Design Approach

for Boston's Complete Streets Guidelines

Design a *Complete Streets Design Guidelines Manual* for the City of Boston that demonstrates the City's commitment to creating streets that are both great public spaces and sustainable transportation networks .

City of Boston
Mayor Thomas M. Menino

Boston Transportation Department
Commissioner Thomas J. Tinlin

Boston Complete Streets

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Boston Parks and Recreation Department
Boston Bikes
Boston Public Health Commission
Commission for Persons with Disabilities
Commission on the Affairs of Elderly
Boston Water and Sewer Commission
Department of Innovation & Technology
Office of Budget Management

Boston Complete Streets

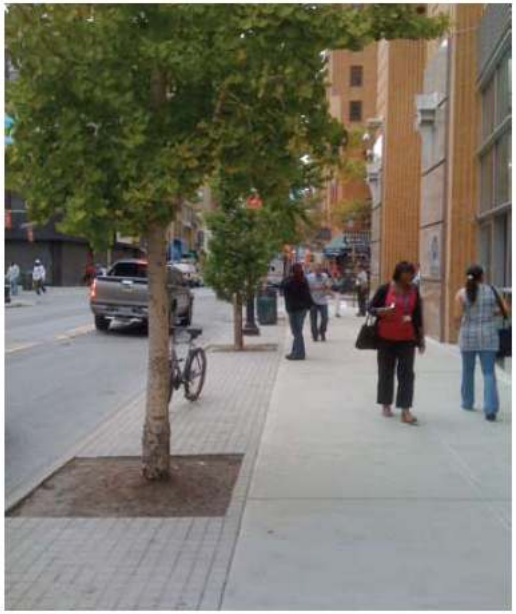
Research-Driven

We studied the structure of street handbooks from other cities:

Square Asphalt or Concrete Pavers

USAGE: OPTIONAL

Precast square–shaped asphalt pavers.



Square asphalt pavers in a furnishing zone: Willoughby Street at Duffield Street, Brooklyn

Benefits

This material is widely available and cost effective

Relatively easy to reset or replace, especially for utility access

Asphalt pavers can be recycled

Considerations

Unit pavers can become loose over time and will require regular maintenance

Application

Can be used on streets where pedestrians will not typically be forced to walk in the furnishing zone

Use of this material generally requires a maintenance agreement

Design

Paver size: 8 inches by 8 inches

Should be sand–set for easier installation and greater permeability wherever impermeable installation generates stormwater runoff

Can be mortar set for stronger structural properties

The area within 18 inches of the curb should be kept free of obstructions

Specification source: NYC DOT Standard Specifications section 6.60 SP

Sustainability Opportunities

High recycled asphalt (RAP) content

High SRI value coloring

Granite Block

USAGE: OPTIONAL

Historic smooth–finish granite block unit pavers often referred to as "cobblestones," commonly used throughout New York City in the 19th Century.

Cobblestones used in a furnishing zone: Battery Park City, Manhattan

Benefits

Visually delineates separation of street uses

Stones convey connection to natural environment

Cobblestones are relatively easy to remove and reset, especially for utility access

Considerations

Stones can become loose over time and will require regular maintenance

Can be slippery when wet

Uneven surface can hinder pedestrian and disabled persons' mobility

Application

Can be used on streets where pedestrians will not typically be forced to walk in the furnishing zone

Use of this material generally requires a maintenance agreement

Design

Should be sand–set for easier installation and greater permeability wherever impermeable installation generates stormwater runoff

Can be mortar set for stronger structural properties

The area within 18 inches of the curb should be kept free of obstructions

Specification source: NYC DOT Standard Specifications section 2.06

Sustainability Opportunities

Salvaged cobbles

Permeable installation

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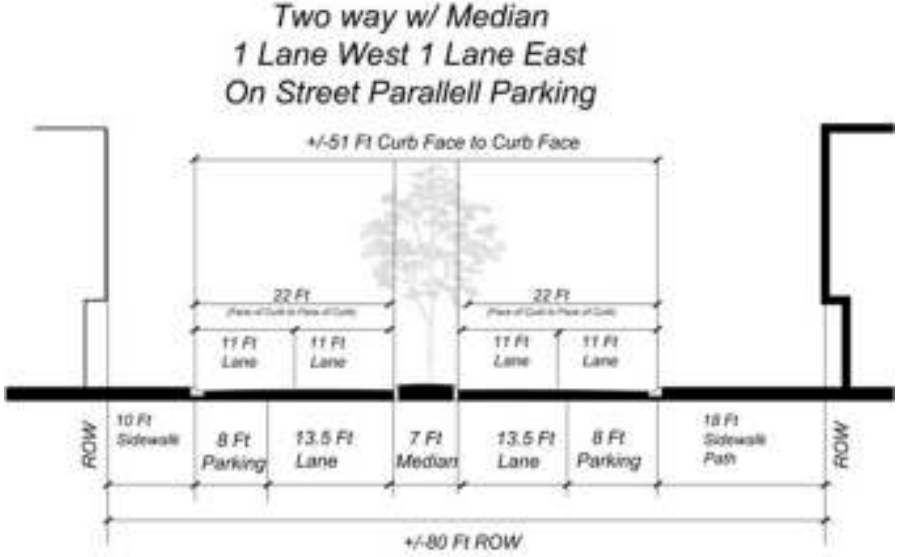

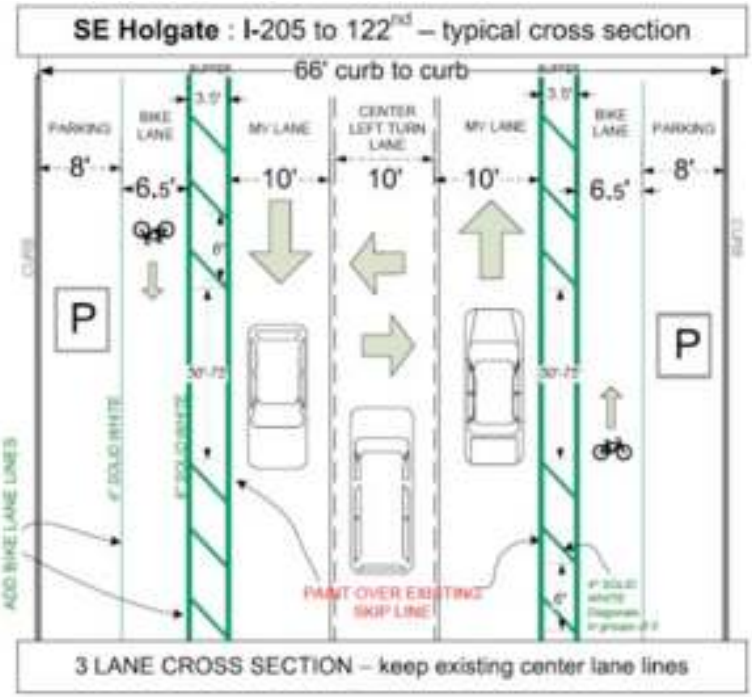

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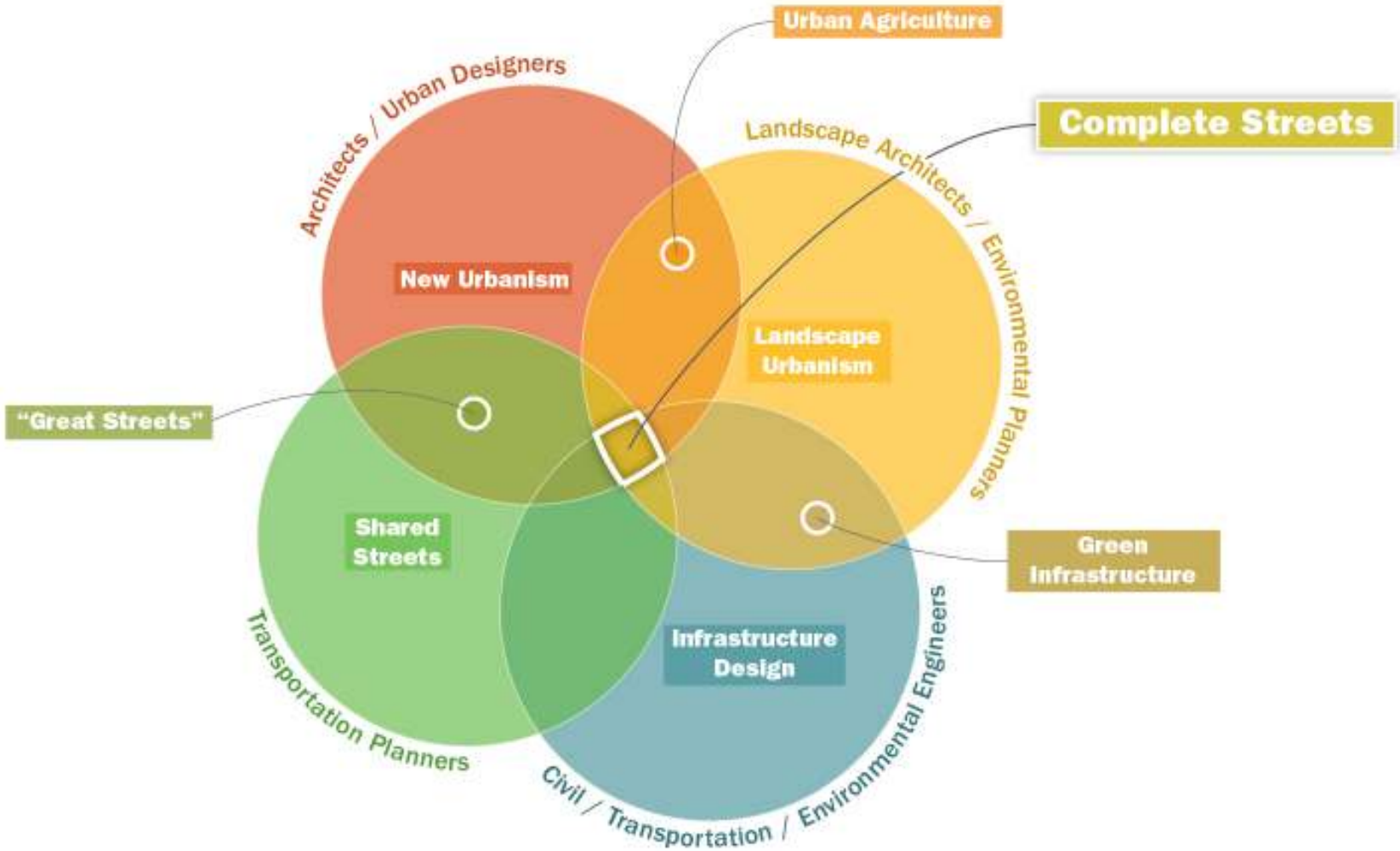

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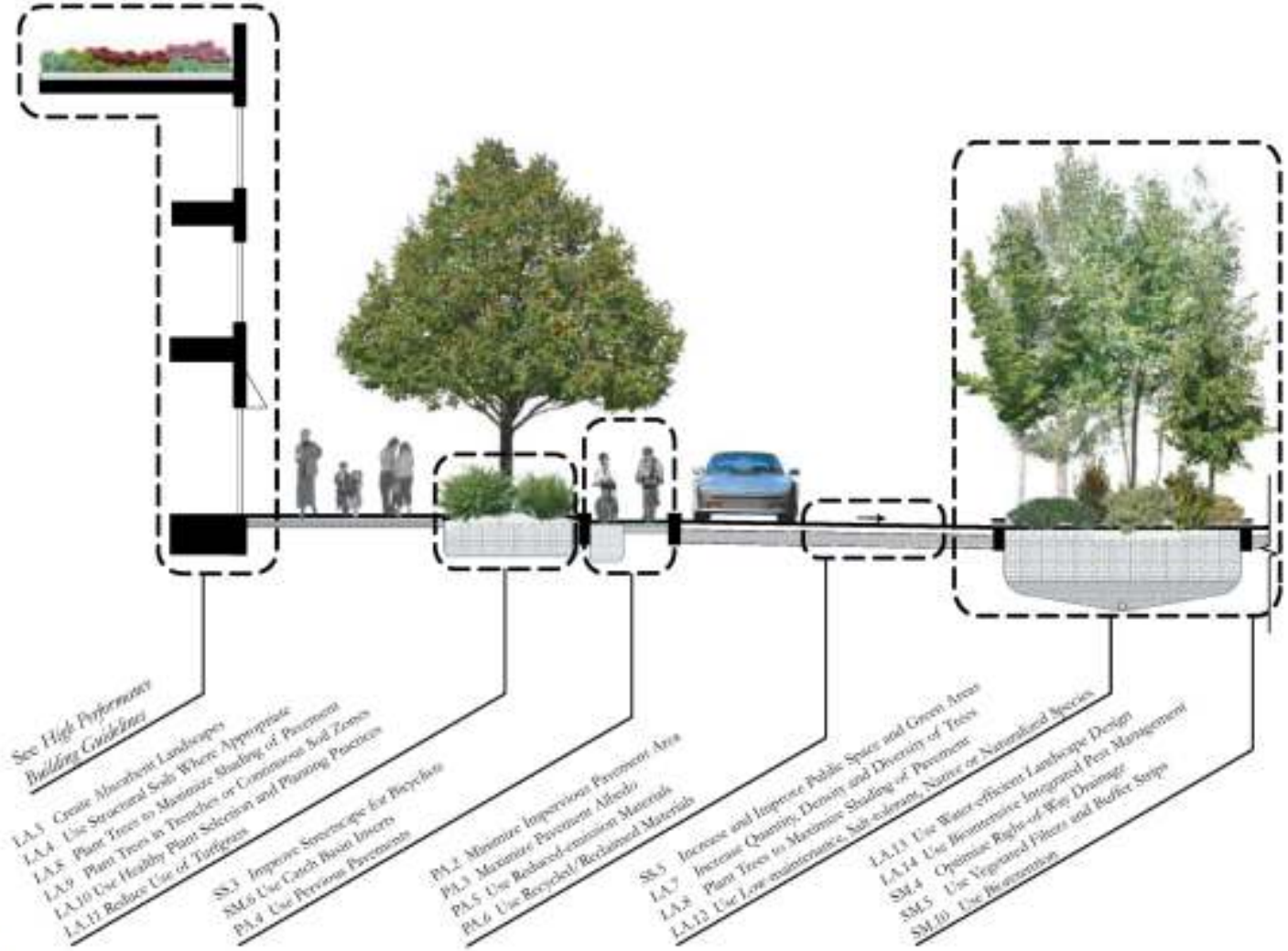
INTEGRATION OF BEST MANAGEMENT PRACTICES



