponsor Guidance Document, Harris County Flood Control District (HCFCD), current edition
- Q. Urban Bikeway Design Guide, NACTO, current edition
- R. Urban Street Design Guide, NACTO, current edition
- S. Accessibility Guidelines for Pedestrian Facilities in the Public Right Of Way (PROWAG)

### 17.03 DEFINITIONS

- A. Bicycle Master Plan - Also called the Houston Bike Plan, this is a planning document that outlines the City's vision for bicycling in the City and associated goals for achieving the stated vision.
- B. Bike Routes - A bicycle route can be designated along any bikeway type with signing and can provide guidance along a series of different styles of bicycle facilities.
- C. Bicycle Facility - parts of a bikeway which may be dedicated, non-dedicated or off-street.
  - 1. Dedicated On-Street Bicycle Facilities provide dedicated space for bicyclists separate from vehicle lanes within the roadway. These facilities can be located on the right side or left side of the road as appropriate based on engineering judgment to accommodate roadway conflicts such as transit vehicles, driveways, and turn movements. Examples include Standard Bike Lane, Buffered Bike Lane, Separated Bike Lane, and Side Path.
  - 2. Non-Dedicated On-Street Bicycle Facilities are on-street are on-street bikeways where bicyclists share the street with motor vehicle traffic. They can be high-comfort facilities on roadway with certain characteristics such as low traffic volumes and speeds.
  - 3. Off-Street Bicycle Facilities provide dedicated space for bicyclists separate from vehicle lanes outside of the roadway.
    - a. Trail: A facility for bicyclists and pedestrians outside of street right-of-way. For trails in Harris County Flood Control District rights-of-way, refer to the HCFCD "Trail Sponsor Guidance Document."
    - b. Side Path: A facility for bicyclists and pedestrians within the street right-of-way but outside the roadway. May consist of a sidewalk widened sufficiently to also support bicycle travel.

- D. Bicycle Parking:
1. Bicycle Parking Station: An area on or projecting on any public right-of-way upon which one or more bicycle racks may be affixed. Amenities may include bicycle fixit stations, bicycle lockers, etc.
  2. Bike Rack: A fixture upon which one or more bicycles may be parked.
  3. Specifications and guidelines for bike racks and their installation are provided in the Houston Bike Racks Application.
- E. Cycle Track - see Separated Bike Lane
- F. Conflict Zone - Space where one mode's primary path crosses another, and can occur at points of transition such as at intersections, bus stop, primary commercial driveways, etc. Pavement markings and signage should be used to define the space and communicate proper use by facility user whether a pedestrian, bicycle, car, or bus.
- G. Contraflow Bike Lanes - are typically separated bike lanes that flow against vehicle traffic on a one-way street. They can be used where the contraflow path closes an important gap in the network and other alternatives are not feasible. They can be installed in conjunction with a separated bicycle facility or non-dedicated bicycle facility on the opposite side of the road that flows in the same direction as vehicle traffic. Contraflow Bike Lanes may be located on the left side of a corridor.
- H. Delineator - treatment or object used to physically separate a bike facility from vehicular traffic or bike traffic from pedestrian traffic. They provide the comfort and safety that make separated bike lanes attractive facilities. The selection of separation type(s) should be based on the presence of on-street parking, overall street and buffer width, cost, durability, aesthetics, traffic speeds, emergency vehicle and service access, and maintenance. Example of delineators include but are not limited to:
1. Armadillo: Oblong low delineator that creates the physical separation for separated bike lanes.
  2. Raised curb buffer: Precast or concrete unit raised and spaced appropriately for continued maintenance and drainage that creates the physical separation for separated bike lanes.
- I. Desired Bicycle Width - Desirable width of a bicycle facility, based the facility's bicycle level of comfort as it relates to roadway traffic volumes, posted speeds and number of vehicular lanes.

- J. Houston Bike Plan Map - Map of all existing and planned City of Houston maintained bicycle facilities. The primary purpose of the map is to define a connected network of bicycle facilities that is updated on a regular basis. Additional facilities may be proposed based on individual project, neighborhood, and connectivity needs.
- K. Level of Comfort - A qualitative measure of the ability of a bicycle facility to provide an experience that the target user considers safe and comfortable. Elements that impact the level of comfort include volume and speed of adjacent automobile traffic, width of bicycle facility, number of driveway and intersection crossings, quality of pavement, and type and width of buffer provided between the bicycle facility and adjacent vehicle travel and parking lanes.
- L. Minimum Width - Alternative width to be considered where ROW is constrained. Values lower than the provided minimum result in a Low-Comfort facility and require review and approval of Houston Public Works staff.
- M. Transit Lane Configurations - Special roadway configurations that dedicate lanes/space to specific modes of transportation.
1. Transit Only Lane - Roadway lanes dedicated to transit vehicles, typically using signs and pavement markings. Vehicles and bicycles may use said lanes if necessary to make a turn or reach a business front or curbside parking (aka Business Access/Transit (BAT) lanes).
  2. Transit and Bicycle Shared Lane - Roadway lanes dedicated to bicycles and transit, ideal for low speed, low traffic roadways.
  3. Bus Turn Radii - Buses require more space on roadway infrastructure due to larger turning radii (20-40 ft). This factor must be considered when designing intersections and station/stop areas as well as the route alignment.
- N. Transit Stations/Stops - A designated location for boarding/alighting of a transit vehicle. Stations/stops may also provide transit users shelter to wait for vehicles.
1. Bus Stop - Any location designated as a boarding/alighting zone within a bus transit route.
    - a. Far Side Stop - A bus stop located beyond an intersection. It requires that buses cross the intersection before stopping to serve passengers.
    - b. Near Side Stop - A bus stop located on the approach side of an intersection. The buses stop to serve passengers before crossing the intersection.

- c. Mid-Block Stop - A bus stop located between two intersections. Traditionally, these stops are located next to a mid-block pedestrian crossing for safe crossing.
  2. Bypass Lane - Transit only lane or right turn lane at the near side of an intersection that allows transit vehicles to pass queued automobiles without a specific transit only signal.
  3. Transit Shelter - Infrastructure installed at transit stop locations to provide protection from the weather.
  4. Bus Boarding Pad - A rectangular slip resistant concrete pad connected to adjacent sidewalks and sidewalk ramps and provide access to transit vehicles.
  5. Bus Pullout - A dedicated space adjacent to roadway infrastructure that brings transit vehicles completely out of traffic into a dedicated space. Provides increased safety during the boarding/alighting process.
  6. Floating Bus Stop - A bus stop whose specific layout allows pedestrian and bicycle right-of-way to locate behind the bus boarding pad, safely separating different modes of transportation. Generally used when a dedicated/protected bike lane travels through a bus stop area.
  7. BRT Station - A transit station for bus rapid transit and its passengers.
  8. Rail Station - A transit station for trains. It is typically an off-street facility where passengers wait for, board, alight, or transfer between transit units (vehicles or trains). A station usually provides information and a waiting area and may have boarding and alighting platforms, ticket or farecard sales, fare collection, and other related facilities Rail stations can be both at-grade or grade separated (for elevated guideways).
- O. Pedestrian Clear Zone - The primary, accessible area along a roadway where pedestrian travel is prioritized. Additional pedestrian clear zone widths are required within transit areas.
- P. Public Transit - Any form of publicly provided passenger transportation containing fixed/non-fixed routes and an established fare system.
1. Bus Transit - A form of public transit that uses bus fleets to provide fixed route and non-fixed route service.
  2. Bus Rapid Transit (BRT) - High capacity bus service with dedicated lanes and upgraded stations. BRT systems are characterized by several of the following components: exclusive transitways, enhanced stations, easily identified vehicles,

high frequency, all-day service, simple route structures, simplified fare collection, and ITS technologies.

3. Light Rail Transit (LRT) - A metropolitan electric railway system characterized by its ability to operate single cars or short trains along exclusive rights-of-way at ground level, on aerial structures, in subways, or occasionally, in streets, and to board and discharge passengers at track or car floor level.
- Q. Retrofit Bicycle Facility - A bicycle facility provided through the reallocation of existing roadway pavement by reducing the width or number of existing vehicle or parking lanes or by using excess, unused pavement. Retrofits typically do not require the roadway widening or median reduction.
- R. Separated Bike Lane - Dedicated on-street space for bikes separated from vehicle traffic with a buffer and a physical delineation device. Facilities can be one or two-way where a one-way facility is similar in nature to buffered bike lanes. Sometimes called a "Cycle Track."
- S. Wayfinding - Directional signage to certain destinations such as libraries, parks, schools, trail entry points, and other attractions.

#### 17.04 BICYCLE GEOMETRIC DESIGN REQUIREMENTS

##### A. General Design Guidance

1. The design of streets within the City of Houston shall consider options for high-comfort bicycle design solutions to improve bikeway connectivity and expansion of the planned bicycle network.
2. Low-comfort bicycle facilities should be avoided wherever possible. Proposed design of any facilities that would be considered low-comfort shall require prior approval from the Transportation and Drainage Operations.
3. The design of bicycle facilities shall accommodate the design bicyclist. The dimensions of a bicycle and associated operating space are summarized in Figure 17.1 and interpreted from the Guide for the Development of Bicycle Facilities, AASHTO.
4. Bicycling is an increasing component of multimodal thoroughfares. Bicycle facilities may be placed at sidewalk level, between sidewalk and pavement level, against the curb, between the curb and the parking lane, or between the parking lane and the vehicle travel lane. Bicycling facilities can benefit pedestrians by providing a buffer between the walking area and the vehicle traveled way.

- 5. Bicycle design speed for bicycle facilities is 12 mph.
- 6. Visibility of bicycle crossings may be emphasized by the use of bicycle-green pavement markings.

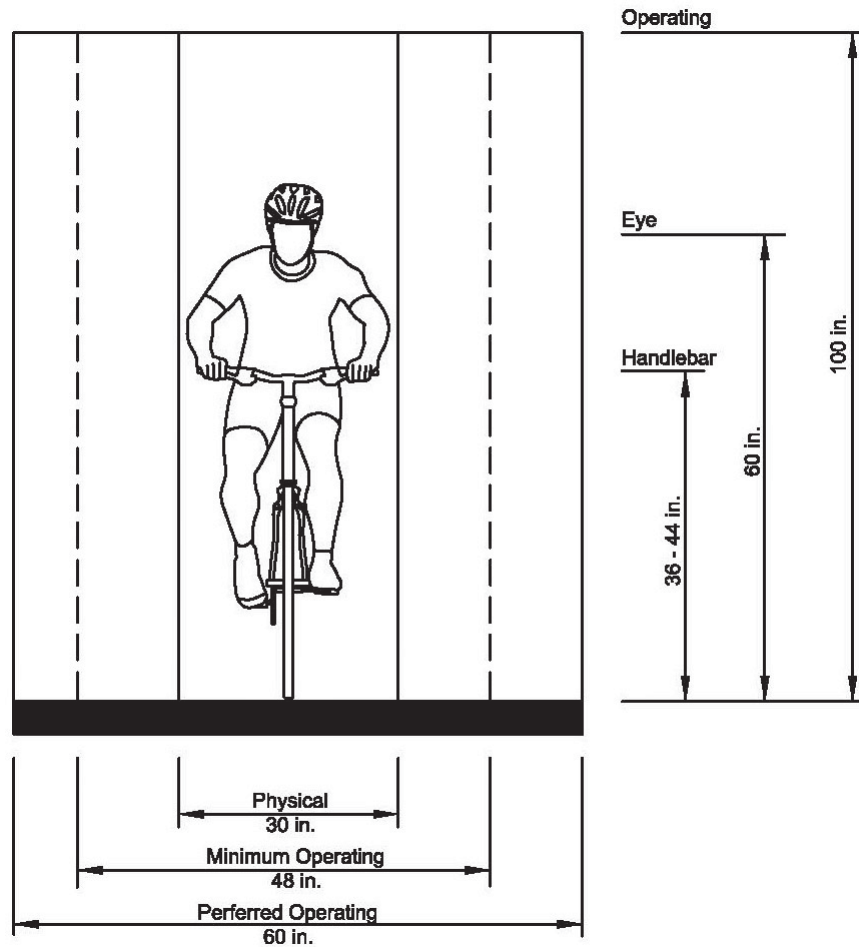


Figure 17.1 Design Bicyclist



## B. Design Considerations

1. Bikeway facilities can be implemented as part of roadway reconstruction projects, through retrofit projects, or in the case of facilities outside of the roadway pavement, through special capital projects or other.
2. Bicycle Retrofit Projects: In some cases, retrofit bicycle facilities can be provided by reallocating existing pavement or by utilizing unused, excess pavement. A traffic study shall be required to determine the impact to other modes of travel on the roadway where an existing vehicular lane of traffic is removed. The traffic study shall be reviewed and approved by Houston Public Works staff before the retrofit can proceed. Houston Public Works may require a public meeting to gauge the public input on a proposed retrofit project. The flowchart below outlines the questions to be addressed by the traffic study.
3. Where delineator is being considered, the designer should evaluate its impacts on accessibility for other road users such as a bus accessing a bus stop, driveway ingress and egress, street sweeper, garbage collection truck, etc.

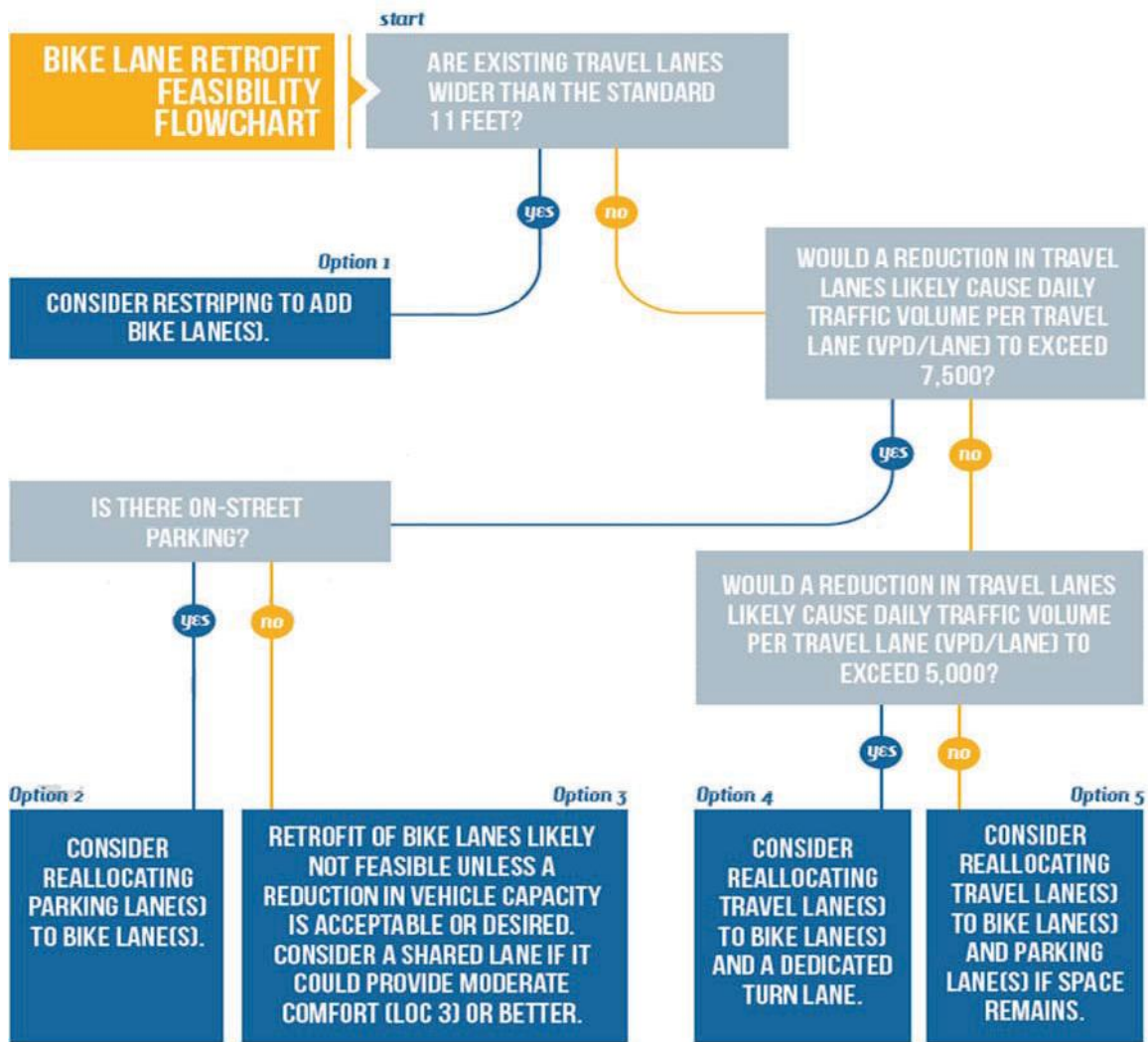
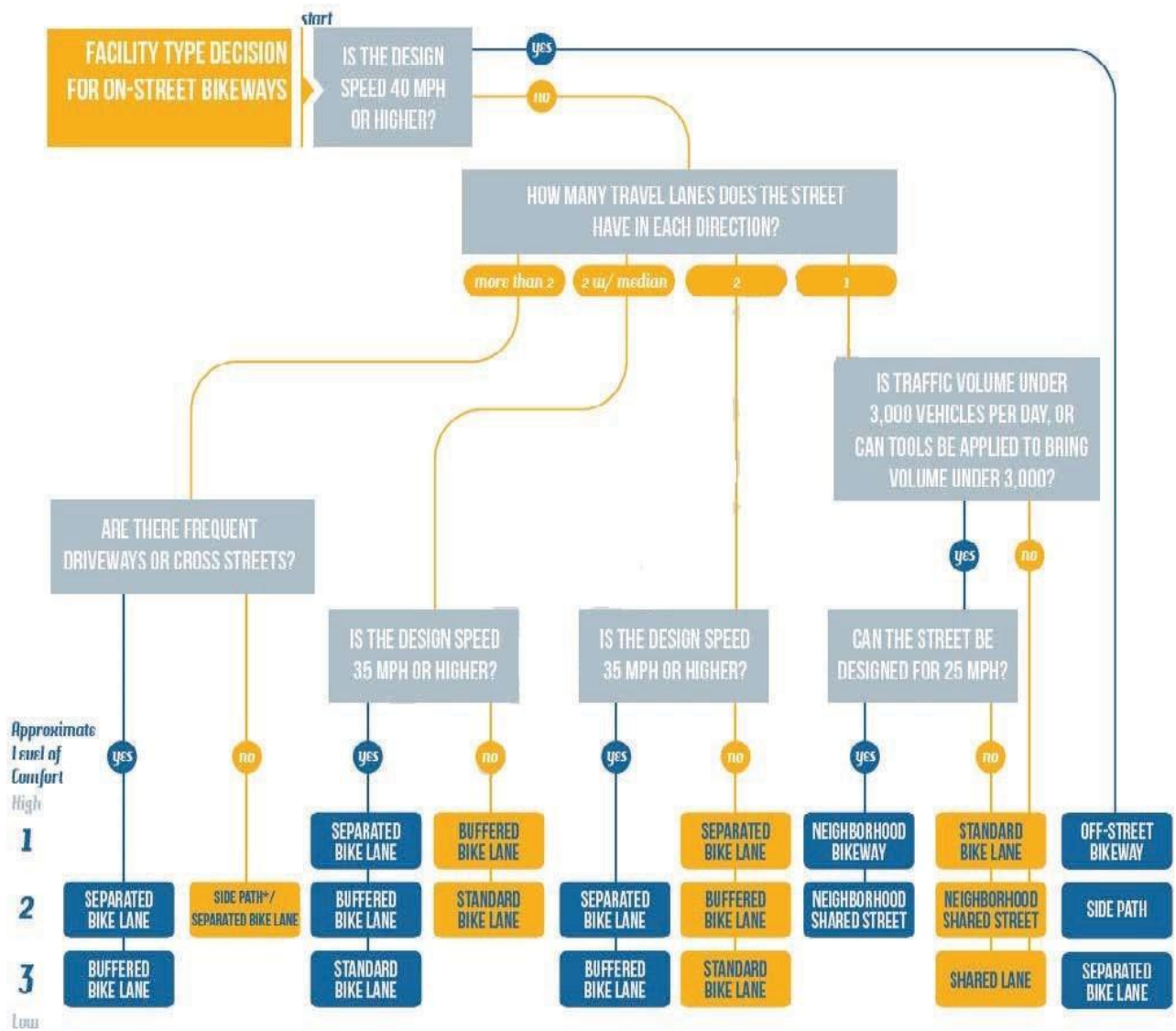


Figure 17.2 Bike Lane Retrofit

C. Selection of Bicycle Facility Type

New bicycle facilities shall provide as high a level of comfort for bicycle traffic as possible within the constraints of a given project. The flowchart below can be used to determine what type of bicycle facility may be appropriate for achieving a desired level of comfort with the specific roadway and traffic characteristics of a given project.



\* Consideration should be given to designating Side paths as one way bikeways and providing them on both sides of a street corridor.

Figure 17.3 Bicycle Facility Type

## D. Facility Type Standards and Guidelines

## 1. Dedicated Bicycle Facilities

- a. Standard Bike Lanes are delineated from vehicular traffic with pavement markings and do not provide a buffer.
  - i. Dimensions: Standard width is six (6)-ft (minimum five (5)-ft).
  - ii. Pavement Markings (Longitudinal): A six (6) inch solid white stripe shall be used to separate the bicycle lane from the adjacent vehicle lane.
  - iii. Pavement Marking (Symbols): In accordance with the Texas MUTCD Section 9c.04, a bicycle symbol and arrow markings shall be used to define bicycle lanes and should be placed at the beginning of a bike lane facility and the start of every block or at regular intervals as necessary to reinforce the intended use. See Standard Detail 01510-04 for pavement marking details.
  - iv. Signage: Bike lane signs (R3-17) and plaques (R3-17aP and R3-17bP) are required and should be placed at the beginning of a bike lane facility and at the start of every block or at regular intervals as necessary to reinforce the intended use.

For standard bike lanes design criteria, refer to City of Houston Standard Detail 01510-09.

- b. Buffered Bike Lanes can be provided on local streets, collectors and major thoroughfares. They are standard bike lanes with additional striped, delineated space separating the bicycle lane from the adjacent vehicle travel lane and/or parking lane. Buffered bike lanes can provide a higher level of comfort in given traffic conditions than standard bike lanes. Buffered bike lanes are generally preferred over of standard bike lanes for increased bicyclist comfort where ROW is sufficient.
  - i. Dimensions: The lane and buffer together shall be at least eight (8)-ft wide. Buffer may be reduced if a raised delineator is provided as approved by Houston Public Works. The minimum bicycle lane width is five (5)-ft.
  - ii. Pavement Markings (Buffer): The buffer shall consist of two six (6)- inch solid white lines, with six (6)-inch diagonal white hatching if three (3) -ft in width or wider. Spacing of hatching should be between 10 and 40 -ft as determined by the engineer to increase motorist compliance.
  - iii. Delineator: A raised, physical delineator shall be provided where buffer space is less than 2-ft between vehicles and bicycles and should be used for increased comfort based on engineering judgment. Examples include armadillos and raised curb buffer. Delineator selection should consider impacts on drainage, bus stops, street sweeping and where not specified here shall require approval from Houston Public Works.