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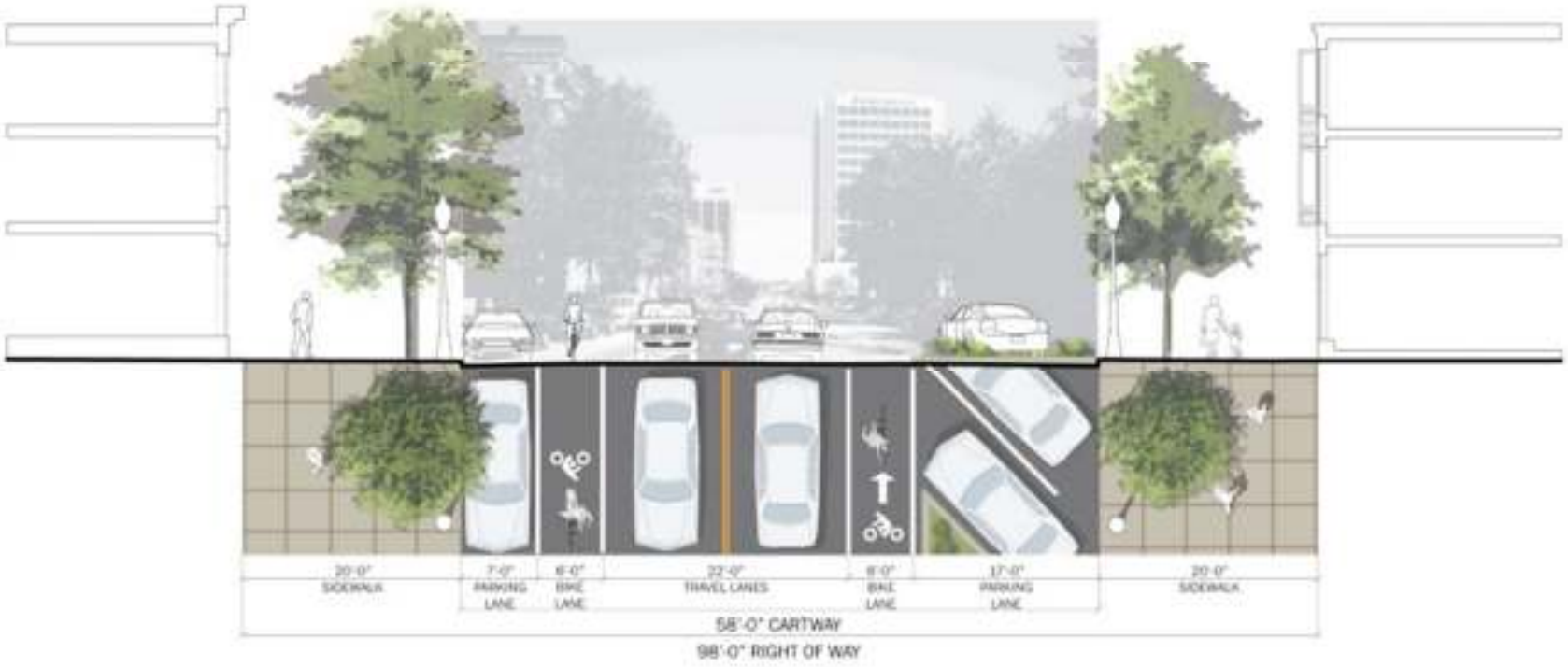
High Performance Infrastructure Guidelines, Design Trust for Public Space, New York City, 2005



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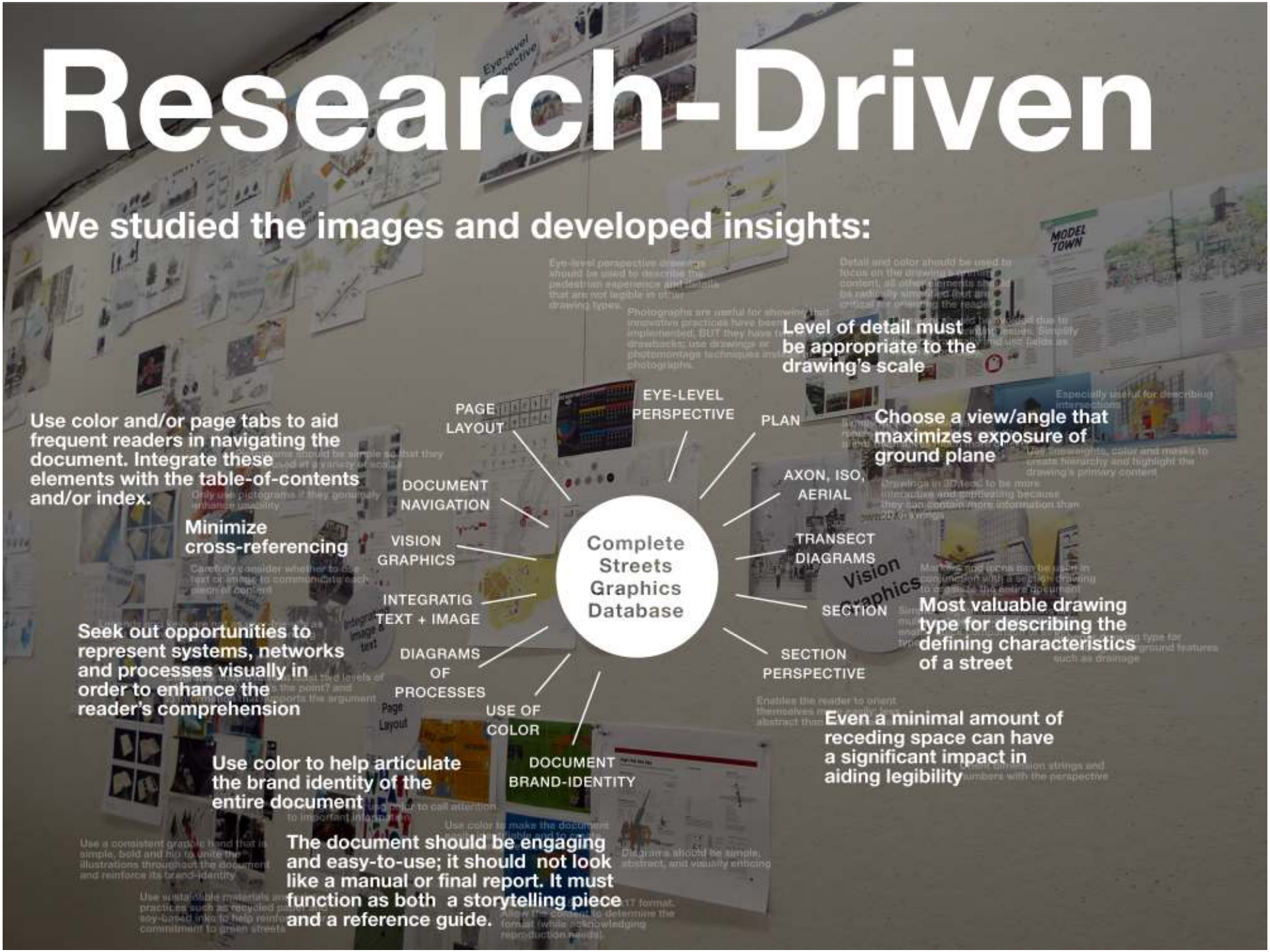
Interface Studio, Philadelphia, PA

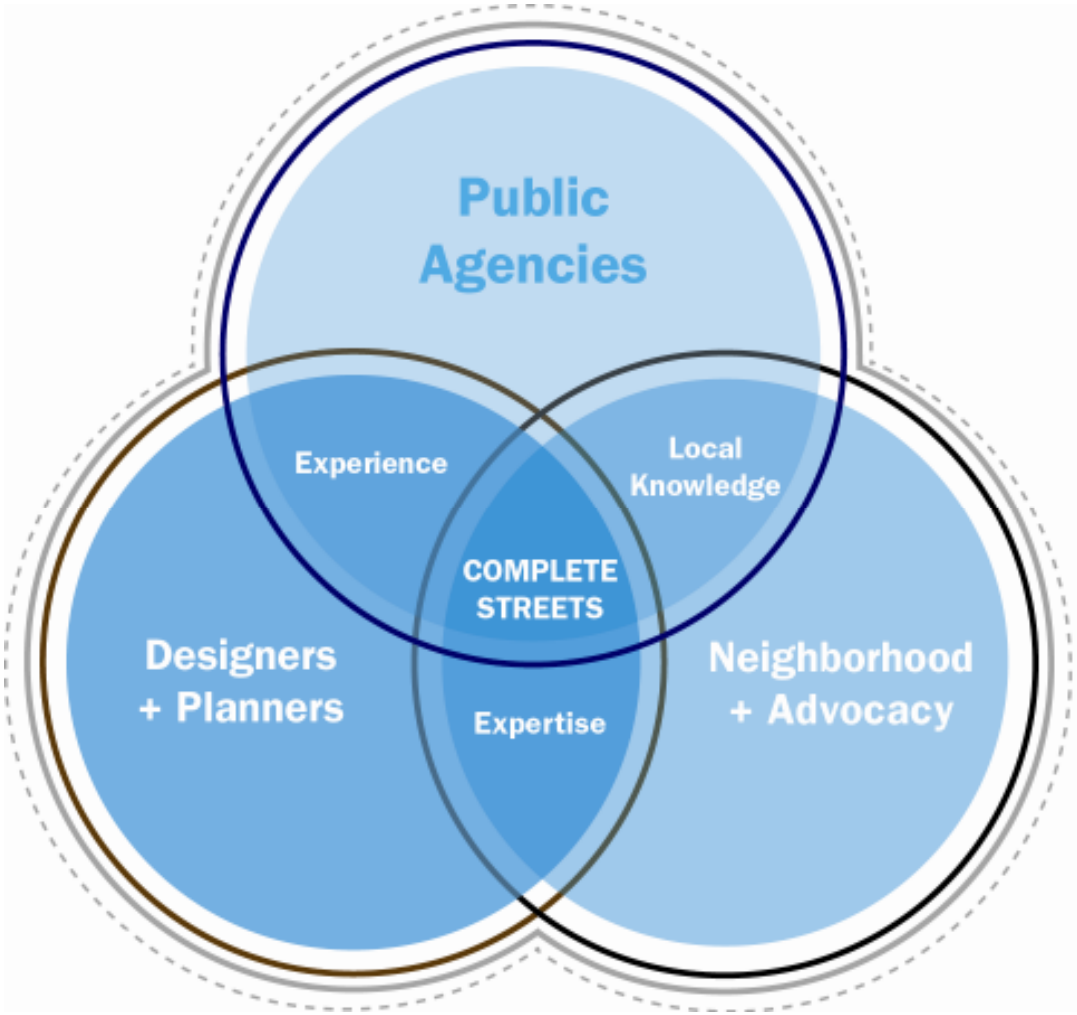
Boston Complete Streets

Interface Studio, Philadelphia, PA

Research-Driven

We studied the images and developed insights:





Boston Complete Streets

Plan Best Practices

01 Detail and color should be used to focus on the drawing's primary content, all other elements should be radically simplified (but are critical for orienting the reader).

02 Level of detail must be appropriate to the drawing's scale

03 Linework should be avoided due to legibility and printing issues. Simplify linework radically and use fields as much as possible.

04 Not as easy to read for laypersons – can we avoid traditional plans altogether?

Two-dimensional Section Best Practices

01 Most valuable drawing type for describing the defining characteristics of a street

02 Simple, diagrammatic sections of multiple streets, aligned vertically, enable quick comparison of street types.

03 Markers and icons can be used in conjunction with a section drawing to organize the entire document

04 Superior drawing type for describing underground features such as drainage

Three-dimensional Section Best Practices

01 Enables the reader to orient themselves more easily; less abstract than traditional section

02 Even showing a very minimal amount of receding space can have a significant impact in aiding legibility

03 Orient dimension strings and numbers with the perspective

Axon, Iso, and Aerial Perspective Best Practices

01 Simple three-dimensional representations can allow reader to orient themselves much more quickly.

02 Drawings in 3D tend to be more interactive and captivating because they can contain more information than 2D drawings

03 Use lineweights, color and masks to create hierarchy and highlight the drawing's primary content

04 Choose a view/angle that maximizes exposure of ground plane

05 Especially useful for describing intersections

Street Types

Design the graphic language to communicate the range of Boston street types.

Existing Class v. New Type

The traditional classifications by themselves, however, are not sufficient when designing a Complete Street. The design of intersections, sidewalks, and transit stops must also take into consideration the local neighborhood context, such as the type and intensity of the adjacent land use, since these factors influence how the street is used. A more nuanced system that reflects the diverse uses and functions of Boston's streets is necessary. For this purpose, Complete Street types have been created.

Traditional road classifications emphasize vehicle movement.

Complete Street Types emphasize the character of the entire street.

Traditional Highway Class

- Arterials
- Collectors
- Locals

Complete Street Types

New Street Types

- Downtown Commercial
- Downtown Mixed-use
- Neighborhood Main
- Neighborhood Connector
- Neighborhood Residential
- Industrial

Special Street Types

- Shared Street
- Parkway
- Boulevard

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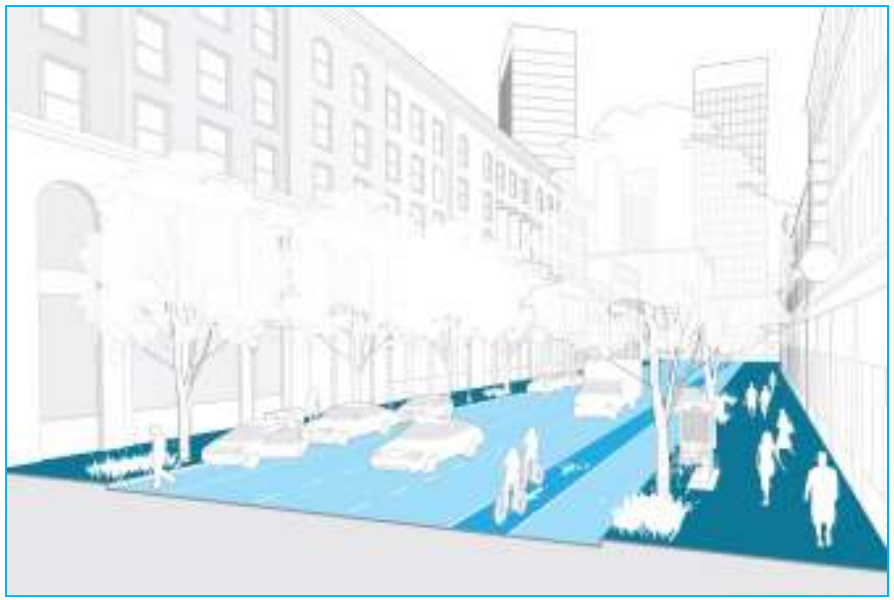
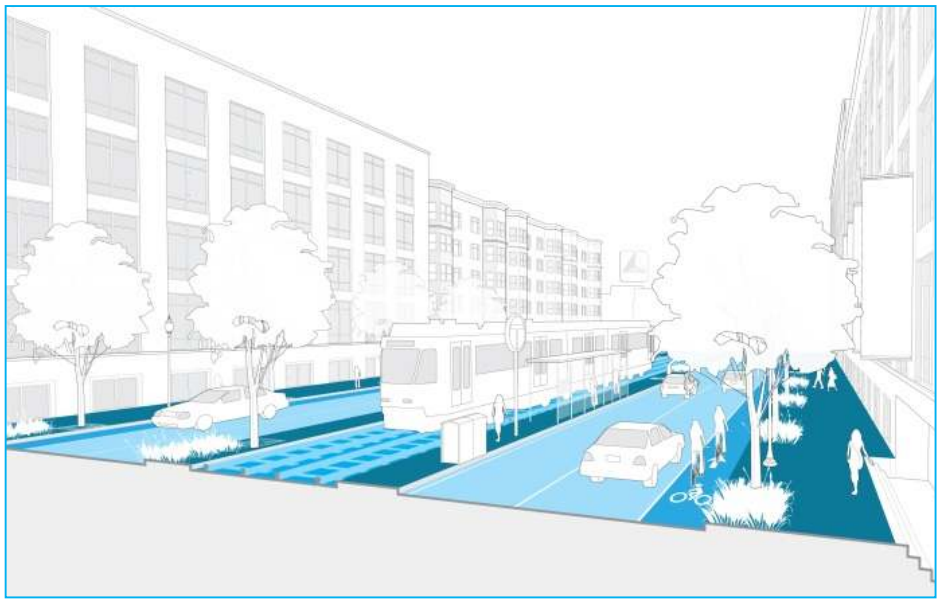