- iv. Pavement Marking (Symbols): In accordance with the Texas MUTCD Section 9c.04, a bicycle symbol and arrow markings shall be used to define bicycle lanes and should be placed at the beginning of a bike lane facility and at the start of every block or at regular intervals as necessary to reinforce the intended use. See Standard Detail 01510-04 for pavement marking details.
- v. Signage: Bike lane signs (R3-17) and plaques (R3-17aP and R3-17bP) are required and should be placed at the beginning of a bike lane facility and at the start of every block or at regular intervals as necessary to reinforce the intended use.

For buffered bike lanes design criteria, refer to City of Houston Standard Detail 01510-09.

- c. Separated One-way Bike Lanes can be provided on collectors and major thoroughfares. It is a dedicated on-street space for bikes, wide enough to allow for one-way bicycle traffic, separated from vehicle traffic with a buffer and, where applicable, a physical delineation device.
  - i. Dimensions: The buffer shall be designed to accommodate and complement the selected delineator device but should typically be at least three (3) -ft. Buffer may be reduced if raised delineators are provided as approved by Houston Public Works staff. The minimum bicycle lane width is five (5) -ft.
  - ii. Delineator: A raised, physical delineator shall be provided where the bike lane runs against the vehicular traffic (contra flow) or buffer space is less than 2-ft between vehicles and bicycles and should be used for increased comfort based on engineering judgment. Examples include armadillos and raised curb buffer. Delineator selection should consider impacts on drainage and street sweeping and where not specified here shall require approval from Houston Public Works staff.
  - iii. Pavement Markings (Buffer): Should complement the delineator type selected. For delineators utilizing a series of discrete elements (e.g. armadillos), a striped buffer shall be utilized and shall consist of two six (6)-in solid white lines, with six (6)-inch diagonal white hatching if three (3)-ft in width or wider. Spacing of hatching should be between 10 and 40-ft as determined by the engineer to increase motorist compliance.
  - iv. Pavement Marking (Symbols): In accordance with the Texas MUTCD Section 9c.04, a bicycle symbol and arrow markings shall be used to define bicycle lanes and should be placed at the beginning of a bike lane facility and at the start of every block or at regular intervals as necessary to reinforce the intended use. See Standard Detail 01510-04 for pavement marking details.

- v. Signage: Bike lane signs (R3-17) and plaques (R3-17aP and R3-17bP) are required and should be spaced at the beginning of a bike lane facility and at the start of every block or at regular intervals as necessary to reinforce the intended use.

For one-way separated bike lanes design criteria, refer to City of Houston Standard Detail 01510-09.

- d. Separated Two-way Bike Lanes: can be provided on collectors and major thoroughfares. It is a dedicated on-street space for bikes separated from vehicle traffic with a buffer and a physical delineation device wide enough to allow for two-way bicycle traffic.
  - i. Dimensions: The buffer shall be designed to accommodate and complement the selected delineator device but should typically be at least three (3)-ft. The minimum bidirectional bicycle lane width is ten (10)-ft.
  - ii. Delineator: A raised physical delineator shall be provided as additional buffer. Examples include armadillo and raised curb buffer. Delineator selection should consider impacts on drainage and street sweeping and shall require approval from Houston Public Works staff.
  - iii. Pavement Markings (Buffer): Should complement the delineator type selected. A striped buffer shall be utilized and shall consist of two six (6)-inch solid white (or yellow if contra flow) lines, with six (6)-inch diagonal white (or yellow) cross-hatching if three (3) - ft in width or wider. Spacing of hatching should be between 10 and 40 -ft as determined by the engineer to increase motorist compliance. Delineators are generally placed in the center of the striped buffer.
  - iv. Pavement Markings (Longitudinal): A dashed yellow line should be used to separate two-way bicycle traffic.
  - v. Pavement Marking (Symbols): In accordance with the Texas MUTCD Section 9c.04, a bicycle symbol and arrow markings shall be used to define bicycle lanes and should be placed at the beginning of a bike lane facility and at the start of every block or at regular intervals as necessary to reinforce the intended use. See Standard Detail 01510-04 for pavement marking details.
  - vi. Signage: Bike lane signs (R3-17) and plaques (R3-17aP and R3-17bP) are required and should be placed at the beginning of a bike lane facility and at the start of every block or at regular intervals as necessary to reinforce the intended use.
  - vii. If physical delineators are used, access should be considered for driveways, solid waste collection, bus stops, and mail delivery.

For two-way separated bike lanes design criteria, refer to City of Houston Standard Detail 01510-09.

- e. Side Paths are bike facilities that run alongside a roadway within the ROW. Side paths may be slightly raised from the street level or at the same grade as the sidewalk. Side paths may provide single or bidirectional bicycle traffic flow. Side paths may be designed as shared use space for bicycles and pedestrians or as dedicated single or double lane bicycle facilities separate from both pedestrian and vehicular traffic. Bicycle-dedicated side paths can be separated from pedestrian traffic physically with a buffer or simply with contrasting pavement materials or colors. Maintenance responsibilities for side paths should be determined before implementation. Side paths can be provided along any roadway regardless of the speed of adjacent traffic. However, they can present challenges when there are an abundance of driveways, intersections, and other conflict points.
  - i. Dimensions.
    - 1. A two-way, bidirectional side path should maintain a standard width of ten (10)-ft (minimum eight (8)-ft), and can be more if separated pedestrian traffic is desired.
    - 2. A buffer of at least three (3)-ft should be provided between the side path and the adjacent motor vehicle lane, and tree plantings incorporated for increased shading.
    - 3. Where pedestrian traffic and bicycle traffic are both heavy, a portion of the side path cross section should be designated for exclusive bicycle use. Designation may include unique pavement texture and/or colors, bike lane pavement markings, and/or signage. For two-way bicycle travel the width of this area is ten (10)-ft; minimum eight (8)-ft. For one-way bicycle travel the width of this area is six (6)-ft; minimum five (5)-ft. This is in addition to the width of the pedestrian travel area.
  - ii. Pavement Markings (Longitudinal): A dashed yellow line may be used to separate two-way bicycle traffic on bidirectional side paths.
  - iii. Pavement Marking (Symbols): For bicycle-exclusive side paths, a bicycle symbol and arrow markings may be used to define bicycle lanes and, if used, should be placed at the beginning of a bike lane facility and every block or at regular intervals as necessary to reinforce the intended use. See Standard Detail 01510-04.
  - iv. Signage: Signage should be provided to designate intended use of the side path. At a minimum, "Bike Route" signs should be provided at the start of the facility and at regular intervals.
  - v. Access Drives: Shall incorporate design considerations for enhanced visibility of the bicycle facility to motorized vehicle users. Prioritized mode at crossing should be clearly defined by signage and/or pavement markings. See E. CORRIDOR DESIGN CONSIDERATIONS of this section.

- vi. Ramps: Width of curb ramps that incorporate pedestrian and bicycle movements shall be equal to the width of the shared use path. Detectable warning surfaces shall extend the full width of the ramp run (excluding any flared sides).

For side path design criteria, refer to City of Houston Standard Detail 01510-09.

## 2. Non-Dedicated Bikeway Facilities

- a. Neighborhood Shared Streets are low speed, low volume, and typically residential streets shared by motor vehicles and bikes and marked with "Bike Route" signs and potentially wayfinding signage. This designation does not include additional treatments to manage vehicle speed or volume.
  - i. Pavement Markings: No special pavement markings are required. Shared Lane Markings may be used if the shared nature of the roadway should be emphasized to encourage driver compliance.
  - ii. Signage: Bike Route signs (D11-1) should be placed at regular intervals based on engineering judgment to inform bicyclists of bicycle route direction changes and to confirm route direction. Bikes May Use Full Lane signs (R4-11) may be used. Wayfinding can be used to provide direction to other high comfort bicycle facilities, trails, or neighborhood destinations and amenities such as schools.
- b. Neighborhood Bikeway: also known as "Bicycle Boulevards," are similar to Neighborhood Shared Streets but provide a more regional connector and may be provided on local streets or collectors where the speed limit does not exceed 30 mph. They have three essential elements:
  - 1. Street design elements that enhance bicycle and pedestrian safety and comfort while maintaining vehicle traffic speeds at levels appropriate to the neighborhood context.
  - 2. Intersection treatments to assist bicyclists crossing roadways with high traffic volumes and/or speeds.
  - 3. Bicycle signage and wayfinding
  - i. Pavement Markings: Shared Lane Markings should be used to emphasize the shared nature of the roadway. See Standard Detail 01510-04. for shared lane marking placement and design consideration. On-street parking may but is not required to be delineated. Parking delineation may be appropriate in dense urban or commercial contexts.
  - ii. Signage: Bike Route signs (D11-1) should be placed at regular intervals based on engineering judgment to inform bicyclists of bicycle route direction changes and to confirm route direction. Bikes May Use Full lane signs (R4-11) shall be used to emphasize the shared nature of the roadway. Wayfinding should be used to provide direction to other high comfort bicycle facilities, trails, or



neighborhood destinations and amenities such as schools. Stop sign placement and direction should provide priority to the bikeway over intersecting local streets to minimize bicycle stops.

- iii. Optional Treatments: Bicycle safety enhancements, such as speed cushions, neighborhood traffic circles, chicanes, and bike-only through movements at intersections can be considered based on engineering judgment and shall require Houston Public Works approval.
- c. Shared Lanes can be located on minor collector, major collector and certain major thoroughfares where there is insufficient ROW for dedicated facilities. They represent roadway travel lanes shared by vehicles and bicyclists on thoroughfares. They do not provide the highest level of comfort for bikes and are appropriate only where ROW is insufficient to provide a dedicated bikeway. They may be used in combination with higher-quality bike facilities to accommodate ROW pinch points. Shared lanes are restricted to roadways with posted speed limits 35 mph or less. Shared Lanes should not exceed 12-ft where no on-street parking is present. Signage and pavement markings are used to provide a visual indicator to vehicle traffic of the dual use and nature of the roadway
  - i. Pavement Markings: Shared Lane Markings shall be used to encourage bicycle travel in the middle or most visible portion of the travel lane.  
If on-street vehicular parking is not present, pavement markings should be placed far enough from the curb to direct bicyclists away from gutters, seams, and other obstacles. Minimum Placement:
    - 1. Shared Use Vehicular Lane Defined: 6-ft from the lane line of the shared use lane
    - 2. Shared Use Lane Not Defined: 6-ft from the center of the roadway where roadway lines do not exist.
  - ii. Signage: Bike Route signs (D11-1) should be placed at regular intervals based on engineering judgment to inform bicyclists of bicycle route direction changes and to confirm route direction. Bikes May Use Full lane signs (R4-11) shall be used to emphasize the shared nature of the roadway.

#### E. CORRIDOR DESIGN CONSIDERATIONS:

- 1. Overview: Bicycle facilities should provide a safe, high-comfort experience for the user as it traverses a corridor from intersection to intersection. Elements along a corridor may present unintended obstacles for bicyclists if not properly designed.

Design considerations presented in this section are not exhaustive. Additional considerations for review should be raised based on engineering

judgment and approved by Houston Public Works.

2. General:

- a. Gutter seams, drainage inlets, and utility covers should be flush with the pavement and oriented to prevent conflicts with bikes. Bicycle facility width should not include the gutter pan because people on bikes are typically unable to use this space.
- b. Bicycle facilities are intended to be flexible to maximize comfort and can transition between facility types to accommodate corridor elements. Bicycle facility transitions (e.g., a bike lane to an off-street side path) should be logical and smooth. Abrupt facility transitions can be confusing, decrease bicycle predictability and increase vehicle conflicts.
- c. Where possible, bicycle facilities should connect to other bicycle facilities, and facility termination should be minimized. Where bicycle facilities terminate, clear signing and striping shall be provided to communicate the termination to bikeway users and other roadway users. Where appropriate, on-street bicycle facilities may transition to a shared space with pedestrians (i.e. side path/trail) or to a non-dedicated bicycle facility type. Bicycle facilities should not terminate in areas that abruptly force bicyclists to merge with high-speed or high-volume vehicular traffic or heavy pedestrian activity.
- d. Ramps may be used to transition bicycles on and off the street and shall not compromise pedestrian realm minimum standard widths.
- e. All signs, signals, and markings related to bicycle facilities shall have maintenance responsibilities established and, if relevant, approved by Houston Public Works.
- f. The design of bicycle facilities and associated physical delineation shall not restrict curbside access for solid waste trucks on streets with curbside trash and/or recycling pickup.
- g. The design of bicycle facilities and associated physical delineation shall not restrict curbside access for transit vehicles at designated transit stops. Physical delineators should be stopped prior to transit stops. On streets where frequent breaks in physical delineation would be required, alternative bicycle facility designs that do not require physical delineation should be considered.

3. On-Street Parking:
  - a. Bike lanes may be provided between the parking lane and the curb or between the parking lane and travel lane.
  - b. Where on-street parallel parking would otherwise be allowed, No Parking in Bike Lane signs (R7-9) may be considered.
  - c. A 3-ft buffer should be provided between a bike lane and an adjacent parking lane to accommodate the door zone when high parking turnover is expected.
4. Railroad Crossings:
  - a. General: Bicycle tires can become stuck in rail flanges when they cross tracks at a small angle. Where bicycle facilities cross a street-surface rail track, bicyclists should be directed to cross tracks at a safe angle (60 degrees minimum, 90 degrees desirable).
  - b. If desired crossing angle is not possible, a warning sign (W10-1 or W10-12) shall be placed in advance of the rail crossing alerting bicyclist of skewed railroad crossing.
  - c. In presence of uneven railroad tracks warning sign (W10-6) should be installed.
5. Bridge Crossings and Tunnels:
  - a. Bridges and tunnels shall accommodate multimodal transportation usage.
  - b. When the approach roadway has an existing or planned bicycle facility, the quality and comfort of bicycle facility on the bridge/tunnel shall equal or exceed that of the facility on the approach roadways.
  - c. When the approach roadway does not have an existing or planned bicycle facility, 10-ft or greater sidewalks should be considered for multimodal consideration on the bridge/tunnel. The absence of an existing bicycle facility on the approach roadway does not justify failure to accommodate bicyclists on the bridge or tunnel.
  - d. Bridge sidewalks and shared-use paths shall be raised above the vehicular pavement level.

- e. Railing/Delineator:
    - i. Exterior bridge railings adjacent to a pedestrian/bicycle facility:
      - 1. Minimum height: 42 inches.
      - 2. Height of 48 inches should be considered in the following cases:
        - Speed of adjacent traffic exceeds 35 mph
        - Width of pedestrian/bicycle facility is less than 10-ft
      - 3. The railing design should minimize opportunities for bicycle handlebars to get caught in the railing.
    - ii. A railing may be used to separate bicycle traffic from pedestrian traffic to improve bicycle/pedestrian safety and comfort where appropriate.
6. Loading/Commercial Zones:
- a. Dedicated loading/commercial zones shall not impede bicycle traffic or encroach on a bicycle facility. Where possible, dedicated bicycle facilities should be placed behind loading zones and adjacent to the pedestrian zone whether on or off-street.
  - b. To avoid conflicts with loading/commercial zones bicycle facility may be transitioned to the adjacent sidewalk where a minimum 10-ft separate pedestrian realm is maintained.
  - c. A painted crosswalk may be provided across the bikeway facility to accommodate loading and unloading of commercial vehicles.
7. Midblock Crossings
- a. General: Midblock crossings are legal pedestrian and bicycle street crossing locations that are not located at roadway intersections. Intersection crossings are generally preferred, but occasionally midblock crossing locations are acceptable. Examples of potentially acceptable midblock crossing locations include a trail in a utility easement that crosses a street at a distance that is farther from the nearest signalized intersection than a trail user would be expected to traverse.
  - b. Midblock crossings shall require Houston Public Works approval.
  - c. Midblock crossings shall be designed at minimum with the following considerations:
    - i. Midblock crossings shall be located at least 100-ft from adjacent intersections.
    - ii. Street name signs should be placed at Major Thoroughfare crossings and should be considered on Collector and Local Street crossings.

- iii. The width of curb ramps serving a midblock crossing shall be equal to the width of the approaching pedestrian or bicycle facility. Detectable warning surfaces shall extend the full width of the ramp.
- iv. Pavement markings shall be used to define all midblock crossing locations.
  - 1. For pedestrian-only midblock crossing, white high visibility crosswalk markings shall be used.
  - 2. For shared-use midblock crossings, Dual Use Markings shall be used, consisting of a series of white stripes flanked by square bicycle-green pavement markings (see Standard Detail 01510- 09A).
- d. Midblock Enhancements: Additional treatments should be considered for increased visibility and refuge at midblock crossings. Enhancements shall require justification per engineering judgment and approval by Houston Public Works. Potential enhancements may include:
  - i. Raised crossing (a.k.a. raised crosswalk). Raised crossings elevate people in the crossing above the road level, thereby increasing their visibility. Raised crossings are not permitted on corridors with design speeds greater than 35 miles per hour.
  - ii. Curb extensions. Curb extension reduce crossing distance and increase visibility of people in the crossing. This treatment can be used when on-street parking exists or where excess pavement exists such that a curb extension can be constructed without decreasing roadway capacity.
  - iii. Median refuge islands. Median refuge islands are located in the center of the roadway to permit a two-stage crossing of the roadway. Median refuges should be considered where center turn lanes are present and are encouraged on corridor with 4 or more lanes, or where roadway configuration is reconfigured from a 4-lane corridor to a 3-lane corridor.
  - iv. Street lighting at midblock trail crossings where feasible and approved by Houston Public Works.
- e. Selection of Midblock Treatments:

Midblock treatments shall be selected to maximize safety of people crossing the street at the midblock location. Selection of treatments should consider the corridor speed, number of lanes and average daily traffic in addition to area context. Several levels of treatment based on these factors are presented below. Standard treatments are required for each level. Optional treatments may be used based on engineering judgment and with Houston Public Works approval. **Table 1-B** provides guidance for the selection of treatment level.

**Table 1-B Criteria for Midblock Crosswalk**

*(Levels A, B, C, D are defined below)*

ADT	Speed Limit	4 lanes with median	2 lanes without median	4 lanes without median
≤ 5,000	≤ 30 mph	A	A	A
	> 30 mph	A	B	C
5,000 - 15,000	≤ 30 mph	B	B	B
	> 30 mph	C	C	D
>15,000	≤ 30 mph	C	D	D
	> 30 mph	D	D	D

**Level A: Midblock crossing pavement markings**

1. Standard: Install, as appropriate, white high-visibility crosswalk markings (pedestrian-only crossing) or Dual Use Markings (shared-use crossing).
2. Optional:
  - a. Install W11-2 pedestrian warning sign (pedestrian-only crossing) or W11-15 pedestrian/bicycle warning sign (shared-use crossing) with W16-9P AHEAD (plaque) mounted on the side of the roadway in advance of the crossing.
  - b. Install W11-2 pedestrian warning sign (pedestrian-only crossing) or W11-15 pedestrian/bicycle warning sign (shared-use crossing) with W16-7PL diagonal downward arrow plaque mounted on the side of the roadway at the crossing.

**Level B: Level A + advance warning signage**

1. Standard:
  - a. Install, as appropriate, white high-visibility crosswalk markings (pedestrian-only crossing) or Dual Use Markings (shared-use crossing).
  - b. Install W11-2 pedestrian warning sign (pedestrian-only crossing) or W11-15 pedestrian/bicycle warning sign (shared-use crossing) with W16-9P AHEAD (plaque) mounted on the side of the roadway in advance of the crossing.

- c. Install W11-2 pedestrian warning sign (pedestrian-only crossing) or W11-15 pedestrian/bicycle warning sign (shared-use crossing) with W16-7PL diagonal downward arrow plaque mounted on the side of the roadway at the crossing.
2. Optional:
    - a. Install "PED XING" (pedestrian-only crossing) or "BIKE XING" (shared-use crossing) advanced pavement marking.

**Level C: Level B + additional pavement markings**

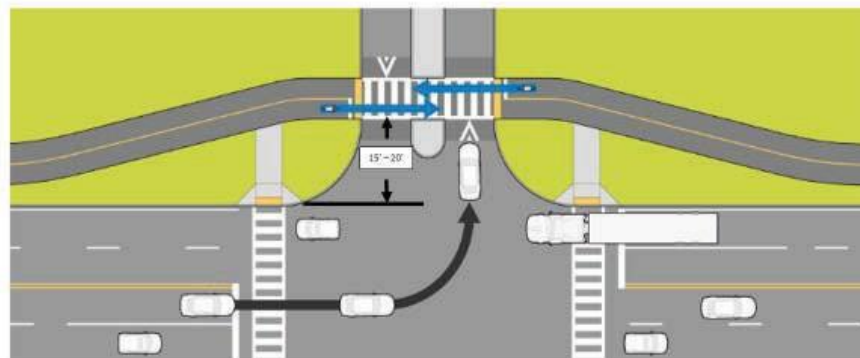
1. Standard:
  - a. Install, as appropriate, white high-visibility crosswalk markings (pedestrian-only crossing) or Dual Use Markings (shared-use crossing).
  - b. Install W11-2 pedestrian warning sign (pedestrian-only crossing) or W11-15 pedestrian/bicycle warning sign (shared-use crossing) with W16-9P AHEAD (plaque) mounted on the side of the roadway in advance of the crossing.
  - c. Install W11-2 pedestrian warning sign (pedestrian-only crossing) or W11-15 pedestrian/bicycle warning sign (shared-use crossing) with W16-7PL diagonal downward arrow (plaque) mounted on the side of the roadway at the crossing.
  - d. Install "PED XING" (pedestrian-only crossing) or "BIKE XING" (shared-use crossing) advanced pavement marking.
  - e. On four-lane roadways, install R1-5 "Yield Here to Pedestrians" (pedestrian-only crossing) or R1-5PB "Yield Here to Pedestrians and Bicyclists" (shared-use crossing) signage and yield lines consisting of isosceles triangles pointing toward oncoming vehicles (see Standard Detail 01510-09A).
2. Optional:
  - a. Raised crossing
  - b. Curb extension
  - c. Median refuge island

**Level D: Level C + crossing enhancements**

1. Standard:
  - a. Install, as appropriate, white high-visibility crosswalk markings (pedestrian-only crossing) or Dual Use Markings (shared-use crossing).
  - b. Install W11-2 pedestrian warning sign (pedestrian-only crossing) or W11-15 pedestrian/bicycle warning sign (shared-use crossing) with W16-9P AHEAD (plaque) mounted on the side of the roadway in advance of the crossing.
  - c. Install W11-2 pedestrian warning sign (pedestrian-only crossing) or W11-15 pedestrian/bicycle warning sign (shared-use crossing) with W16-7PL diagonal downward arrow plaque mounted on the side of the roadway at the crossing.
  - d. Install "PED XING" (pedestrian-only crossing) or "BIKE XING" (shared-use crossing) advanced pavement marking.
  - e. On four-lane roadways, install R1-5 "Yield Here to Pedestrians" (pedestrian-only crossing) or R1-5PB "Yield Here to Pedestrians and Bicyclists" (shared-use crossing) signage and yield lines consisting of isosceles triangles pointing toward oncoming vehicles (see Standard Detail 01510-09A).
  - f. Consider a traffic signal or hybrid pedestrian beacon if the appropriate warrants in the TMUTCD are satisfied. Requires approval of City Traffic Engineer.
  - g. Enhancements are strongly encouraged where appropriate, including:
    - i. Raised crossing
    - ii. Curb extension
    - iii. Median refuge island
  
8. Driveways:
  - a. Driveways shall be designed to safely accommodate bicyclists, pedestrians and motorized vehicle users. Where a driveway crosses a dedicated on-street or off-street bikeway, the driveway should be designed to enhance the visibility of the bikeway user.
  