Boston Complete Streets

Downtown Commercial

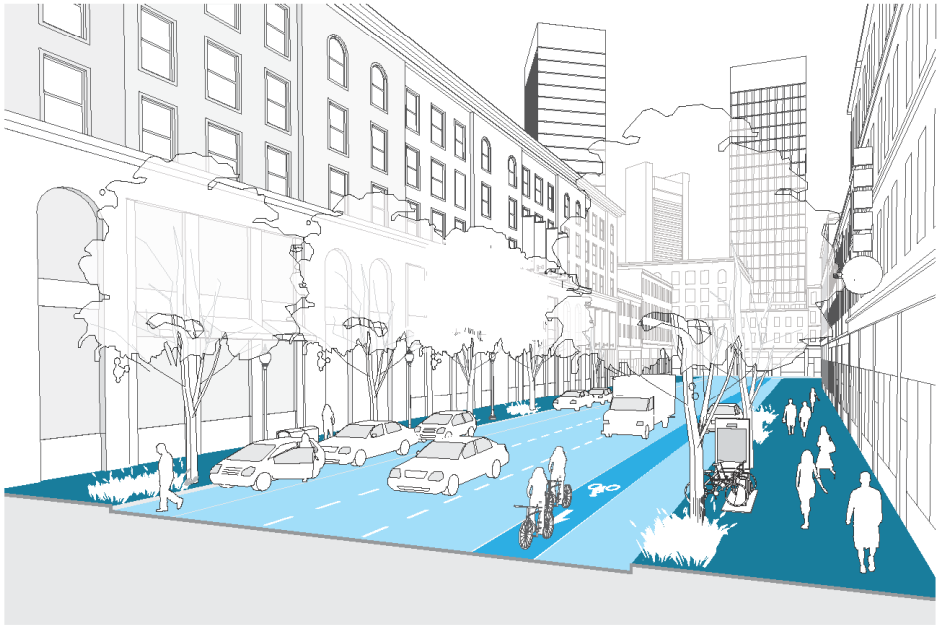
Overview

Downtown Commercial Streets define Boston's dense commercial core. These street types are found primarily in the Financial District, Government Center, Chinatown, the Leather District, Back Bay, and the South Boston Waterfront. Containing a mix of mid- and high-rise office buildings, the streets serve as international cultural destinations and connect with highways and transit hubs that serve the Greater Boston region.

These often-iconic streets play a key role in the regional movement of people, and their designs must support extremely high user volumes. Congestion, commercial vehicle traffic, and high volumes of pedestrians and bicycles, combined with relatively short blocks and numerous irregular intersections make achieving the right modal balance a considerable challenge. Lined with a mix of century-old and modern building facades and grand lobbies these streets require wide sidewalks with enhanced finishes. Designs must also respect historic significance of these streets.

Example Streets

- Congress Street (Government Center/Financial District)
- State Street (Government Center/Financial District)
- Kneeland Street (Chinatown/Leather District)
- Summer Street (Financial District/South Boston Waterfront)
- Boylston Street (Back Bay)



Boston Complete Streets

Boulevards

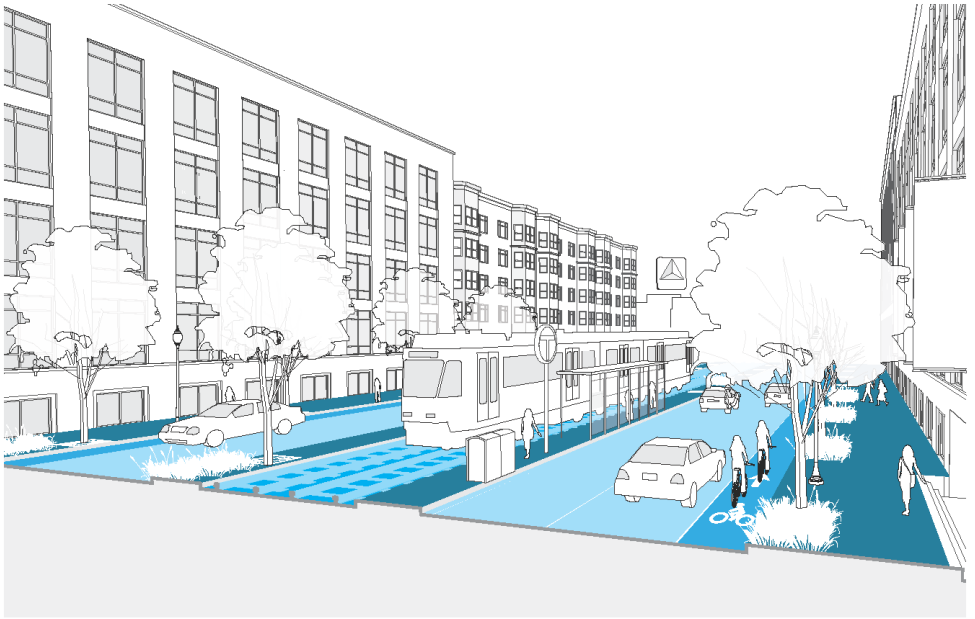
Overview

Boulevards, like Parkways, are defined by their grand scale and urban design. Boston has a rich heritage of these streets, with Commonwealth Avenue in the Back Bay being recognized as one of the nation's premier boulevards. They usually have a consistent design for the length of the corridor, often with wide planted medians or furnishing zones, and they connect important civic and natural places. Boulevards also often feature longer block lengths.

Significant mature tree cover, combined with promenades or median malls provide great walking and social spaces along Boulevards. Boulevards differ from Parkways in that they normally have buildings and active land uses along both sides of the street. Medians may also accommodate light-rail or bus rapid-transit service.

Example Streets

- William J. Day Boulevard (South Boston)
- Commonwealth Avenue (Back Bay, Fenway, Allston/ Brighton)
- Huntington Avenue (Fenway/South End)



Boston Complete Streets

Parkways

Overview

Parkways are typically four-lane roads characterized by long, uninterrupted stretches running parallel to Boston's open space systems such as the Emerald Necklace and the Charles River. Many Parkways have historic elements, including continuous rows of trees and curbing that they share with the adjacent parkland. As Parkways run along uninterrupted stretches of open spaces they have fewer intersections. While this feature often makes them convenient for motor vehicles, the combination of higher speeds and longer distances between signalized crossings can make Parkways difficult for pedestrians and bicyclists to cross.

Normally Parkways do not provide on-street parking, and sight lines are often limited due to hills and curves in the roadway. Existing Parkways in the City are typically under the jurisdiction of the state.

Example Streets

- West Roxbury Parkway (West Roxbury/Roslindale)
- Riverway (Fenway/Mission Hill)

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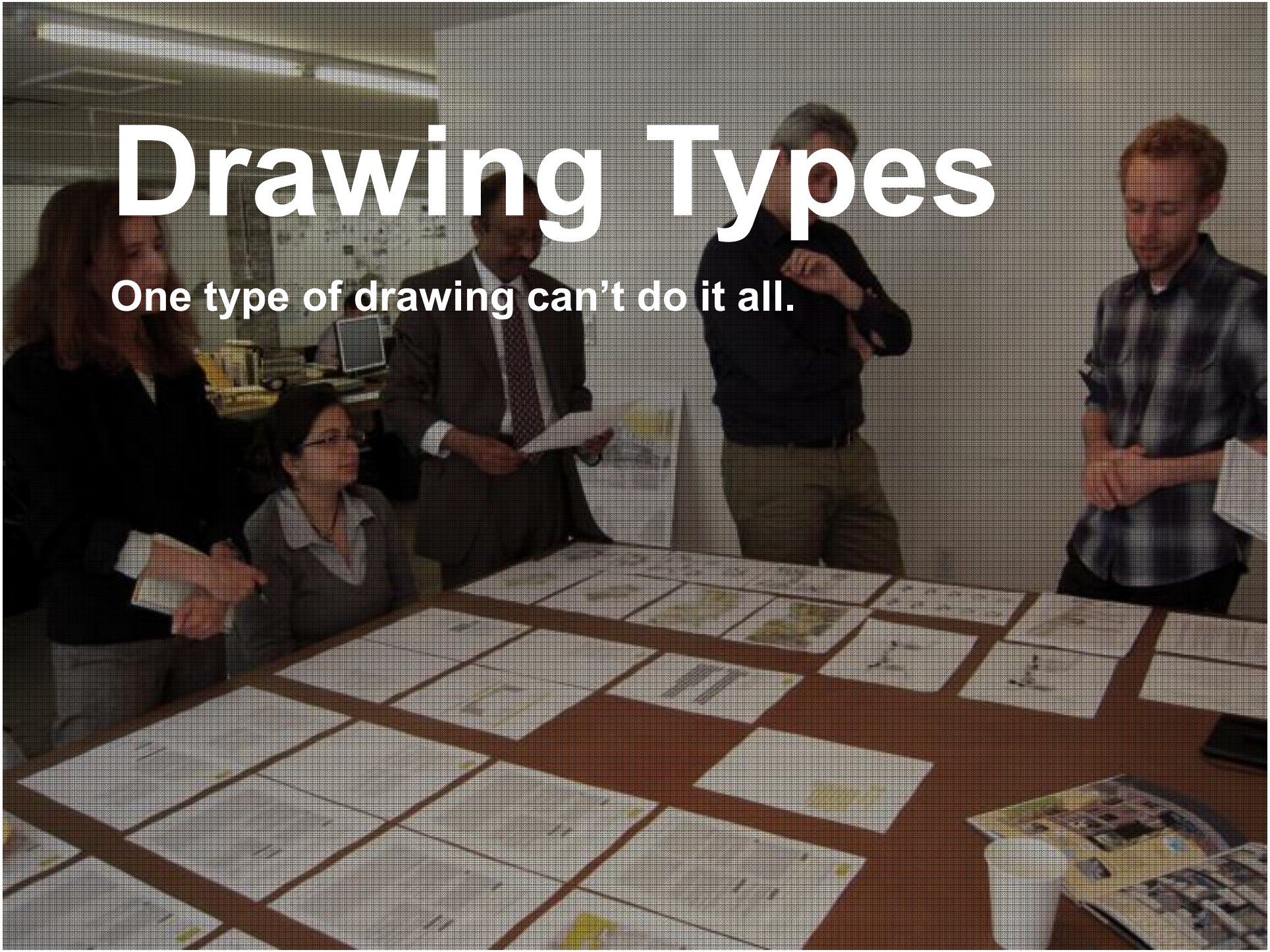
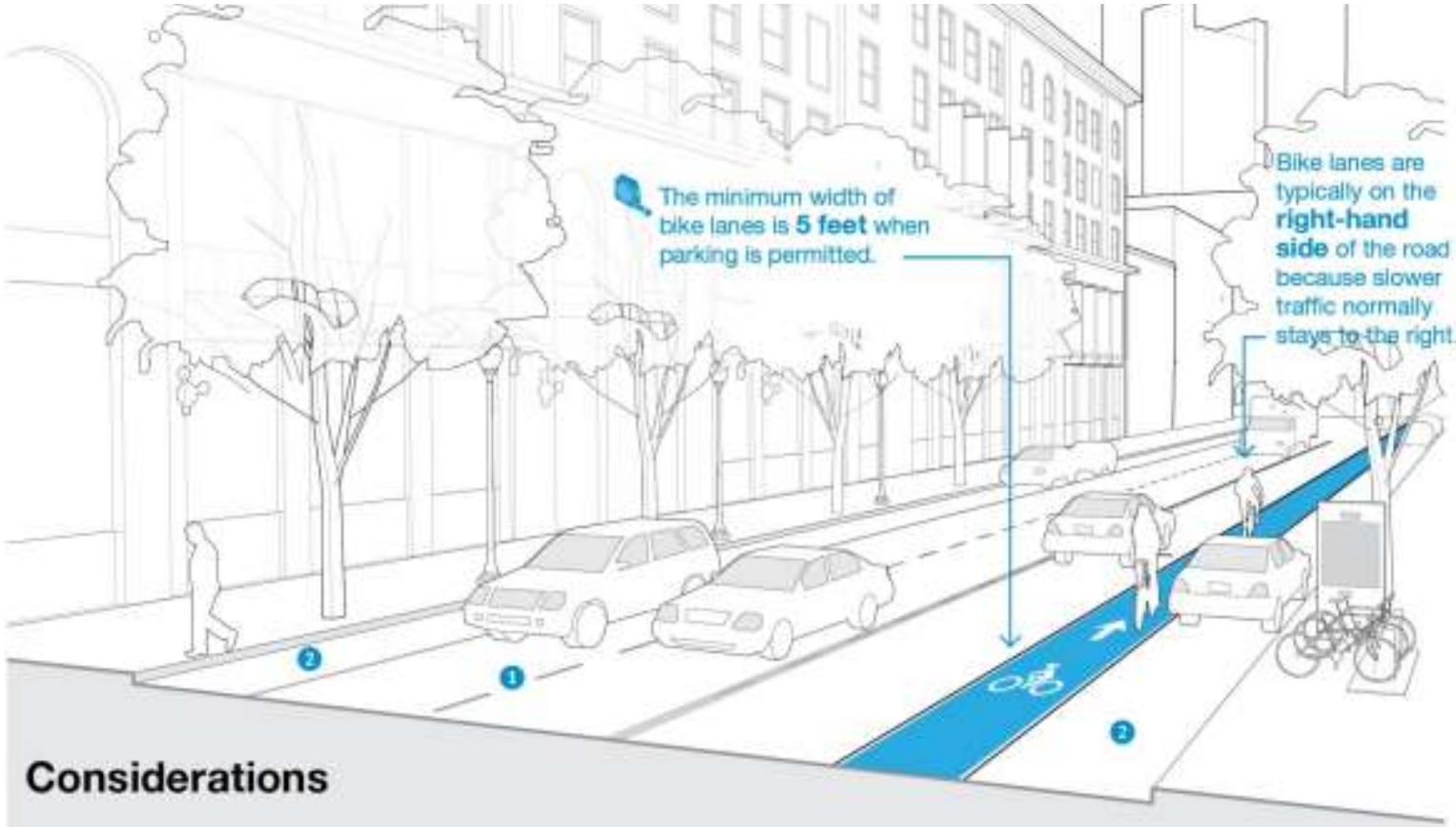
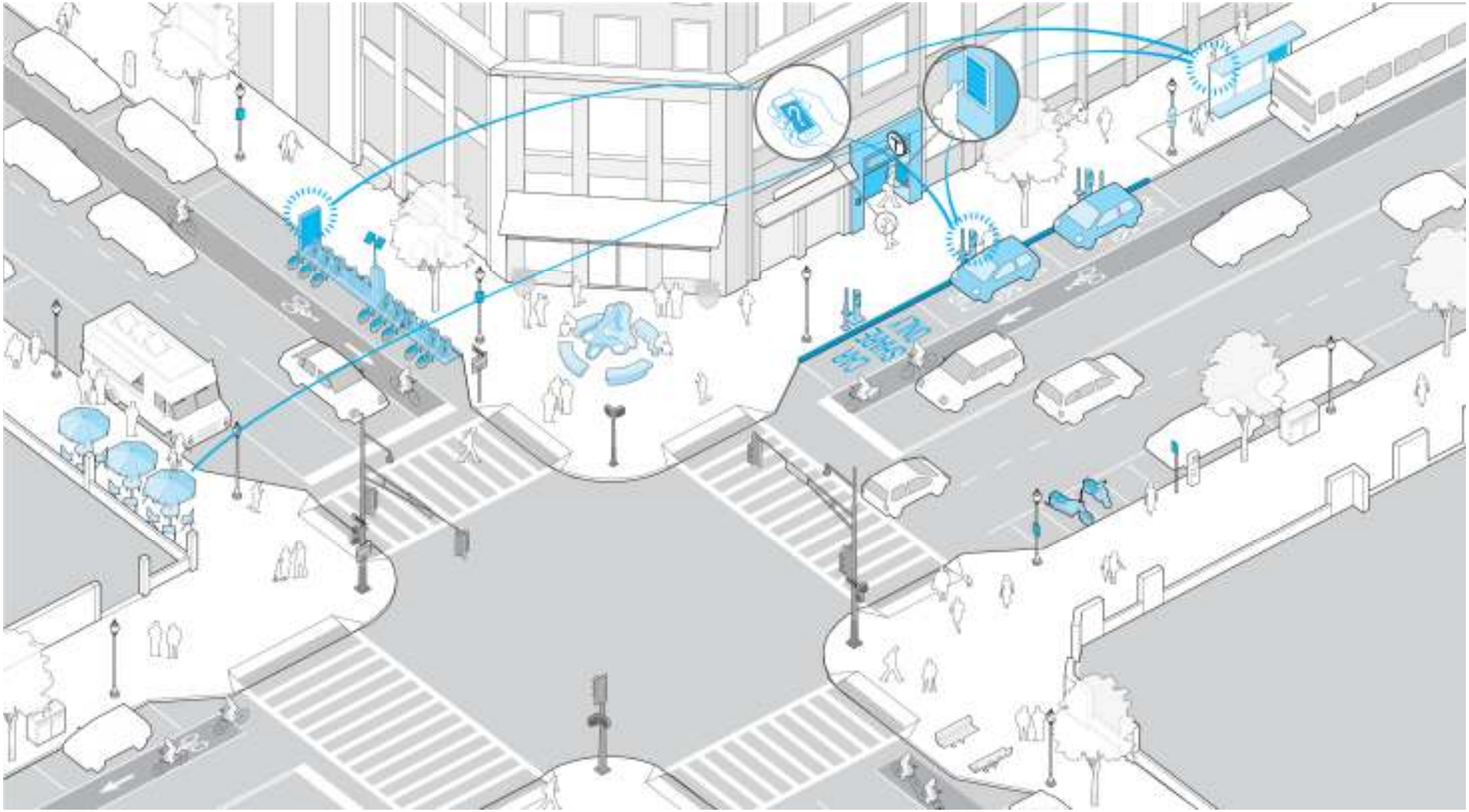