  - b. Signage:
    - i. Stops signs (R1-1) should be placed on primary commercial driveways to indicate a full stop by motor vehicles before entering and crossing a bicycle facility. Where the bicycle facility is in or immediately adjacent to the roadway, the stop sign should be placed before the bicycle facility.
    - ii. Where a stop sign is not provided on the driveway approach, Bicycle Crossing Warning Sign (W11-1) or dual Combination Bike and Ped Crossing Warning Sign (W11-15) should be considered.



- c. **Pavement Markings:** Where bicycle facilities cross driveways, the design should clearly communicate that bicyclists have the right-of-way by defining the bicycle facility width and associated placement across the driveway. Green bicycle pavement markings should be used across primary commercial driveways.
- d. **Curb Radius:** Driveway curb radius should be selected to encourage slower vehicular movements across the bicycle facility. Based on engineering judgment, the smallest feasible curb radius should be selected based on AASHTO design vehicles. Additional curb radius design considerations are discussed in Chapter 15.08.
- e. **Driveway Spacing:** Driveway consolidation should be considered where bike facilities are present. Each driveway presents an additional vehicle-bicycle conflict point. Refer to Chapter 15.08 for driveway spacing standards.
- f. **Vehicle Parking** should be prohibited at least 20-ft from the edge of a driveway along the roadway.
- g. **Landscaping and other street-side elements** shall not reduce sight distance across the bicycle facility below AASHTO minimums.
- h. **Optional Treatments:** Bicycle safety enhancements such as raised crossings and recessed driveway crossings can be considered based on engineering judgment and shall require Houston Public Works approval prior to implementation. Recessed driveway crossings should be between 15-ft to 20- ft from the edge of the roadway pavement to enable one vehicle to queue between the roadway and the bicycle facility. See figure below:



## F. INTERSECTION TREATMENTS

1. Overview: Intersections present significant challenges to bicyclists, and specific accommodations should be provided to ensure bicyclist safety and comfort. These accommodations may include additional signing and striping, signal modifications, and deliberate transitions from one type of bicycle facility to another.
2. Standard Intersection Treatments for Bicycles Facilities
  - a. General:
    - i. Bicyclists are required by law to obey traffic control devices at intersections; therefore, traffic control devices shall be designed to account for identified bicycle needs.
    - ii. Intersections shall be designed to logically position bicyclists through an intersection from an approaching bicycle facility to the receiving bicycle facility.
    - iii. Wayfinding signage should be included wherever two designated bicycle facilities intersect or where a bicycle facility changes direction.
    - iv. Green bicycle pavement markings may be used to increase bicycle facility visibility and identify potential conflict areas and increased cyclist/vehicular awareness. Green bicycle pavement markings should not be used in lieu of but in addition to white pavement markings.
  - b. Traffic signal considerations:

General standards for signalized intersections are defined in Chapter 15 and include bicycle accommodations. Bicycle-related signal options are summarized below.

    - i. Signal timing and actuation shall consider the needs of bicyclists.
    - ii. Bicycle signal heads may be installed at signalized intersections to provide guidance for bicyclists at intersections where movements may not be apparent or where bicycle-specific signal strategies (e.g. bicycle- only phases) are employed.
    - iii. Bicycle detection should be used along high-comfort bicycle facilities at actuated traffic signals to alert the signal controller of bicyclist demand.
    - iv. When bicycle detection is used, a Bicycle Signal Actuation Sign (R10-22) should be used, and a Bicycle Detection Marking (Standard Detail 01510-09A) shall be placed on the pavement indicating the optimal position for a bicyclist to actuate the signal.
    - v. Visibility-limited signal faces shall be adjusted to ensure bicyclists can see the signal indications. If the visibility-limited signal faces cannot be aimed to serve the bicyclist, then separate signal faces shall be provided for bicyclists.

- c. On-street bicycle facilities:
  - i. On-street bicycle facilities generally do not include crossing markings through intersections. However, crossing markings should be considered when additional guidance is needed to direct bicyclists through the intersection or when increased awareness of bicyclists activity is desired.
  - ii. Intersection crossing markings are shown on Standard Detail 01510- 09A and may consist of:
    - 1. Dashed white pavement markings aligned with the lateral extensions of the approach bicycle facility.
    - 2. A combination of dashed white pavement markings and green bicycle pavement markings may be considered when additional guidance is needed to direct bicyclists through the intersection or when increased visibility is desired.
  - iii. If used, intersection crossing markings shall define a space through the intersection with a width that is the greater of 1) the width of the approaching bicycle facility or 2) the standard width for a corresponding high-comfort bicycle facility.
  - iv. On approaches to intersections without dedicated right-turn lanes, on- street bicycle facilities should be extended to the STOP bar with the typical characteristics of the facility.
  - v. On approaches to major intersections without dedicated right-turn lanes and with high right-turn volumes or with a transit stop, on-street bicycle facilities should be extended to the STOP bar. Any buffer should be dropped approximately 50-200-ft from the STOP bar, and from that point the bicycle facility should be defined by dot striping to emphasize the movements of right-turn vehicles across the bicycle facility.
  - vi. Bicycle facilities should not generally terminate at intersections. Where on-street bicycle facilities end at an intersection, signage should be sufficient to provide bicyclists an opportunity to safely make necessary accommodations. At a minimum, "Bike Lane Ends" signage (R3-17, R3-17b) signage shall be used.
  - vii. At intersections where on-street, high-comfort bicycle facilities cannot be extended to the intersection because of geometric or ROW constraints, off-street bicycle facility transitions should be explored.
  - viii. When transitioning between off-street bicycle facilities and on-street bicycle facilities, the grade should be smooth and comfortable, without significant longitudinal pavement joints or sharp changes in direction. Maximum slope should be 1:7.

- d. Separated on-street bicycle facilities:
    - i. For two-way separated on-street bicycle facilities (i.e., cycle tracks), bidirectional bicycle traffic shall be designated through the intersection with a center yellow dash and corresponding white dash on the vehicle side lateral extension of the bicycle facility.
    - ii. Bicycle-green pavement markings may be considered when additional guidance is needed to direct bicyclists through the intersection or when increased visibility is desired.
  - e. Off-street bicycle facilities:
    - i. People riding bicycles on off-street facilities may not utilize standard pedestrian crosswalks, whether the crosswalks are marked or unmarked. Bicycle crossings must provide bicycle-specific crossing markings.
    - ii. Where off-street bicycle-only facilities cross a road, bicycle-green continental pavement markings should designate the bicycle crossing area. These markings should be placed adjacent to the white pedestrian continental pavement markings if present. These roadway crossings may be midblock, at unsignalized intersections, or at signalized intersections.
    - iii. Where off-street shared bicycle/pedestrian facilities cross a road, Dual Use Markings shall be used. These roadway crossings may be midblock, at unsignalized intersections, or at signalized intersections.
    - iv. Dual Use Markings shall consist of white 24-inch continental pavement markings flanked by 24-inch by 24-inch square green bicycle pavement markings. The width of the white markings shall be greater of 8-ft or the width of the approach facility. See Standard Detail 01510-09A.
3. Special Case Intersection Accommodations for Bicycle Facilities
- a. Dedicated Right-Turn Lanes
    - i. General:
      - 1. Dedicated right-turn lanes present crossing challenges for bicycle facilities and should be designed to highlight the crossing maneuver and prioritize bicyclists.
      - 2. The need for dedicated vehicular turn lanes at intersections should be based on vehicular capacity requirements. Where capacity requirements are satisfied by multiple lane assignment combinations, a dedicated right-turn lane should be considered when bicycle/right-turn conflicts are projected to be high (more than approximately 5 bike/turning-vehicle conflicts/peak hour).
    - ii. Design:
      - 1. See Standard Detail 01510-09A for design details.
      - 2. Where a dedicated right-turn lane is used, an adjacent on-street bike lane should continue through to the intersection on the left side of the right-turn lane.

3. An on-street bike lane shall not be located on the right side of a dedicated right-turn lane.
  4. Where a dedicated right-turn lane crosses a bike lane, the bike lane shall not be required to shift more than 3-ft. This is intended to clarify the requirement for vehicles crossing into the dedicated right-turn lane to yield to bicyclists in the bicycle lane.
- iii. Markings:
1. The width of an on-street bike lane adjacent to the left side of a dedicated right-turn lane shall be a minimum of 5-ft (desirable 6- ft).
  2. The bike lane through the bike/right-turn conflict zone shall be delineated with combination white/bicycle-green dashed pavement markings.
  3. The defined conflict zone should end a minimum of 20-ft from the intersection. Within the section of the bike lane past the conflict zone, the lane shall be fully demarcated with green bicycle pavement markings between two 6-in solid white lines and shall include bike lane symbol and arrow pavement markings.
- iv. Signage:
1. A "Right Lane Must Turn Right" sign shall be used at the intersection, and a "Begin Right Turn Lane / Yield to Bikes" sign shall be used at the beginning of the bike lane/right-turn conflict zone.
- b. Two-Stage Turn Queue Boxes
- i. General:
1. Two-Stage Turn Queue Boxes are an intersection improvement consisting of pavement markings and signage that simplify turn movements for bicyclists across adjacent lanes of traffic or to accommodate two stage crossings. They are most frequently used to facilitate left-turn movements for bicyclists in a bike lane without requiring bicyclists to first merge with adjacent traffic into the appropriate turn lane. Instead, bicyclists make the turn in two movements: first, proceeding through the intersection in the bike lane, then turning ninety degrees within the Queue Box to face in the desired direction in front of motorists on the cross street. Two- Stage Turn Queue Boxes should be considered at intersections for roadways with heavy traffic volumes and when designated on- street bicycle facilities are provided on both intersecting streets.
  2. Shall require approval by Houston Public Works.
  3. Should only be installed along roadways with designated on-street bicycle facilities.

## ii. Design

1. Shall be green bicycle pavement markings with an approved material that provides adequate surface traction.
2. Shall include a bicycle symbol and turn arrow pavement markings to designate the space for turning bicycle use only.
3. Shall be placed in a protected zone that will not be encroached upon by vehicles along the origin street. Depending on the intersection geometry, this zone can be located between the lateral extension of the bicycle facility and the adjacent travel lane on the origin street when a buffer exists or between the pedestrian crosswalk and the bicycle lane.
4. Shall include a "No Turn on Red" sign mounted on the signal assembly directed towards the vehicles on the cross street that would stop behind the turn box.
5. Should be positioned to orient the bicyclist towards the receiving bicycle facility on the cross street.
6. May utilize Intersection Crossing Markings to indicate desired path of bicyclists across the intersection in relation to the Two-Stage Turn Queue Box.