Drawing Types
One type of drawing can’t do it all.



Considerations

- Bicycle lanes are normally placed on the right hand side of the road to reflect the general traffic principle of slower traffic keeping to the right.
- On one-way streets and streets with wider medians, consider a left-side bike lane (see next section).
- Where additional space is available, consider providing a buffered bike lane (see page TK).
- On constrained corridors with high parking turnover, consider providing a buffered bike lane or using parking T's instead of longitudinal parking stripe to guide bicyclists away from parked vehicles.
- Wider bike lanes enable bicyclists to pass one another on heavily traveled corridors and increase separation from faster traffic.



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URBAN DESIGN

Vehicular Access Across Sidewalks

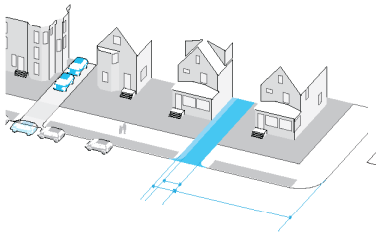
SHY/FRONTAGE ZONE
PEDESTRIAN ZONE
GREENSCAPE/FURNITURE ZONE
CURB ZONE

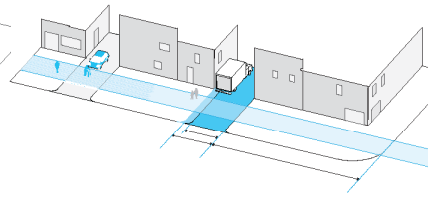
Overview

Buildings edges with parking access and loading zones/service areas create weak spots in the streetscape and require special treatments. Driveways in locations where the street wall is set back from the road can also create challenges for pedestrians and must be designed with their needs in mind.

New driveways, or changes to existing driveways for either commercial or residential use require approval from the Public Improvements Commission.

	MIN DISTANCE FROM SIGNALIZED INTERSECTION	MIN DISTANCE FROM UNSIGNALIZED INTERSECTION	MIN DRIVEWAY WIDTH	MAX DRIVEWAY WIDTH
COMMERCIAL DRIVEWAYS	100'	100'	20' (TWO WAY)	24' (TWO WAY)
RESIDENTIAL DRIVEWAYS	40'	20'	10' (TWO WAY)	12' (TWO WAY)





Use

Driveways are a necessary element in order to provide vehicular access from the public way to private property. Nevertheless, the design of driveways should indicate the priority of the continuous pedestrian zone over the yielding vehicular path. Careful consideration should be given to the design of driveways in order to minimize disruption to the pedestrian while ensuring safe operation. The following design guidelines should be followed:

- The public sidewalk has the right-of-way over private crossings and driveways should be designed to reinforce this principle. The pedestrian zone should be clearly delineated across driveways in order to give drivers the expectation that they should yield to pedestrians (e.g. if the sidewalk is composed of concrete, the concrete surface treatment should be continuous across the driveway).
- The pedestrian zone should be continuous across the driveway and must meet the requirements of the Americans with Disabilities Act Accessibility Guidelines for accessible pedestrian routes, including the requirements for **no more than a 2% cross slope.**

Considerations

- In constrained locations where the width of the sidewalk is insufficient to for fully raised crossing, the roadway can be partially raised and the sidewalk partially lowered. This design minimizes the disruption to the pedestrian while providing a traffic calming effect. On a typical 6" high sidewalk, this compromise can be achieved by ramping down sidewalk at the driveway three inches and raising the driveway by the same amount.
- If the driveway apron and the sidewalk are the same material, consideration should be given to providing a delineating feature along the edge of the sidewalk. This may come in the form of striping or a different hardscape surface.
- In locations where a driveway must function as an intersection, it should be designed with pedestrian safety features such as crosswalks, small corner radii and (if signalized) pedestrian signal heads.

Additional guidance on driveway design is provided in Boston Transportation Driveway Guidance for the Boston Zoning Board of Appeal. www.cityofboston.gov/online_services/reportsandpublications.asp

URBAN DESIGN

Building Entrances

SHY/FRONTAGE ZONE
PEDESTRIAN ZONE
GREENSCAPE/FURNITURE ZONE
CURB ZONE

Overview

Building entrances connect the indoors with the public realm. They should be convenient and welcoming to pedestrians. Building facades are private property and are not directly under the control of the City. However, as building edges frame streets, the cooperation of building owners is critical to the success of any vibrant, livable place. Incentives, such as public improvements, loan programs, streamlined permitting, design services, etc. can leverage private investment.

Considerations

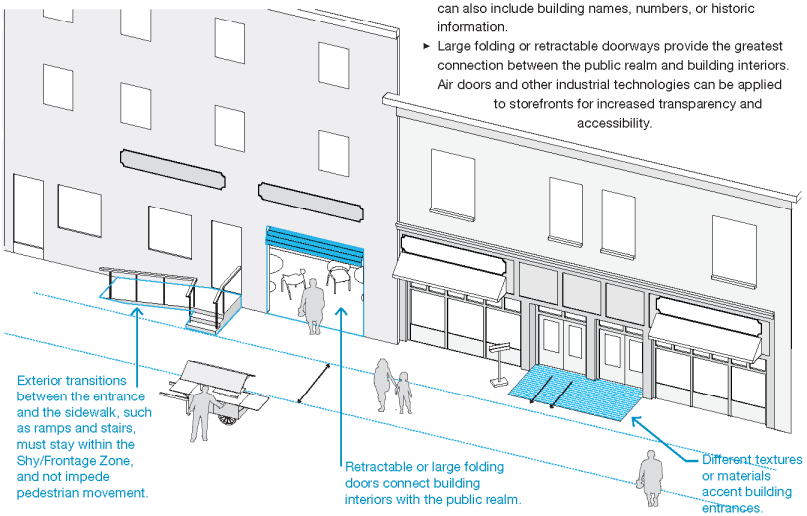
Buildings with raised first floors require a transition to meet the sidewalk. Exterior transitions including stairways, railings, and ramps must stay within the Frontage Zone. Access that is integrated into the interior of the building is generally preferable but not always feasible. Interior ramps or lifts can occupy valuable retail space or crowd circulation within lobbies.

Use

The design individual entrances is especially important on Downtown Commercial, Downtown Mixed-Use, Shared and Neighborhood Main Street types which require a strong edge and plenty of visual interest. Entrances of buildings on Neighborhood Residential and Neighborhood Connector Streets may be set back from the sidewalk where appropriate but should face the street and maintain a consistent street wall without large gaps.

The design of building entrances should include the following characteristics:

- Entrances to buildings should face the street and open to the sidewalk.
- The structure surrounding building entrances should be limited to the Frontage Zone to minimize impact on the pedestrian path.
- Individual building entries may be accented with the use of texture or material changes in the pavement directly in front of the points of entry. Such pavement accents can also include building names, numbers, or historic information.
- Large folding or retractable doorways provide the greatest connection between the public realm and building interiors. Air doors and other industrial technologies can be applied to storefronts for increased transparency and accessibility.



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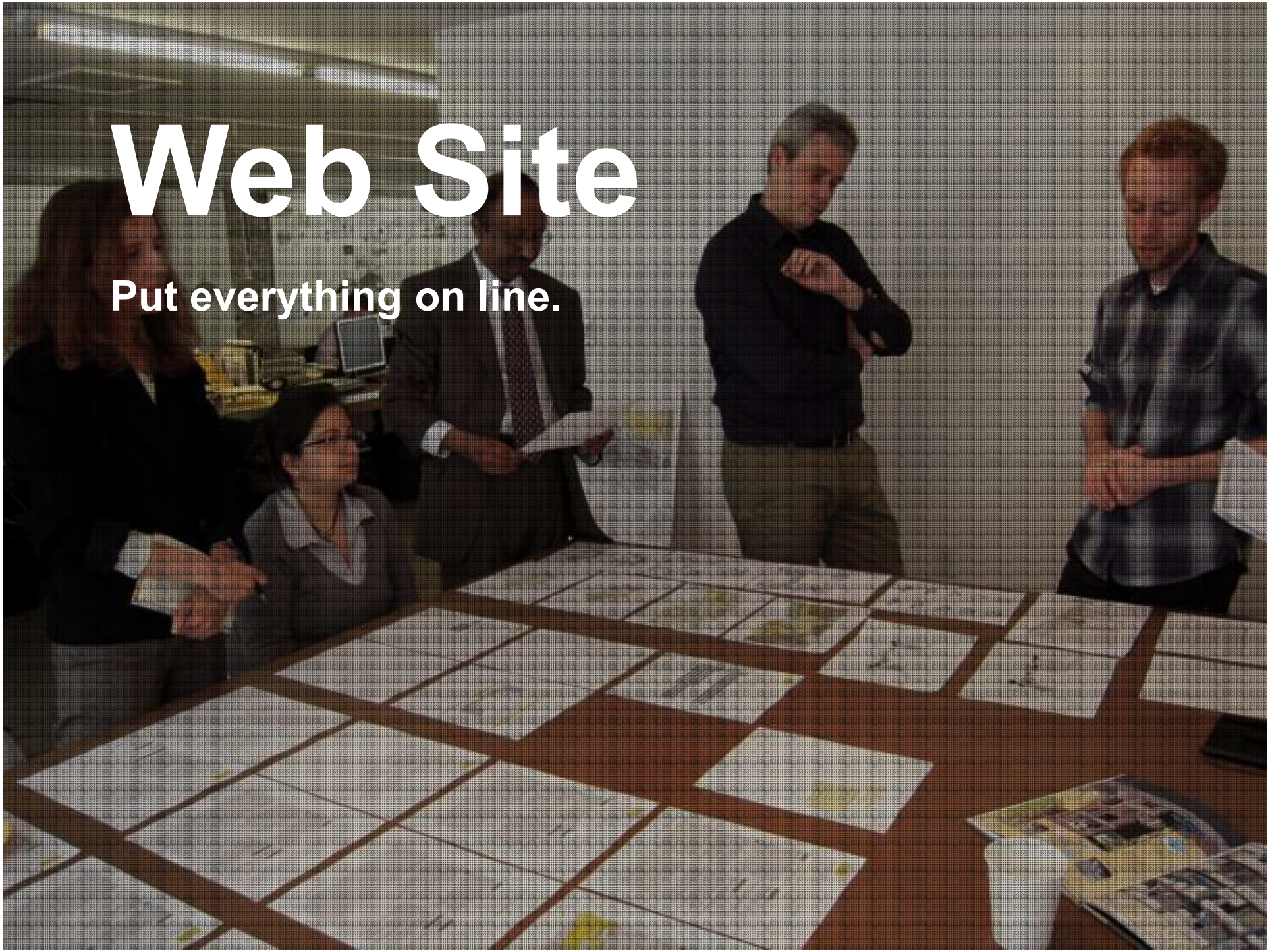
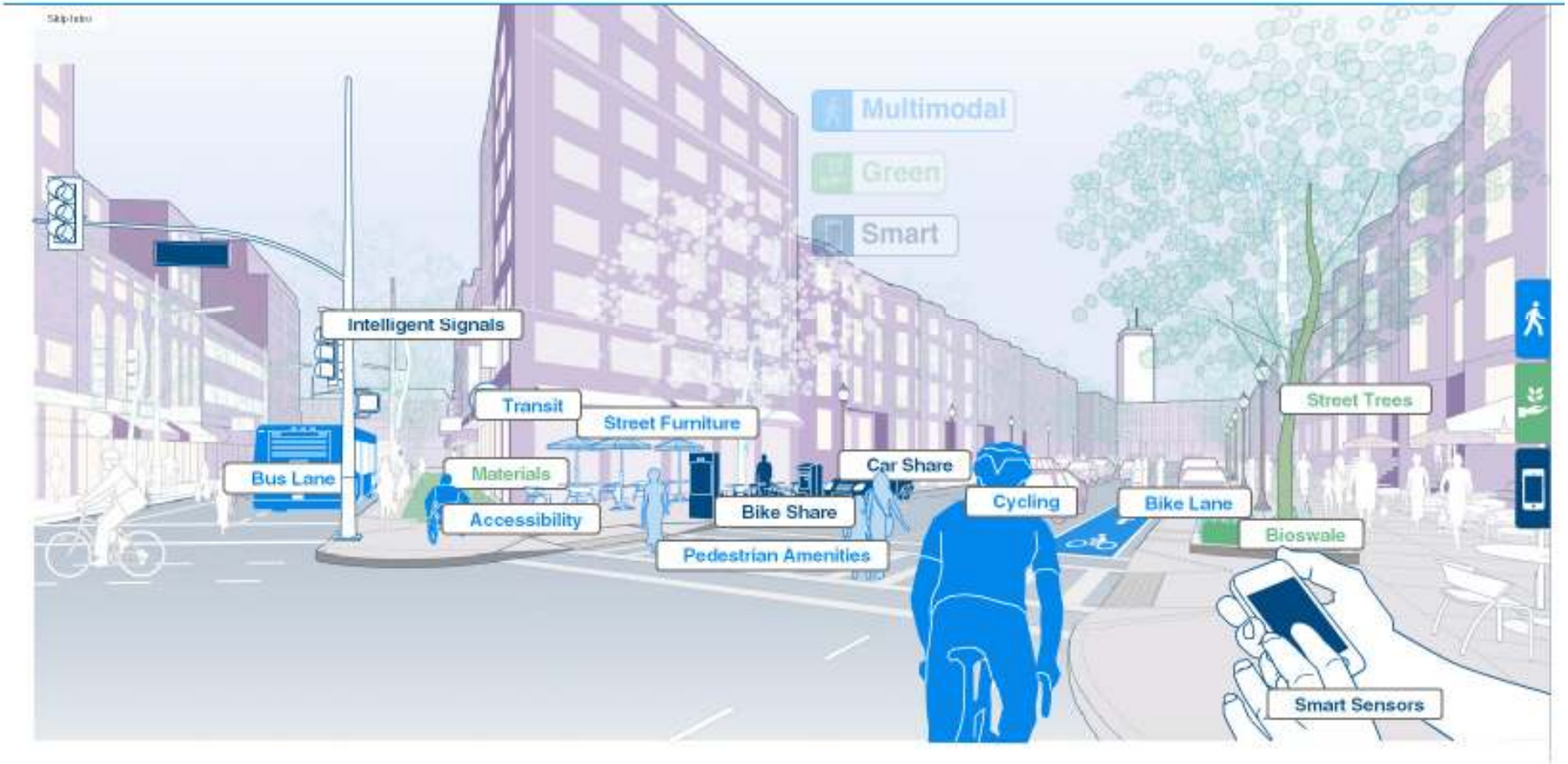

Web Site
Put everything on line.


Multimodal
Green
Smart
Intelligent Signals
Transit
Street Furniture
Bus Lane
Materials
Accessibility
Car Share
Bike Share
Pedestrian Amenities
Cycling
Bike Lane
Street Trees
Bioswale
Smart Sensors

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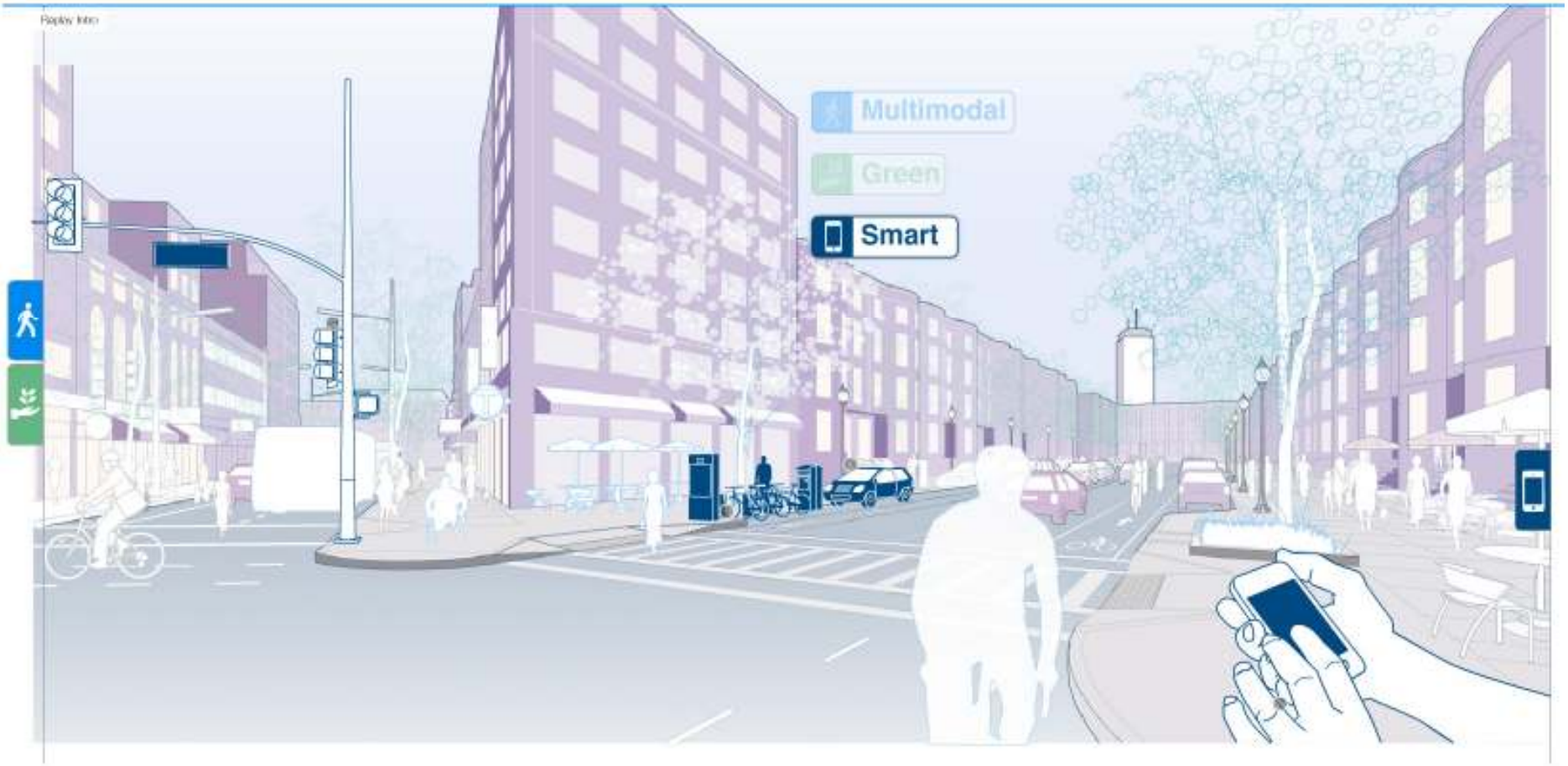

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City of Boston
Mayor Thomas M. Menino
Boston Transportation Department
Commissioner Thomas J. Tinlin

News

Get the latest update on new and exciting complete streets-related initiatives here. To be the first to participate in the conversation, join our mailing list, subscribe to our RSS feed, or follow us on Facebook.

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Electric Vehicle Charging Station Location Update

As more and more Bostonians and visitors alike purchase, rent and become more aware of electric vehicles as a viable option for clean, affordable transportation. The City of Boston is currently working on an online map for the public available ...
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Posted on January 26, 2012

Boston Bike Network Plan Open House

The second open house for the Boston Bike Network Plan saw a great turnout for the November 16th event in the Boston Public Library. The Boston Bicycle Network plan aims to increase bicycling and to improve safety, comfort and connectivity for ...
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Posted on November 9, 2011

Boston Complete Streets

City of Boston
Mayor Thomas M. Menino
Boston Transportation Department
Commissioner Thomas J. Tinlin

Projects

The City of Boston is currently designing and constructing projects in Boston's neighborhoods that have embraced the Complete Streets approach. To learn more and participate in the public process, follow the links to each project.

Melnea Cass Boulevard Design Project

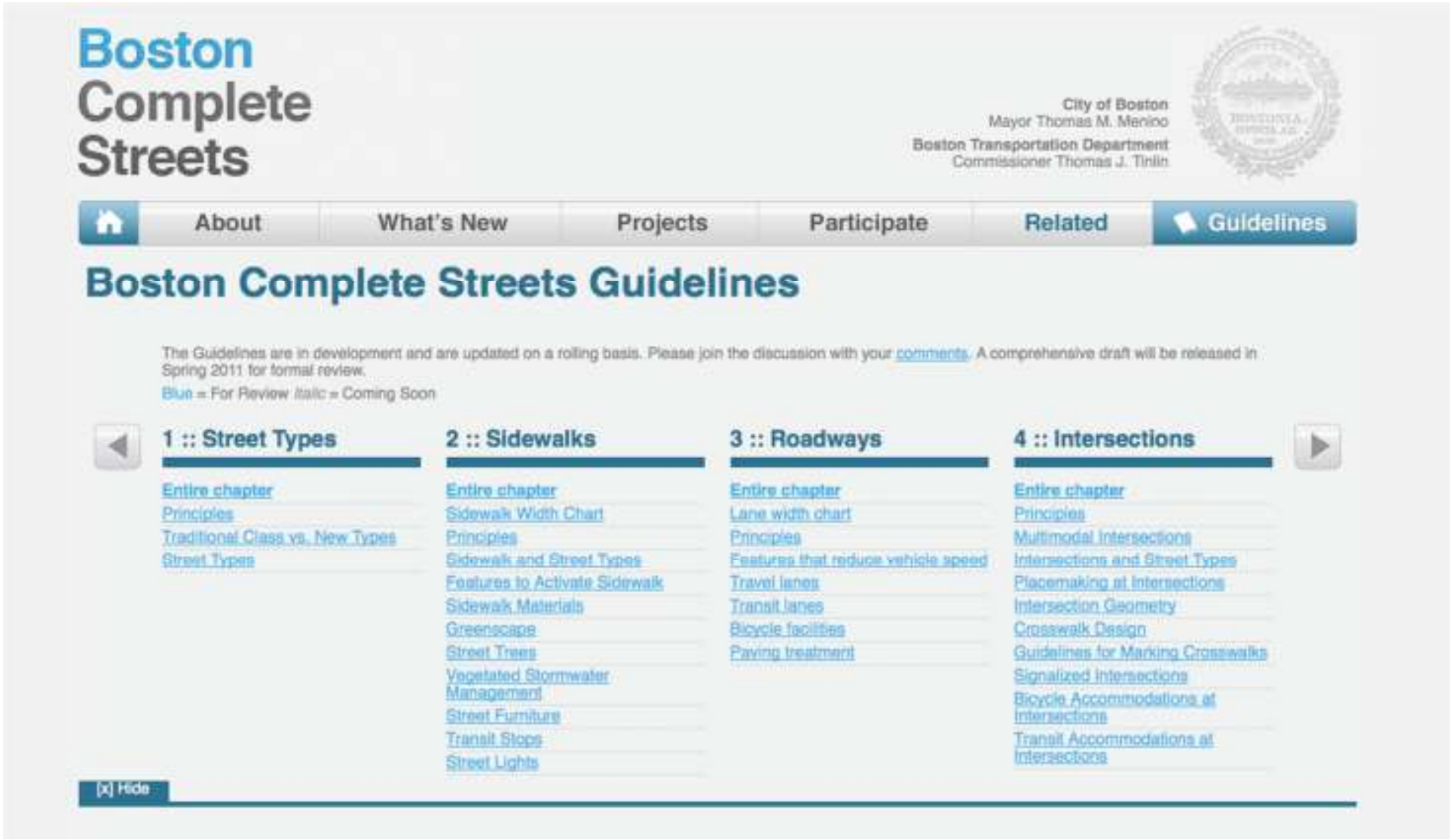
Project Manager: Pat Hoey, Boston Transportation Department, Pat Hoey, Boston Transportation Department

The Boston Transportation Department is working with the Roxbury community to redesign Melnea Cass Boulevard with the goal of making it a neighborhood friendly corridor. The scope includes the development of roadway and streetscape designs that create a pedestrian friendly … Continue reading →

Peabody Square, Dorchester

Status: In construction
Project Manager: Patrick Hoey, Boston Transportation Department

Located at one of Dorchester Avenue's principle crossroads, Peabody Square is re-emerging as a center for community life with thriving restaurants, new housing and a refurbished Ashmont Station. The new design will realign Talbot Avenue to create a plaza for … Continue reading →



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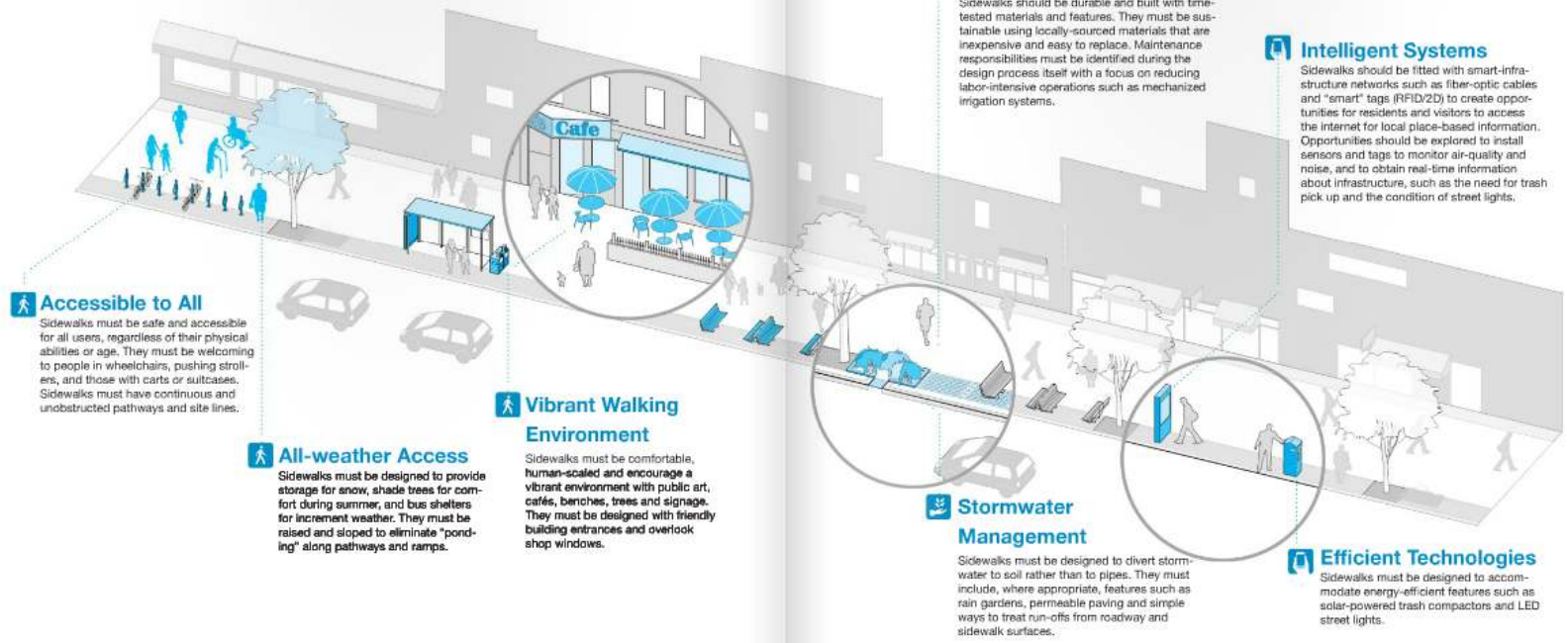
Principles

A major goal of these sidewalk guidelines is to enhance Boston's legacy as great walking city by providing a physical framework that encourages people to walk as part of their everyday routine.