## c. Bicycle Box:

- i. Purpose: Bike boxes are an intersection design component consisting of pavement markings and signage that enables bicyclists to queue at a red light in front of stopped vehicles in adjacent lanes. Bike boxes promote bicyclist safety by positioning bike riders in front of vehicular traffic improving bicyclist visibility and reducing potential conflicts between bicyclists and turning vehicles. They should be considered at locations where the volume of turning traffic in conflict with an adjacent bicycle facility is high.
- ii. Suitability and approvals
  1. Shall require approval by the City Traffic Engineer.
  2. Shall be allowed only at signalized intersections.
  3. Shall only be used in conjunction with on-street bicycle facilities, including standard bike lanes, buffered bike lanes, and separated bicycle lanes.
  4. Shall only be approved across a single direction of general purpose lanes. A single bike box will not be approved across bidirectional travel lanes.
  5. A bike box may extend across multiple adjacent lanes to accommodate bicycle left-turn movements.

- iii. Design
  1. See Standard Detail 01510-09A for design details.
  2. Shall be filled with bicycle-green pavement markings that provides adequate surface traction.
  3. Shall be located between the pedestrian crosswalk and the vehicular STOP bar.
  4. Shall include a bicycle symbol pavement marker to designate the space for bicycle use only.
  5. Shall include a R10-11A "No Turn on Red" sign mounted on the signal assembly when those movements would be otherwise allowed across the bike box.
  
- d. Roundabouts
  - i. Purpose: See Chapter 15 regarding general Roundabout Considerations for all roadway users. Bicycle considerations are discussed here.
  - ii. Bicycle lanes shall not be provided within the circulatory roadway.
  - iii. Where bicycle lanes or shoulders are used on approach roadways, they should be terminated at least 100-ft from the edge of the circulatory roadway.
  - iv. Bicyclists may choose to merge with traffic and travel like other vehicles, or a ramp may be provided to allow them to exit the roadway onto the sidewalk (or shared use path) and travel as pedestrians.
  - v. If a ramp is provided for bicyclists to access the sidewalk, the slope shall not exceed 7:1. Lighting should be considered for increased facility safety at transition point.
  
- 4. Side-of-street Transitions
  - a. General: Side-of-street transitions provide options for transitioning a bicycle facility from one side of the street to the other. For example, a bidirectional cycle track that transitions to a pair of standard one-way bicycle lanes at a traffic signal.
  
  - b. Two Stage Crossings
    - i. General
      1. Accommodate bicyclist transitions from one side of the roadway to the other at a signalized intersection by requiring bicyclists to cross each road on a separate signal phase.
      2. Shall require approval by Houston Public Works.
      3. Shall require bicycle-specific signals and/or signal timing consideration for each stage of the crossing.

4. A designated staging zone shall be provided in which bicyclists can safely wait for the second crossing phase. Staging locations may be located on or off-street based roadway geometrics, available pavement width, presence of on-street parking, lane assignments, and turning movements.
  5. This staging zone shall not place the bicyclist in conflict with vehicular traffic.
  6. Appropriate pavement markings should be provided to define each crossing.
- ii. Design
    1. Shall use bicycle-green pavement markings with an approved material that provides adequate surface traction.
    2. Shall include a bicycle symbol and turn arrow pavement markings to designate the space for turning bicycle use only.
    3. Shall be placed in a protected zone that will not be encroached upon by vehicles along the origin or cross street.
    4. May utilize Intersection Crossing Markings to indicate desired path of bicyclists across the intersection.
- c. Diagonal Crossing Phase
    - i. General: Bicyclists transition from one side of the road to the other in a single, independent signal phase at a signalized intersection.
    - ii. Shall require approval by Houston Public Works.
    - iii. Is, when feasible, the preferred method of transitioning bicycle travel from one side of the roadway to the opposite side.
    - iv. Shall require a traffic study to determine feasibility of a diagonal crossing phase. The study shall utilize existing traffic counts and bicycle counts or, if bicycle counts are unavailable, a projection of bicycle usage to determine existing and projected intersection level-of-service (LOS) under NO-BUILD and BUILD scenarios. The LOS shall be computed using Highway Capacity Manual methodology, as detailed in Chapter 15: Traffic Studies.
    - v. Shall utilize a bicycle-specific signal head, pointing diagonally across the intersection from the receiving bicycle facility towards the originating bicycle facility.
    - vi. Shall utilize a specific bicycle crossing signal phase that allows bicycles to travel diagonally across the intersection without vehicular conflicts.
    - vii. Shall require bicycle detection of a type approved by Houston Public Works to call the diagonal signal phase. The diagonal signal phase shall not be called without a detected bicyclist.
    - viii. May utilize individual signal phases for the different directions of bicycle travel (when applicable) so that the diagonal signal phase is only called when a bicycle is traveling in that direction.



- ix. Shall utilize Intersection Crossing Markings to delineate diagonal path of travel across intersection.
- x. Should utilize a Bicycle Pavement Marking Symbol and an Arrow Pavement Marker to indicate the diagonal direction of bicycle travel.
- xi. Shall utilize signage to indicate the diagonal crossing for the bicycle approach.

G. BIKEWAY AMENITIES

- 1. Bike Parking: Bicycle parking and associated bicycle racks placed within the public right of way should not impede the flow of traffic (vehicular, pedestrian, or other) or cause any unnecessary obstruction within the right of way. Bike rack spacing and placement shall be approved by Houston Public Works staff. General Spacing standards include:

Table 17.1 – Spacing Standards

Location	Orientation	Minimum (in)	Standard (in)
Between Racks	Side-by-Side	36"	48"
	End-to-end	72"	96"
From Curb	Perpendicular	36"	-
	Parallel	24"	-
From Wall	Perpendicular	48"	-
	Parallel	36"	-
From Tree	Parallel	36"	48"

- 2. Wayfinding: Wayfinding provide direction, destination, and distance information as needed for bicycle travel. If several destinations are to be shown at a single location, they may be placed on a single sign with an arrow (and the distance, if desired) for each name. If more than one destination lies in the same direction, a single arrow may be used for the destinations.
  - a. A Bike Route sign (D11-1) may be used along any type of bicycle facility as a wayfinding sign.
  - b. The D1 series of wayfinding signage may be used in conjunction with a Bike Route sign (D11-1).

- c. Wayfinding signage, if used, should be placed at logical intervals, especially prior to and at bicycle network decision points.
- d. Alternative wayfinding signage design may be provided on off-street trails.
- e. Listed Destinations: Requires coordination with and approval by Houston Public Works. Wayfinding should indicate directions to neighborhood amenities and destinations. Wayfinding within the public right-of-way shall not promote the use of any one private or for-profit business (except for grocery stores). Examples of acceptable destinations include:
  - i. Management District (i.e. Downtown, Montrose, EaDO, etc.),
  - ii. Transit station (i.e. Park-n-Ride, light rail platform)
  - iii. Government service centers
  - iv. Trail access points
  - v. School/University
  - vi. Library,
  - vii. Grocery Store
  - viii. Bikeway amenities (bike parking, bike shop, bike service center.
  - ix. Bicycle Parking Area - D4-3

#### H. BIKE DETOURS

- 1. Bicycle detours shall be provided wherever a bicycle facility is obstructed.
- 2. Bicycle detours shall provide a level of user comfort that is equivalent to or superior to that of the obstructed facility.
- 3. Bicycle detours shall be provided for trail obstructions that reroute trail users to a public street.

#### 17.05 RESERVED FOR TRANSIT DESIGN REQUIREMENTS

- A. TRANSIT OVERVIEW: TRANSIT OVERVIEW: Reserved
- B. TRANSIT SECTION INTRODUCTION: Reserved
- C. TRANSIT STOP TYPOLOGIES, STANDARD DIMENSIONS: Reserved
- D. TRANSIT STOP PLACEMENT: Reserved
- E. TRANSIT STOP CONFIGURATIONS: Reserved
- F. TRANSITWAYS: Reserved
- G. PAVEMENT MARKINGS/SIGNAGE: Reserved

## 17.06 PEDESTRIAN REALM DESIGN REQUIREMENTS

## A. PEDESTRIAN REALM OVERVIEW

The Pedestrian Realm is the area within a public right-of-way or easement between the back of curb or the edge of the roadway, as applicable, and outermost edge of the public right-of-way or easement. This area provides the necessary space for safe, comfortable, and accessible pedestrian activity, and may accommodate other approved public amenities, infrastructure, or uses. This section details the requirements and design standards for the Pedestrian Realm.

There are three main components of the Pedestrian Realm: the Safety Buffer, the Sidewalk, and the Frontage Buffer. Figure 17.4 illustrates the relative location of each component within the Pedestrian Realm.

1. Safety Buffer – The area between the back-of-curb or the edge of roadway, and the edge of the Sidewalk nearest the back-of-curb or the edge of roadway.<sup>1</sup> It creates a safe and comfortable distance between a person using the Sidewalk and vehicles on the adjacent roadway.
2. Sidewalk – A publicly accessible firm-and-stable-surfaced path that is improved and designed for or is ordinarily used by pedestrians.<sup>2</sup> This is the primary accessible pathway in the Pedestrian Realm and serves as a continuous obstacle-free space for people to safely and comfortably walk or use a wheelchair.
3. Frontage Buffer – The area immediately adjacent to the outermost edge of the Sidewalk. It is designed to reduce potential conflicts that may decrease pedestrian visibility or limit the practical use of the Sidewalk. The Frontage Buffer may be paved or unpaved and is an essential component for pedestrian safety and comfort.

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<sup>1</sup> City of Houston Code of Ordinances: Section 40-551

<sup>2</sup> City of Houston Code of Ordinances: Section 40-551

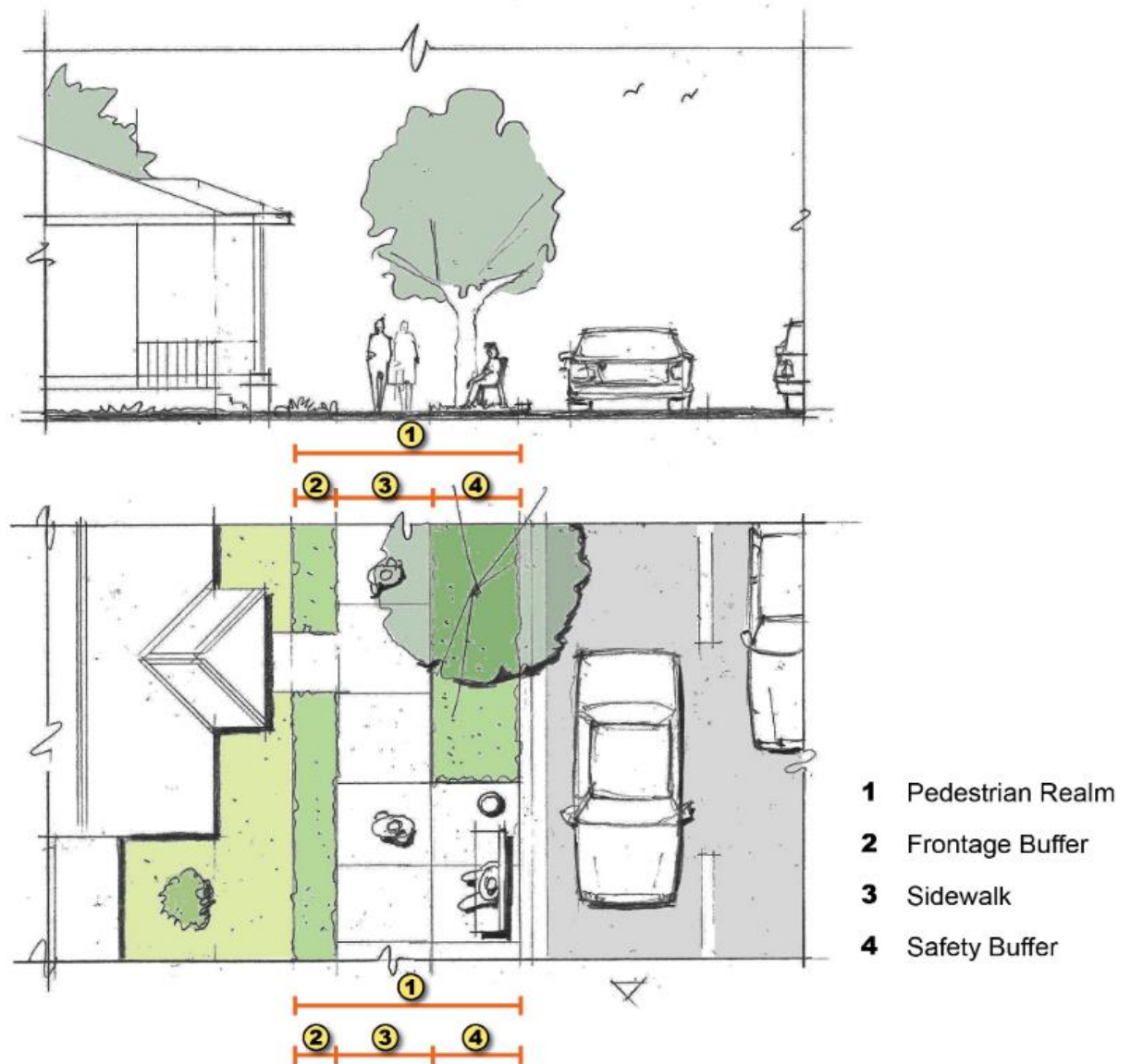


Figure 17.4 – Pedestrian Realm Components

Depending on the existing right-of-way or easement conditions and the adjacent context, the design of each Pedestrian Realm component may vary. The intent of this Section is to provide design guidance to ensure the Pedestrian Realm along each public street has:

1. A safe and comfortable design for all people using or interacting with the Pedestrian Realm;
2. A dedicated and unobstructed path for people to walk or use a wheelchair and, where permitted, for people to use a bicycle or other micro-mobility device; and

3. Space for approved public amenities, trees and landscaping, infrastructure, or other uses in accordance with this Design Manual, the Code of Ordinances, and other applicable regulations or standards.

In most scenarios, the entire Pedestrian Realm is located within the public right-of-way. In some scenarios, however, a portion of the Pedestrian Realm may be within a public easement on private property. Whether part of Pedestrian Realm is within private property or not depends on the “S” dimension under subsection 10.3.03.A (Roadway Cross Sections):

1. When the “S” dimension is wide enough to accommodate the required Pedestrian Realm components detailed in 17.06.B, the entire Pedestrian Realm will be located within public right-of-way. Figure 17.5 illustrates this scenario.

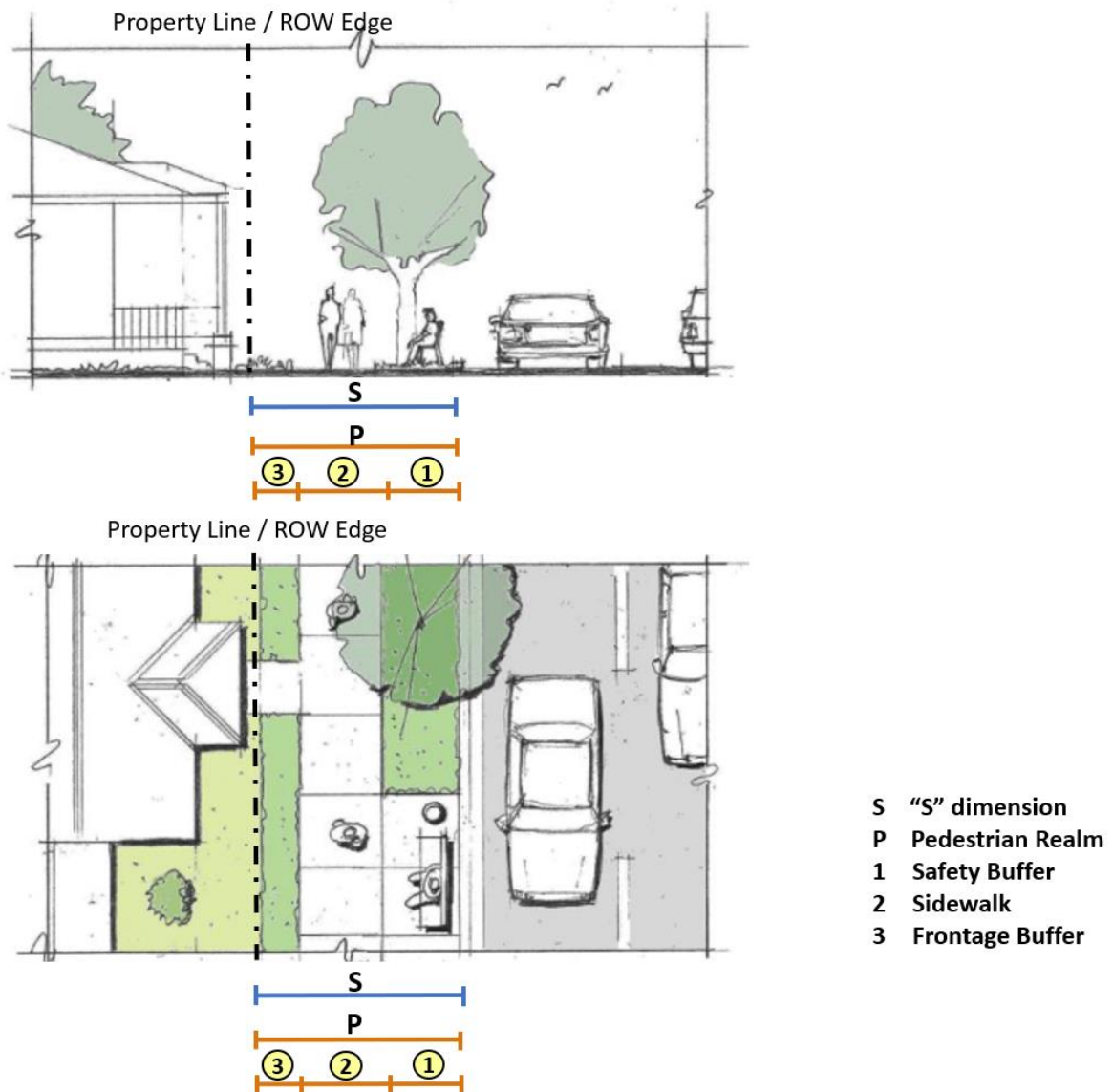


Figure 17.5 – Entire Pedestrian Realm Located within Public Right-of-Way

- When the “S” dimension is not wide enough to accommodate the required Pedestrian Realm components detailed in 17.06.B, part of the Pedestrian Realm will need to be within a public easement on the private property. The duly recorded easement must grant the public a perpetual, non-exclusive easement on, over, and across the private land for the construction, maintenance, and use of a sidewalk.<sup>3</sup> Figure 17.6 illustrates this scenario.

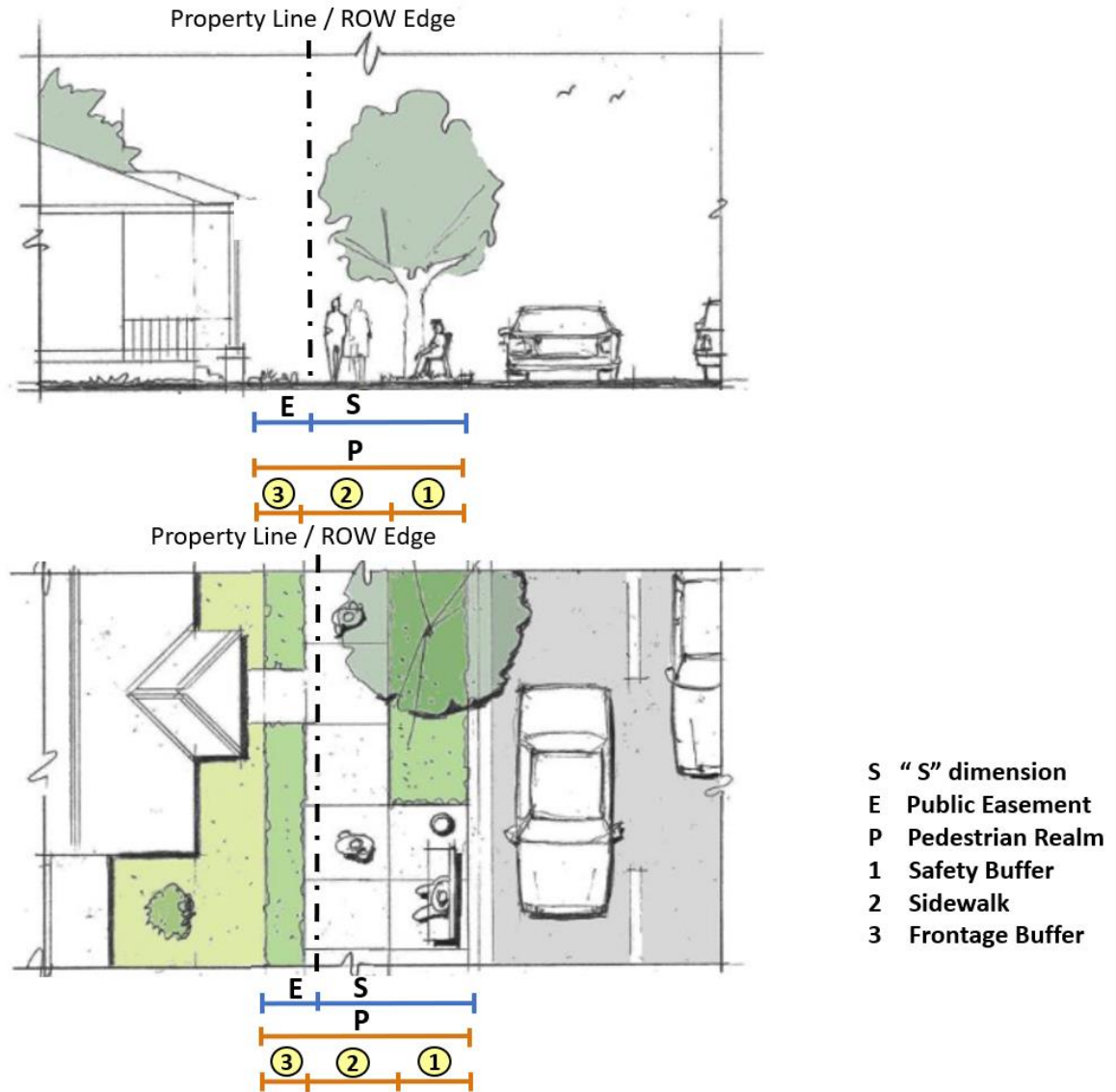


Figure 17.6 – Portion of Pedestrian Realm Located within Private Property

<sup>3</sup> Code of Ordinances: Section 40-551

## B. PEDESTRIAN REALM DESIGN STANDARDS

### 1. General Sidewalk Design

The Sidewalk must be designed to ensure that a person has a safe and comfortable place to walk or use a wheelchair. It must be a level and continuous surface free of obstructions and encroachments, including but not limited to above-grade features such as utility poles and equipment, signposts, kiosks, traffic signal equipment, parking meters, guywires, fire hydrants, bollards, bus or transit shelters, bicycle racks, planters or plantings, street furniture, valet parking service stands, artwork, mailboxes, fences or barriers, door or gate swing, and structural support columns or other building elements.

The placement of a new above-grade feature within the minimum required Sidewalk or within an existing substandard Sidewalk is prohibited unless a modification is granted under the Modification of Standards process detailed in Chapter 40, Article XXII of the Code of Ordinances or otherwise expressly authorized by law.