An equally important goal is to enhance the vitality of Boston's streets as public spaces. To encourage people to linger, sidewalks need to be safe, comfortable, and attractive, with facilities that provide options for people of all ages and abilities. Lively sidewalks become venues for people to participate in face-to-face activities, support businesses abutting them, and to use new innovations in digital technology to interact with the public realm.



Accessible to All

Sidewalks must be safe and accessible for all users, regardless of their physical abilities or age. They must be welcoming to people in wheelchairs, pushing strollers, and those with carts or suitcases. Sidewalks must have continuous and unobstructed pathways and site lines.

All-weather Access

Sidewalks must be designed to provide storage for snow, shade trees for comfort during summer, and bus shelters for increment weather. They must be raised and sloped to eliminate "ponding" along pathways and ramps.

Vibrant Walking Environment

Sidewalks must be comfortable, human-scaled and encourage a vibrant environment with public art, cafés, benches, trees and signage. They must be designed with friendly building entrances and overlook shop windows.

Download this document

Finally, sidewalks inhabit valuable space in Boston's network of streets that can be used to support healthy trees and treat stormwater as a resource to cultivate attractive and easy-to-maintain greenscape. The benefits of a robust tree canopy run the gamut from reducing stress to reducing the impacts of climate change.

These guidelines set a high standard for accessibility, safety, environmental performance and aesthetics in sidewalk design. In all cases, they should be viewed as the minimum design criteria for all sidewalk construction and re-construction in the City of Boston. However, it is also recognized that sidewalk construction often occurs in constrained environments. This chapter discusses the decision-making process for locations where preferred widths cannot be achieved. Lastly, where applicable neighborhood-specific studies exist, sidewalks design should conform to the adopted streetscape plan for the area.

Ease of Maintenance

Sidewalks should be durable and built with time-tested materials and features. They must be sustainable using locally-sourced materials that are inexpensive and easy to replace. Maintenance responsibilities must be identified during the design process itself with a focus on reducing labor-intensive operations such as mechanized irrigation systems.

Intelligent Systems

Sidewalks should be fitted with smart-infrastructure networks such as fiber-optic cables and "smart" tags (RFID/2D) to create opportunities for residents and visitors to access the internet for local place-based information. Opportunities should be explored to install sensors and tags to monitor air-quality and noise, and to obtain real-time information about infrastructure, such as the need for trash pick up and the condition of street lights.

Stormwater Management

Sidewalks must be designed to divert stormwater to soil rather than to pipes. They must include, where appropriate, features such as rain gardens, permeable paving and simple ways to treat run-offs from roadway and sidewalk surfaces.

Efficient Technologies

Sidewalks must be designed to accommodate energy-efficient features such as solar-powered trash compactors and LED street lights.

Boston Complete Streets

Download this document

Principles

Traffic Signals
Signal cycle lengths should be kept to a minimum to reduce delay for all users. As technology advances, traffic signalization should move towards a smart system that passively detects pedestrians, bicyclists, transit, and motor vehicles in order to become more efficient, reducing delay and improving safety for all users.

Intersections for all
Intersection design should balance the need to move motor vehicles efficiently with the need for safe and efficient movement of non-motorized users. Pedestrians and bicyclists are susceptible to far greater injuries in the event of a crash with a motor vehicle. This principle applies to all aspects of intersection design, from determining the number of lanes, to the configuration of crosswalks, to the design of traffic signals.

Reclaim Space
Intersections that contain wide, undefined areas of pavement that are not necessary for the efficient movement of motor vehicles provide opportunities to reclaim street space for pedestrians, transit users, and bicyclists.

Air Quality
Opportunities should be explored to install sensors that monitor air quality at intersections to measure the impact of congestion-reducing measures.

Obeying the Law
Intersections should encourage drivers to obey all laws, and in particular, laws that impact the safety of non-motorized users. Signals should be programmed in a consistent, predictable manner to help encourage good behaviors.

Balancing Environmental Concerns
Emission reduction strategies at intersections, such as efficient signal design, should not discourage environmentally-friendly modes such as walking and bicycling.

All-weather Access
Intersections should function well for all users under all environmental conditions including rain and snow.

"Tagging"
"Tags" that assist mobile devices locate on-line resources should be installed at intersections to help facilitate way-finding and info rm the public about local facilities and businesses.

Reducing Runoff
Green street elements should be incorporated whenever possible to reduce runoff and reduce the amount of impervious surface at intersections and street corners.

Traffic Management
Traffic signals should be controlled from The Boston Transportation Department's (BTD) Traffic Management Center where they can remotely make modifications to the signal timing to respond to unusual situations in real-time.

Accessible
Universal design principles should inform all aspects of intersection design, including both geometry and signal timing. New national guidelines for accessible design in the public right-of-way should be followed with a commitment to achieving the best outcome for all users within the constraints of each site.

Please refer to **BTD's Engineering Design Requirements and Special Operations Design Guidelines** on the City of Boston's website. Also, see **Chapter 6 Implementation** for a description of the project planning and design process.

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STREET FURNITURE

Bicycle Racks

FRONTAGE ZONE
PEDESTRIAN ZONE
FURNISHING ZONE

Overview

Bicycle racks are required to be installed as part of street reconstruction projects on non-residential streets. The dimensions below represent the recommended minimum clearance between the nearest element of an unoccupied bicycle rack and the adjacent object. Most importantly, racks should not be installed so parked bicycles obstruct the Pedestrian Zone and not obstruct access to fire hydrants.

Use

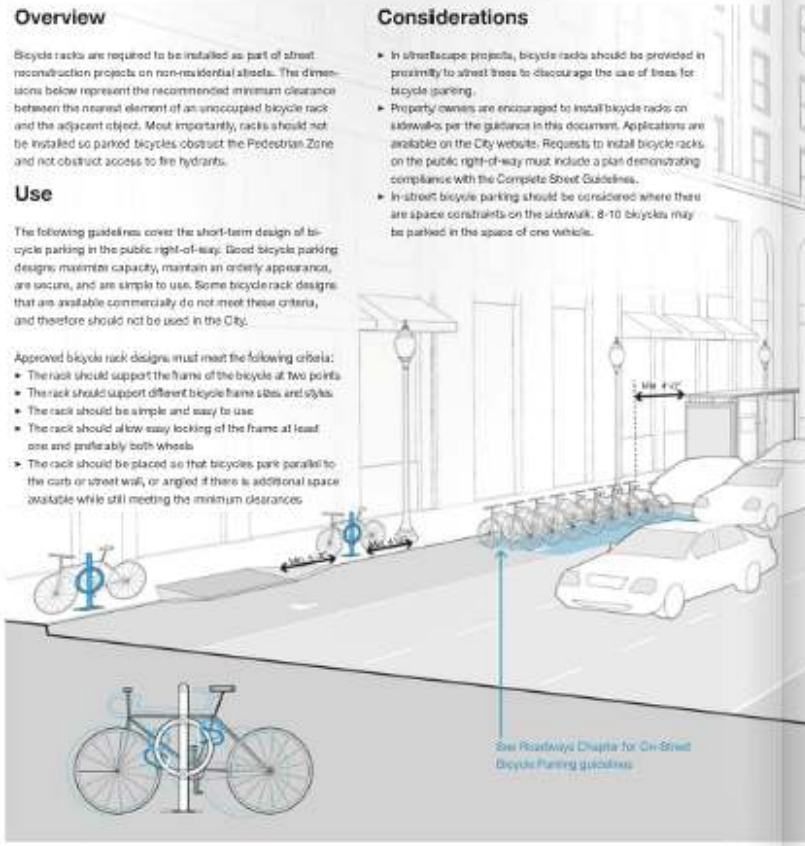
The following guidelines cover the short-term design of bicycle parking in the public right-of-way. Good bicycle parking designs maximize capacity, maintain an orderly appearance, are secure, and are simple to use. Some bicycle rack designs that are available commercially do not meet these criteria, and therefore should not be used in the City.

Approved bicycle rack designs must meet the following criteria:

- The rack should support the frame of the bicycle at two points
- The rack should support different bicycle frame sizes and styles
- The rack should be simple and easy to use
- The rack should allow easy locking of the frame at least one and preferably both wheels
- The rack should be placed so that bicycles park parallel to the curb or street wall, or angled if there is additional space available while still meeting the minimum clearances

Considerations

- In streetscape projects, bicycle racks should be provided in proximity to street trees to discourage the use of trees for bicycle parking.
- Property owners are encouraged to install bicycle racks on sidewalks per the guidance in this document. Applications are available on the City website. Requests to install bicycle racks on the public right-of-way must include a plan demonstrating compliance with the Complete Street Guidelines.
- In-street bicycle parking should be considered where there are space constraints on the sidewalk. 8-10 bicycles may be parked in the space of one vehicle.



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STREET FURNITURE

Bicycle Shelters

FRONTAGE ZONE
PEDESTRIAN ZONE
FURNISHING ZONE

Overview

Where possible, bicycle parking shelters should provide weather protection for as many parked bicycles as possible. Shelters should be a **minimum of 6'-0" wide and a minimum of 7'-6" high**. The length of a shelter depends upon the number of bicycle racks that it is designed to accommodate. Installation footings must meet all structural and loading requirements. Stand-alone bicycle parking shelter designs in the public right-of-way must be approved by the Public Improvements Commission.

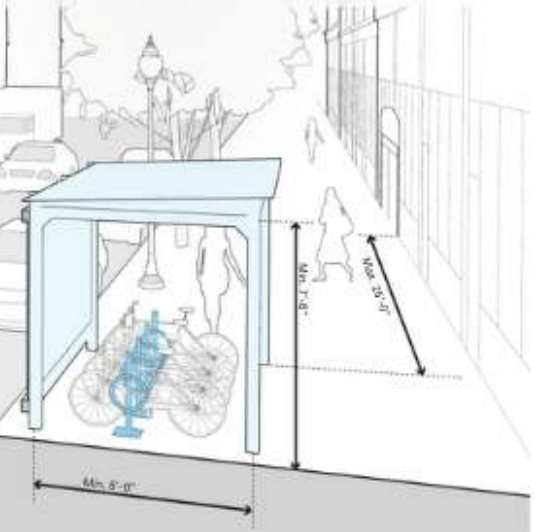
Use

Bike shelters should be:

- Located **within 25'-0"** of the main entrance to the building they serve
- Installed in either the Streetscape Furnishing Zone or Frontage Zone – not the Pedestrian Zone
- Placed so that, when occupied, bicycles do not intrude into the Pedestrian Zone

Considerations

- Bicycle shelter installation on pavers requires approved footing.
- Bicycle shelters should be located in well-lit, well-traversed areas. Passive detection lighting should be provided in areas of low ambient light.



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Bus Stop Location

Overview

All bus stop locations must be ADA compliant, and should be safe, convenient, well-lit, and clearly visible. Proper spacing and siting of bus stops involves many considerations, such as the bus route, population density, popular destinations, transfer locations, intersection operations and geometry, parking restrictions, and sightlines.

Use

Where buses are required to pull out of traffic, bus stops should be located at the near- or far-side of intersections wherever possible and not at mid-block locations. Mid-block bus stops require the most amount of curbside space. Intersections are also convenient for passengers because they can intercept other transit connections, crosswalks, pedestrian routes and building entrances easily.

Where bus bulbs are provided, the length of the bus stop can be less than the prescribed minimums listed below because buses will not be required to pull out of traffic. The minimum bus stop length at bus bulbs should provide a clear and level landing pad at each door of the bus (3).

MBTA Bus Stop Spacing Distances

	DENSITY POPULATION / SQUARE MILE	DISTANCE BETWEEN STOPS
MINIMUM (2)		750'
HIGH DENSITY (URBAN)	5,000 >	750'
MEDIUM DENSITY	3,500–5,000	750'–1,000'
LOW DENSITY (SUBURBAN)	< 3,500	> 1,000'–1,320'
BRT ROUTE	5,000 >	1,500'

SOURCE: MBTA BUS STOP GUIDELINES

The preferred and minimum lengths of bus stops for each location can be found below:

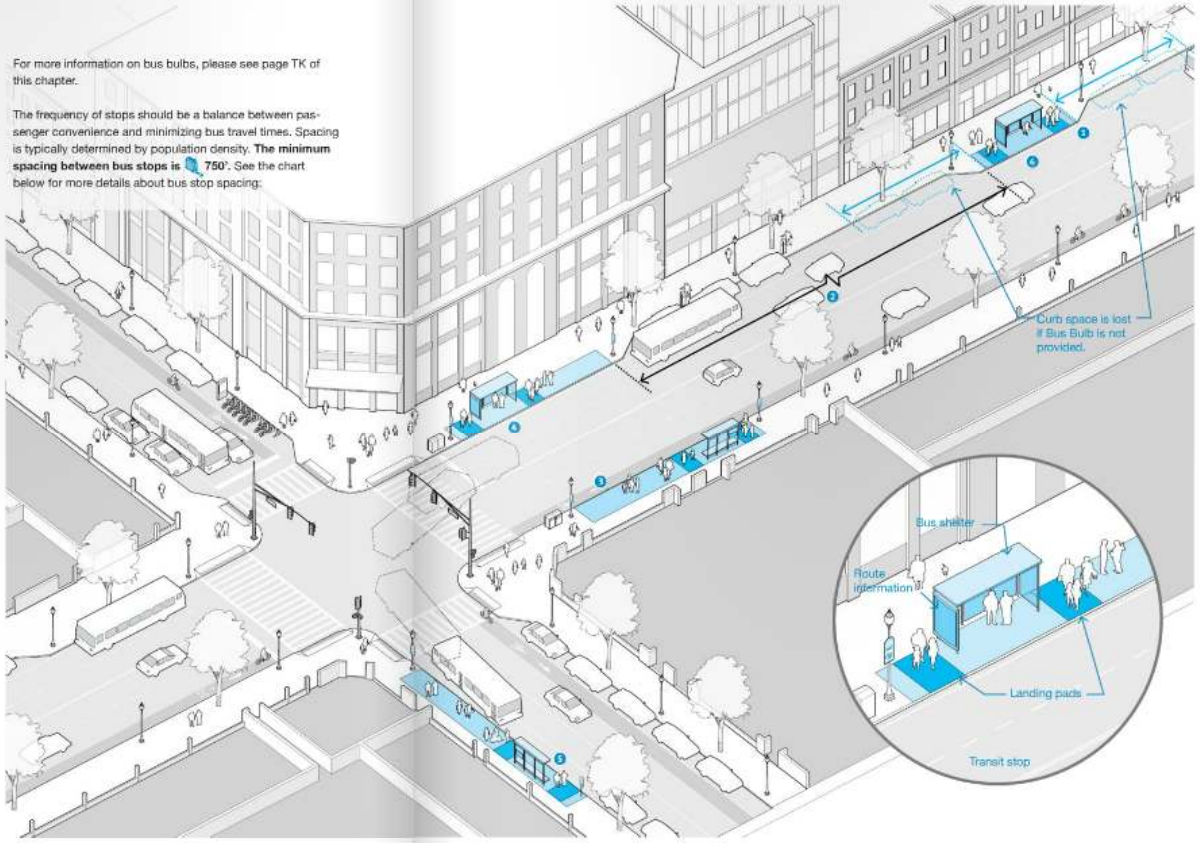
MBTA Bus Stop Lengths

	40' BUS		60' BUS	
PLACEMENT	Preferred	Minimum	Preferred	Minimum
FAR-SIDE (3)	80'	60'	100'	80'
NEAR-SIDE (4)	100'	80'	120'	100'
FAR-SIDE, AFTER LEFT TURN (5)	130'	100'	150'	120'
MIDBLOCK (6)	130'	100'	150'	120'

SOURCE: MBTA BUS STOP GUIDELINES

For more information on bus bulbs, please see page TK of this chapter.

The frequency of stops should be a balance between passenger convenience and minimizing bus travel times. Spacing is typically determined by population density. **The minimum spacing between bus stops is 750'.** See the chart below for more details about bus stop spacing.



IV. INTERSECTIONS

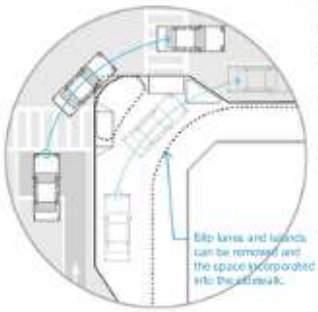
Reclaiming Space at Intersections

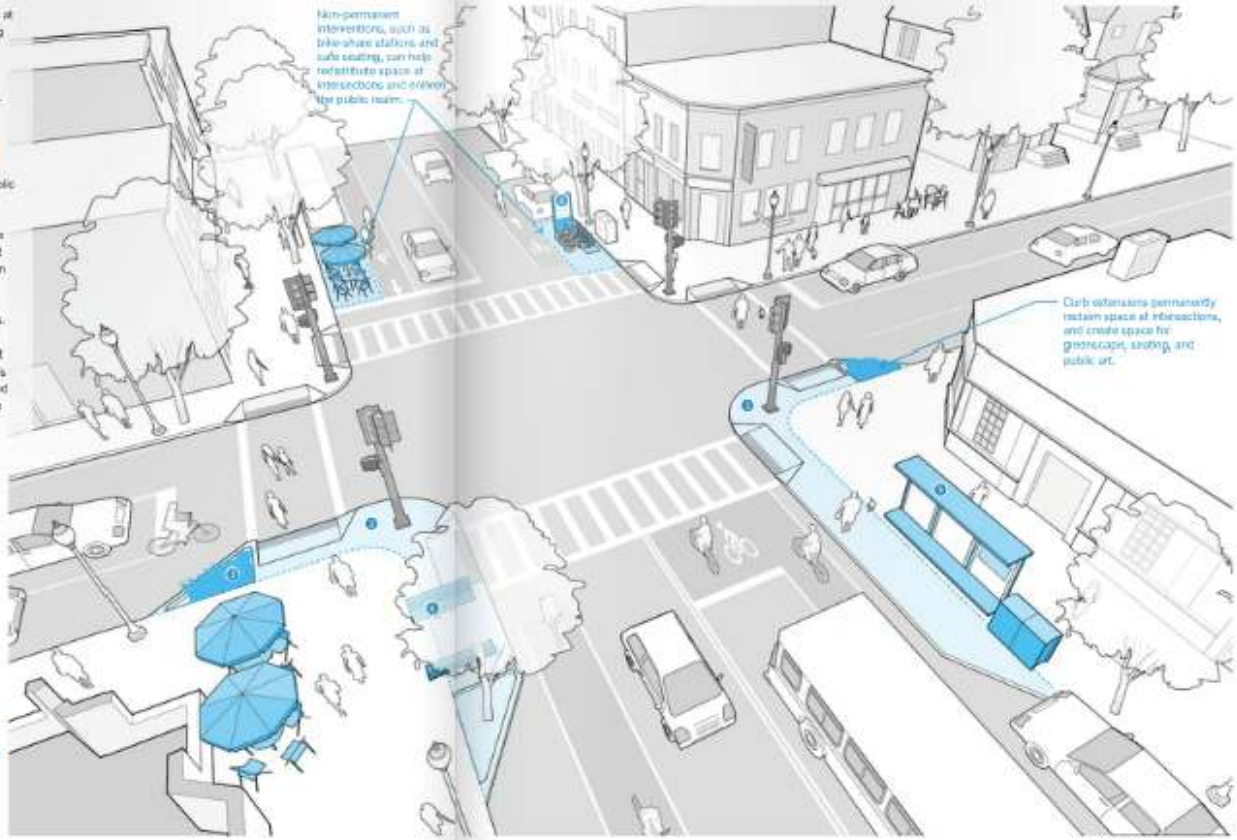
Reclaiming space for pedestrians and non-motorized users at intersections can be accomplished with short term and long term solutions.

Short term ways to redistribute space at intersections include reclaiming parking spaces for bicycle lanes, temporary plazas, and mock curb extensions ❶. Space can be redefined with seating areas, planters, and paint.

Long term options include permanent curb extensions ❷ with room for greenscape ❸, seating ❹, vending, and public art. Sometimes this type of space can be created in the middle of an intersection or extended from a single corner. Reclaiming pavement from the intersection can make space for a large sculpture which can also serve as a gateway and landmark. An island or extension can also provide a location for a transit stop ❺.

Some intersections are especially broad for historic reasons. It might be because streets intersect at irregular angles, particularly along historic routes, or that the radius was built for streetcar tracks or even a roundhouse for streetcars. This additional real estate at major intersections can be reclaimed to make the space more comfortable for pedestrians and to reinforce the prominence of the corner.





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SIGNALIZED INTERSECTIONS

Protected, Exclusive, and Concurrent Phasing

Overview

The three options for the pedestrian phase are protected, exclusive, or concurrent phases. **A protected pedestrian phase** is when pedestrians are able to cross when there are no conflicting motorists, or conflicting motorists have a red indication. **An exclusive pedestrian phase** is an additional phase that is provided for pedestrian movements only, while all vehicular traffic is stopped. **A concurrent pedestrian phase** is when pedestrians are able to cross while parallel and conflicting vehicular traffic are also moving.

Use

Protected phases should be used always when there are no conflicting movements with other modes.

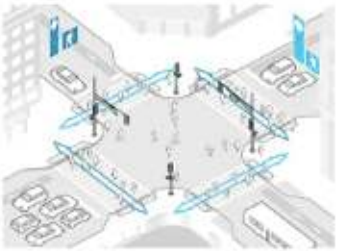
Exclusive pedestrian phases and **protected pedestrian phases** should generally be used at intersections where:

- Conflicting turning vehicles are equal to or greater than 250 vehicles per hour
- Sight distance is restricted
- Intersection geometry is complex
- The intersection is near elderly housing, schools, recreational areas, medical facilities, or other facilities within a safety zone.

Concurrent pedestrian phases shall be used at all intersections where the above conditions are not present. Concurrent phasing should be accompanied by proper signage, such as **TURNING VEHICLES YIELD TO PEDESTRIANS** and **WATCH FOR TURNING VEHICLES.**

Considerations

- Exclusive pedestrian phases increase pedestrian safety but also increase delay for all intersection users.
- BTD's Traffic Signal Operations Design Guidelines encourages using concurrent pedestrian phases to ensure pedestrians cross with the walk phase and to reduce delays to pedestrians and motor vehicles.
- Leading pedestrian intervals may be considered for concurrent phasing where appropriate and are discussed on page TK.
- **NO TURN ON RED** signs should be considered at intersections with exclusive pedestrian phases and are discussed on page TK.
- **TURNING VEHICLES YIELD TO PEDESTRIANS** and **WATCH FOR TURNING VEHICLES** signs should be used at intersections with concurrent pedestrian phases where conflicting vehicle movements are present.
- A leading left-turn (i.e. left-turn arrow) can be confusing for pedestrians who expect that they can step into the roadway once crossing traffic receives a red indication. Where a left-turn arrow is provided for motor vehicles, a lagging left-turn phase should be used, wherever possible.



Exclusive Pedestrian Phase

Concurrent Pedestrian Phase

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SIGNALIZED INTERSECTIONS

Automatic vs. Actuated Pedestrian Phases

Overview

Pedestrian phases can be programmed to be automatic each cycle, or be actuated using pushbuttons. Automatic pedestrian phases are preferred and should be used in high pedestrian volume areas where the pedestrian phase is needed during every intersection cycle. Research has shown that only 50% of pedestrians actually us pushbuttons when provided. Vehicles at signalized intersections are detected automatically, so pedestrians should be provided the same service. Pedestrian pushbuttons may be installed at locations where pedestrians are expected intermittently.

Use

The City of Boston's policy is for the pedestrian phase to be automatic during every cycle at locations where pedestrians are present more than 50% of the time during peak hours on all Street Types. Automatic pedestrian phasing may also be appropriate where pedestrian volumes do not meet 50% during peak hours when determined by an engineering study on a case-by-case basis. Pushbuttons should only be considered in the following situations:

- At intersections that do not meet the appropriate pedestrian volumes.
- At intersections designed to operate with motor vehicle detection that is actuated or semi-actuated.
- In cases where pedestrians are not able to cross the entire street in one phase. In this situation, a pedestrian pushbutton must be provided in the (1) median, and the median must be a minimum of 6' wide.
- Pushbutton-integrated accessible pedestrian signals (APS) are desired, but not required, at intersections with an automatic pedestrian phase. The APS would only call accessible features not the pedestrian **WALK** signal indication. At a minimum pre-timed locations require pedestrian head-mounted APS (which do not provide vibrotactile indications) automatically activated during each pedestrian phase. These must be located above and aimed down at the waiting area of the crosswalk. For more information on requirements for accessible pedestrian signals please see page TK of this Chapter.

Where concurrent pedestrian phasing is used at locations where motor vehicles cannot turn onto a one-way street, the pedestrian signals provided to cross the one-way street should be given a **WALK** indication and clearance interval each time the major street phase is being served.

Considerations

Details on where pushbuttons should be provided are located in the latest edition of the MUTCD. Research is also being conducted on developing passive pedestrian detection devices that would activate the pedestrian phase based on the presence of pedestrians either at the curb or within the crosswalk. These devices would eliminate the need for pedestrians to use the pushbutton; however, they are more expensive to install and maintain.

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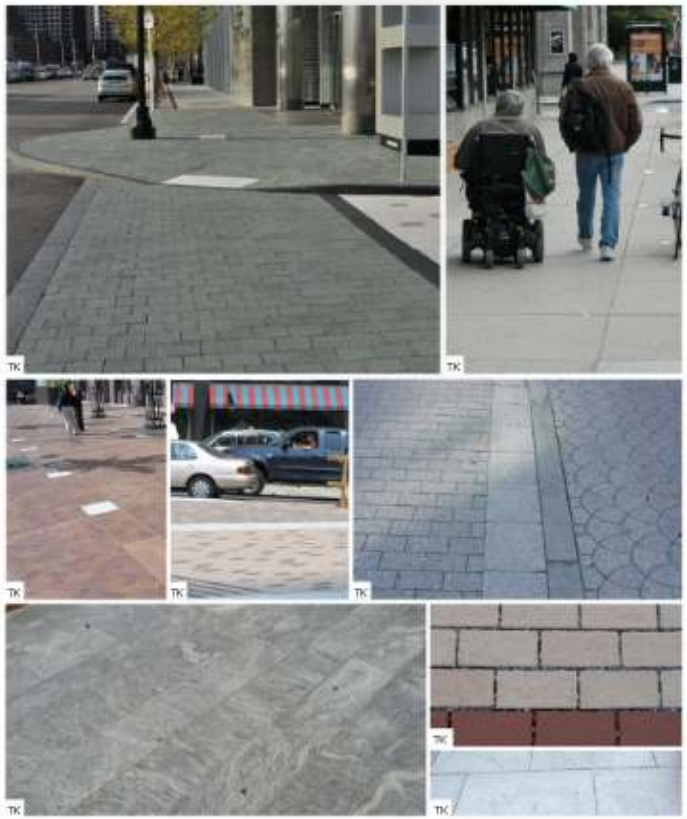

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Sidewalk Materials

TK Materials and Sidewalk Zones
TK Permeable Pavement

The key components of sidewalk construction are material selection and installation. **These two aspects should come together to create smooth, stable, slip resistant, and durable sidewalks.**

Sidewalk design plays a major role in establishing and reinforcing neighborhood and city identity. Selecting a specific palette of materials, colors, and patterns can be used to identify a neighborhood or district. In general, Neighborhood Residential and Industrial Street Types with relatively narrow sidewalks should utilize a single material for the entire sidewalk. Downtown Commercial and Neighborhood Connector Street Types with wider sidewalks may use more than one type of paving material to differentiate between sidewalk zones. Varying sidewalk materials within a single zone can be used to accent or embellish special areas such as building entrances, trails, plaza edges, or transit zones. Inserting the name of each cross street in the paving at street corners is a functional and decorative technique. New or reconstructed sidewalks should always match those of existing sidewalks to create a continuous walking and visual experience.