#### *Additional Sidewalk Design Considerations:*

- a. The Sidewalk must be constructed in accordance with Agency standard details, Texas Accessibility Standards (TAS), and Americans with Disabilities Act (ADA) requirements. If there is a conflict in the requirements, the strictest requirement(s) shall govern.
- b. The Sidewalk must be designed to avoid conflicts with approved above-grade features or topography and to form a continuous path of travel along the street that connects to other existing Sidewalks, where applicable. Sidewalks should keep as much as possible to the natural path of travel parallel to the roadway and should align with the crosswalk at intersections. While Sidewalks do not need to be perfectly straight, curves or turns that direct the pedestrian away from the natural path should not be introduced solely for aesthetic reasons. When a Sidewalk must deviate from a straight path to accommodate trees, connect to other existing Sidewalks (including adjoining property), or to avoid surface utilities or other above-grade features, legible and smooth transitions are required to ensure the minimum unobstructed width required by this section is maintained.
- c. If a Sidewalk is designed to also be used by people on bicycles or other approved micro-mobility devices, it must meet the design requirements for an off-street bicycle facility or trail under Section 17.04 (Bicycle Geometric Design Requirements).
- d. The design of a Sidewalk near an approved bus or transit stop must meet the requirements of Section 17.05, Chapter 10 subsection 10.3.03.B.2 and, when applicable, be coordinated with METRO or other transit operators.

- e. Sidewalks traversing a railroad track must be at 0% slope for a distance of five (5) feet from the centerline of the track in each direction. The sidewalk should cross the railroad track as close as possible to 90-degrees.
- f. Alternative methods of Sidewalk construction may be used in places where tree preservation is of concern. Alternative materials must comply with 17.06.B.1.a of this subsection. They may be, but are not limited to, decomposed granite and checkered plates. If alternative material is selected by the Engineer, the Engineer shall create and submit an alternative material sidewalk construction specification as a part of the design submittal. The specification shall include measurement and payment, material requirements, and instructions on execution. All alternatives shall be coordinated with the City's Urban Forester, as applicable, and approved by the City Engineer.

## 2. General Safety Buffer Design

The Safety Buffer may be paved or unpaved. Approved above-grade features such as utility poles and equipment, signposts, kiosks, traffic signal equipment, parking meters, guywires, fire hydrants, bollards, bus or transit stops, bicycle racks, planters or plantings, street furniture, valet parking service stands, artwork, mailboxes, and other permitted uses may be placed within the Safety Buffer. Except for approved driveways that perpendicularly cross the Safety Buffer, vehicular uses are prohibited.

## 3. Vertical Clearance Standards

### a. Sidewalk

The minimum unobstructed vertical clearance of a Sidewalk is eight (8) feet as measured vertically from the surface of the Sidewalk. Additional vertical clearance requirements apply for certain improvements constructed over a Sidewalk along a designated Walkable Place Street or TOD Street in accordance with the Enhanced Pedestrian Realm Standards of Chapter 42, Article IV of the Code of Ordinances.

### b. Frontage Buffer

The Frontage Buffer must be kept free from visual obstructions in the space above 24 inches and below eight (8) feet in height as measured vertically from the surface of the adjacent Sidewalk. Vertical elements that do not significantly restrict visibility are permitted (e.g. individual trees, streetlights, utility poles, signposts, and certain street furniture). The City Engineer may modify the standards of this subsection when, upon review of written documentation provided by the individual or entity requesting the modification, the City Engineer concludes that the standards are technically or otherwise infeasible due to the presence of existing permitted physical conditions.



4. Pedestrian Realm Width Standards

This subsection establishes minimum width standards for each of the main Pedestrian Realm components for all new Sidewalk construction and certain reconstruction of a Sidewalk. Chapter 40, Article XXII of the Code of Ordinances details scenarios that are exempt from one or more of these standards.

a. Frontage Buffer and Safety Buffer Width

Table 17.2 illustrates both the optimal and minimum width standards for the Safety Buffer and the Frontage Buffer.

Table 17.2 – Frontage Buffer and Safety Buffer Width Standards

Classification	Optimal	Minimum
Safety Buffer	6 feet or more	4 feet
Frontage Buffer	3 feet or more	1 foot

If a combination Sidewalk and paved Safety Buffer is immediately adjacent to an approved on-street cutback for either a pedestrian drop-off/loading area or parking, then the minimum width of the Safety Buffer may be reduced. The resulting combined width of the Sidewalk and paved Safety Buffer in this scenario must be at least ten (10) feet and the design must be approved by the Traffic Engineer and City Engineer. The minimum Sidewalk required by this Section must remain free of obstructions and encroachments. The minimum width of the Safety Buffer may be reduced or eliminated, as appropriate, adjacent to the section of the Sidewalk designed to create a continuous path of travel to connect to an existing Sidewalk.

b. Sidewalk Width

Table 17.3 illustrates the minimum Sidewalk width standards based on the classification of the street which the Sidewalk runs along. Modifications to the minimum Sidewalk width may be granted under the Modification of Standards process detailed in Chapter 40, Article XXII of the Code of Ordinances.

Table 17.3 – Minimum Sidewalk Width Standards

Street Type	Type	Minimum Width
Within Central Business District <sup>4</sup>	All	8 feet
Major Thoroughfare	Walkable Places Street	As designated by the Walkable Places Plan
	TOD Street	8 feet
	All Others	6 feet
All Other Public Streets	Walkable Places Street	As designated by the Walkable Places Plan
	TOD Street	6 feet
	All Others	5 feet

**C. ENHANCED PEDESTRIAN REALM STANDARDS ON TRANSIT-ORIENTED DEVELOPMENT STREETS AND WALKABLE PLACES STREETS**

New development and certain redevelopment along a designated Transit-Oriented Development Street (TOD Street) or Walkable Places Street must meet additional requirements for the Pedestrian Realm and private property adjacent to the public street. These requirements are detailed in Chapter 42, Article IV of the Code of Ordinances.<sup>5</sup>

**D. PEDESTRIAN SAFETY AND VISIBILITY BUFFER**

The intersection of a Sidewalk with a driveway is subject to a Pedestrian Safety and Visibility Buffer in accordance with Chapter 40, Article I of the Code of Ordinances and illustrated in Figures 17.7 and 17.8 below. The Pedestrian Realm may overlap part of the Pedestrian Safety and Visibility Buffer requirement, where applicable.

<sup>4</sup> “Central Business District” is defined in Chapter 42, Article I of the Code of Ordinances.

<sup>5</sup> Users’ Guide available at: <https://houstontx.gov/planning/walkable-places-users-guide.html>

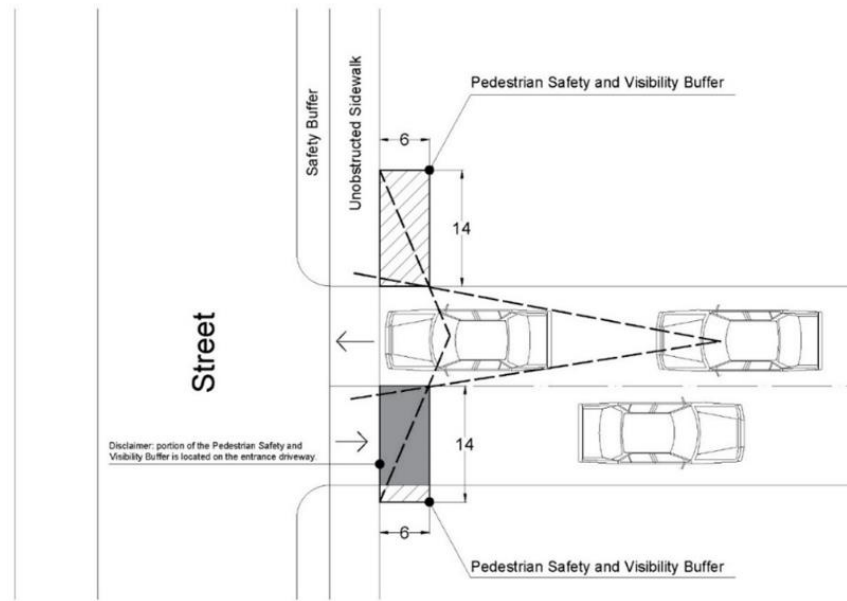


Figure 17.7 – Pedestrian Safety and Visibility Buffer – Two-Way Driveway<sup>6</sup>

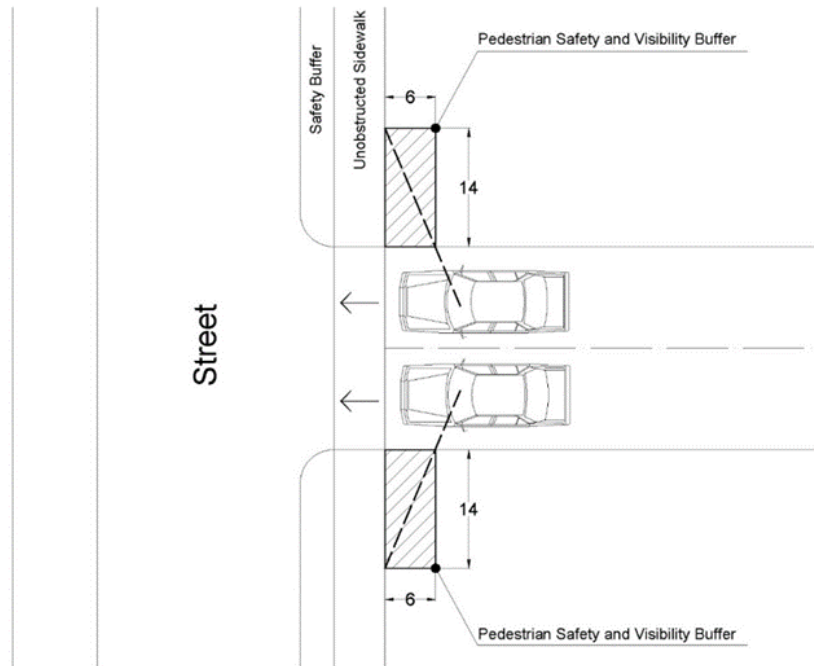


Figure 17.8 – Pedestrian Safety and Visibility Buffer – One-Way Driveway<sup>7</sup>

<sup>6</sup> City of Houston Code of Ordinances Section 40-32

<sup>7</sup> City of Houston Code of Ordinances Section 40-32

## E. MIDBLOCK CROSSINGS

1. Requires prior approval by the Traffic Engineer and City Engineer.
2. Must be designed with legible and smooth transitions to ensure the minimum unobstructed Sidewalk width required by section 17.06.B is maintained.
3. May be appropriate based on area context including, but not limited to, trail intersections and at major trip generators.
4. All Midblock Crossings must meet or exceed applicable accessibility standards.
5. For further design considerations, see subsection 17.04.E.7 (Midblock Crossings).

## F. CURB RAMPS

1. Curb ramps shall be constructed at all intersection corners for any approach that includes a defined Sidewalk.
2. Curb ramps must cross the street as close as possible to 90 degrees to the centerline of street.
3. Curb ramps shall not point into the center of the intersection.
4. Curb ramps constructed on an intersection corner shall be interconnected to create a walking route around the corner that does not require a Sidewalk user to enter the street.
5. The design of curb ramps shall consider ramp direction, driveway crossings, crosswalk locations and the location of the Sidewalk with respect to the curb. Standard curb ramp details are shown in the City's Standard Details.
6. Where use of standard curb ramp details is not possible due to field conditions, engineer shall submit proposed design drawings to City Engineer for approval. Design drawings shall include site field survey conditions.
7. All ramps and sidewalks/walkways shall be constructed in accordance with Agency standard details, Texas Accessibility Standards (TAS), and Americans with Disabilities Act (ADA) requirements. If there is a conflict in the requirements, the strictest requirements shall govern.
8. Curb ramps that are steeper than a 1:15 max slope will not be accepted by the City of Houston.

END OF CHAPTER