Boston's sidewalks must be accessible to people of all ages and abilities. This includes everyone from people with sight, hearing, or mobility impairments to those pushing strollers or shopping carts. Accessibility is most critical in the Pedestrian Zone and at crossings. Materials and installation methods should be selected to minimize gaps, discontinuity, rough surfaces or any other vibration causing features. In addition to potentially creating tripping hazards as materials settle and age, such variations in the surface also cause uncomfortable or painful bumps and vibrations for pedestrians using any wheeled devices including walkers, strollers, and wheelchairs.

The Boston Public Works Department, in coordination with the Boston Transportation Department and the Disabilities Commission, is responsible for the management of publicly-owned sidewalks in Boston. All sidewalk designs must be approved by the Public Works Department. Maintenance agreements with abutters are required when non-standard materials or installation details are used.

The following sections address creating comfortable sidewalks that also provide opportunities to improve environmental performance and reinforce sense of place in Boston neighborhoods.

Accessibility

The design features that have the greatest impact on accessibility are the grade and cross-slope of the **sidewalk, curb ramps, crossings, and the selection of materials.** The following guidelines meet or exceed all Federal and local guidelines and regulations regarding accessibility:

- Surfaces should be smooth, stable, and slip resistant and should minimize gaps, rough surfaces, and vibration causing features. Discontinuities in the surface, such as gaps, rises, and falls, **should not exceed** 1/8".
- The **cross-slope** of the walking zone **may not exceed** 2%; 1% is desirable (less than 0.5% will not drain.)
- Ramps must be present at all intersections (excluding raised crosswalks.) Their design should minimize conflicts with motor vehicles. Detectable warnings must be included in the ramps or approaching raised crosswalks to indicate where the roadway begins. Please refer to the Chapter 5 for detailed intersection and crossing guidelines.
- Design of sidewalks should avoid pooling. Even small amounts of water can obscure hazards and form ice.
- Designs should minimize conflicts with common obstacles in the Pedestrian Zone such as street lighting poles, traffic control boxes, sandwich boards, and tree grates. Tripping hazards like settled, uneven sidewalk materials, abandoned sign posts, and low planters should be addressed when redesigning and during new construction of sidewalks.
- The Pedestrian Zone should be continuous across driveways and meet all of the guidelines above. (Please refer to Vehicle Access Across Sidewalks earlier in this Chapter on page TK).

Note: This section focuses on guidelines for the Pedestrian Zone. Please also refer to accessibility guidelines within the Roadway and Intersection Chapters for a discussion of accessibility issues in other areas.

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STREET TREES

Choosing the Right Tree

Tree selection needs to address the ability of the tree to mature in a given microclimate as well as its ability to meet design objectives. Scale and form are key design considerations.

Large canopy shade trees are highly desirable on city streets because of their unique presence and the critical role they play in the urban forest ecosystem. Providing sufficient rooting space is a challenge, however this is not a reason to plant smaller trees. Even small trees will suffer in a limited rooting environment. Given all the uncontrollable variables in a street, it is worth taking a chance that a large tree will survive even in less than ideal conditions.

Choosing a tree with the right habitat can help minimize conflicts with adjacent infrastructure:

- Shallow rooted species should be considered near sewer or drain pipes
- Columnar forms should be considered near overhead wires
- Trees with deeper roots and small trunk flare should be used next to pavement

For specific microclimates, tolerance to drought, inundation, vehicular emissions and salt, and ability to remediate pollutants are important considerations. From an aesthetic perspective, spring flowers, fall color, the quality of light and shade, and the abundance of fruit, nuts, and leaf litter are important in addition to scale and form.

A complete list of street trees approved by the Boston Parks Department is available on their website. Some examples include:

LARGE STATURE SHADE TREES:

Used on parkways, boulevards, streets and plazas

Canopy and form: Spreading to create a continuous canopy

Sample species: Red Maple, Sweetgum, Honeylocust, London Planetree, Red Oak

MEDIUM STATURE TREES:

Used on smaller scale streets and plazas, and areas with utility wires

Canopy and form: Spreading to create a continuous canopy; columnar trees near overhead wires

Sample species: Ginkgo Maple, American Hophornbeam, Hedgemaple, Columnar Red Maple

SHORT STATURE ORNAMENTAL TREES:

Used in planters, plazas, medians, landscaped areas, sometimes residential edges

Canopy and form: Spreading, rounded, or columnar

Sample species: Magnolia, Crab Apple, Cherry, Shadblow (single-stem), Eastern Redbud (single-stem)

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STREET TREES

Tree Siting and Spacing

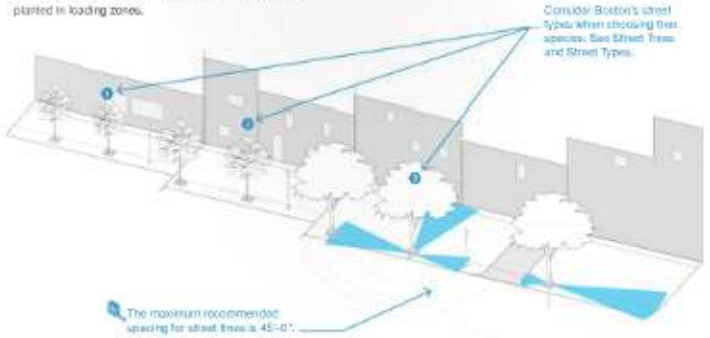
Trees should be planted in locations that provide the best conditions for growth within a given design framework. This could mean planting in private yards in residential areas (with permission from owners), or clustering trees in open planting areas in wide sidewalks or plazas. Large, contiguous planting areas should be exploited where available or created (using covered trenches) when feasible to enable large canopy shade trees to reach maturity.

Street tree plantings should strive for continuity along a street while respecting adjacent uses. Each tree should complement and not interfere with first floor uses, entryways, cafés, or other activities in the building zone. Trees should not be planted in loading zones.

The following guidelines have been developed for tree spacing and offsets. Note that these guidelines are not absolute requirements. Where site-specific conditions prohibit meeting the guidelines, trees should be considered at the discretion of the Boston Parks Department.

Considerations

- Offsets are measured from the centerline of the tree.
- **Maximum spacing of** 45'-0" **is needed to achieve a** street canopy.



	1 SHORT STATURE ORNAMENTAL	2 MEDIUM STATURE TREES	3 LARGE STATURE SHADE TREES
ON-CENTER SPACING	25'-0"	35'-0"	45'-0"
OFFSET FROM CURBS OR PATH EDGES	2'-6"	2'-6"	2'-6"
OFFSET FROM LIGHT POLES	10'-0"	10'-0" (25'-0", IF COLUMNAR)	15'-0"
OFFSET (HORIZONTAL) FROM OVERHEAD WIRES	10'-0"	10'-0" (25'-0", IF COLUMNAR)	15'-0"
OFFSET FROM UNDERGROUND UTILITIES	10'-0"	10'-0"	10'-0"
OFFSET FROM DRIVEWAYS, FIRE HYDRANTS, LOADING ZONES	10'-0"	10'-0"	10'-0"
OFFSET FROM INTERSECTIONS (DEPENDING ON DIRECTION OF TRAFFIC)	20'-0"	20'-0"–40'-0"	20'-0"–40'-0"

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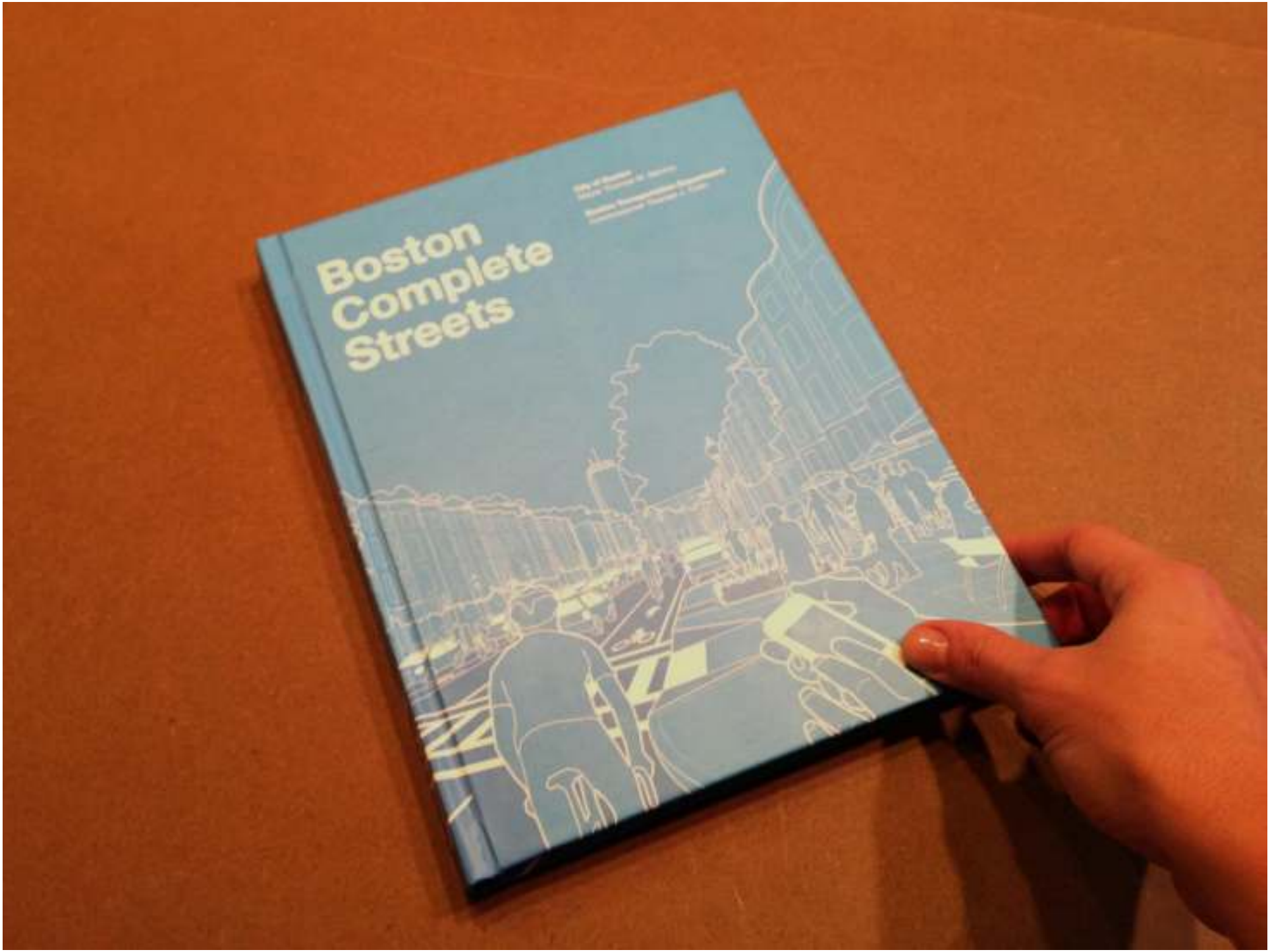
The Blue Book

The final product is still important.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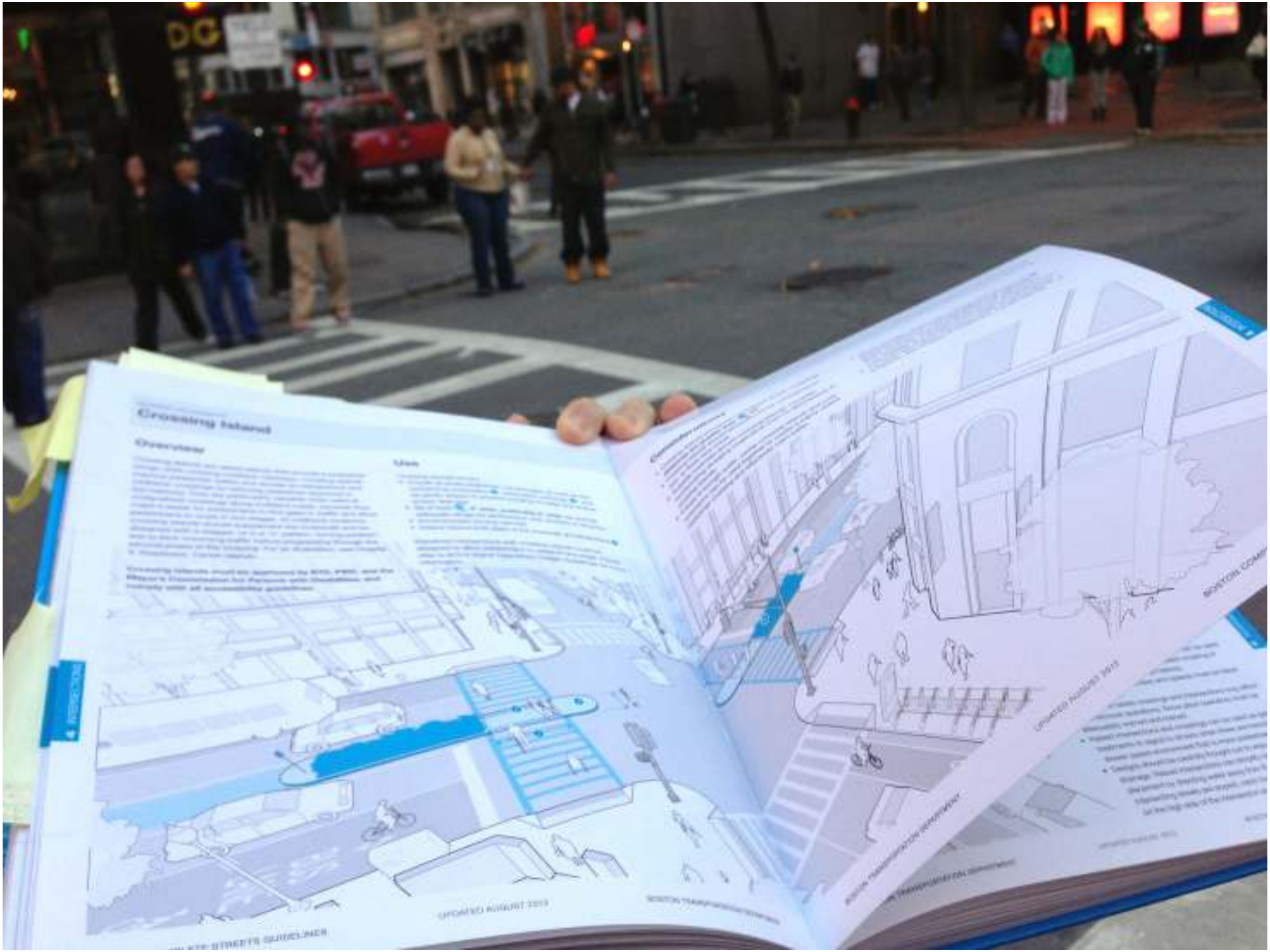
Crossing Islands
Overview
Uses
UPDATED AUGUST 2013