

## V. Changing Mobility Considerations

### 5.1 Addressing the Shift in How Transportation is Viewed

During Phase I of the City Mobility Planning initiative, the City of Houston contemplated the concept of providing multi-modal transportation options within a corridor. That conversation led to the development of alternative design standards located within [Appendix 2 of Chapter 10](#) of the [Infrastructure Design Manual](#). These alternative cross-sections provide for a myriad of design configurations that promote multi-modal concepts in partnership with the automobile.

The City recognizes that automobile travel will continue to be a vital component of transportation within the region. This is especially true in areas with large job and population clusters of activity. The Heights-Northside study area is no exception and is expected to see an increase in automobile traffic, especially as the area continues to attract new residential and commercial development. However, as highlighted within the

existing conditions chapter of this report, there are still opportunities within the network to explore new options of how to best move people in a safe and effective manner. Incorporating alternative modes of transportation into the system design before network failure, extends the capacity of the existing system by encouraging modal change of the user. By providing users with safe, alternative modal options, the burden of limited space along street corridors to be widened for automobile travel only can be balanced by alternative facility types which can accommodate more people in a smaller space (i.e. Bus transit or bicycle facilities).

The following subsection of this chapter represents various topics being contemplated across the United States and, within recent years, in the City of Houston. Although exact policies on how to best target specified topics are still under consideration by City of Houston, the provided concepts are highlighted as a platform for future conversations and related evaluation of complete system mobility.



PHOTO PROVIDED COURTESY CITY OF HOUSTON

## 5.2 Complete Streets and Houston

### What is a Complete Street?

The motivation for designing Complete Streets is felt by many major cities for different reasons. In some communities, traffic has become an unmanageable challenge and right-of-way is limited. In other areas, health-conscious communities have learned that using other modes of transportation benefits their social and physical health. Regardless of the motivating factor, creating corridors for more than just the automobile is a shift in policy that is gaining momentum in the United States.

### Tying into the Existing Culture of Houston

Houston is known for its innovation and market driven approach to development. With this notion in mind, Mayor Annise Parker issued an Executive Order to develop a Houston Complete Streets and Transportation Plan. This initiative promotes the use of Complete Streets throughout the City of Houston. In her press release on October 10, 2013, Mayor Parker stated, "Houston is a city that embraces its diversity. This Complete Streets policy applies the same approach to our mobility system by meeting the diverse needs of all Houstonians while also creating more accessible and attractive connections to residential areas, parks, businesses, restaurants, schools and employment centers." Houston's can-do attitude to meet not only its transportation, but communities needs, is well suited for a new era of Complete Streets which promotes increased flexibility in street design more apt to suit Houston's diverse market.

The development and implementation of the Complete Streets policy will be a new way of thinking for many officials and residents within Houston. When it comes to streets, Houston has relied on increasing roadway capacity (i.e. street widening) for vehicles to meet the needs of an ever-growing population. However, we "all hate Houston Traffic" is a well-known slogan in Houston and is representative of the cultural change taking place. Given complete streets is more apt to the movement of people, and not just vehicles, the community at large seems amenable to this new policy change. However, what this policy means for a car-focused community is still not greatly understood by the community

### Elements of Design

Complete Streets has many design characteristics that is inclusive of the entire right-of-way including the travelway (or street), streetside and context. Within the travelway, a Complete Street provides for modal use deemed appropriate for the corridor. Travelway considerations include lane width of travel lanes, transit facilities accommodations, on-street bicycle facilities, on-street parking, medians and pedestrian crossings. Design elements for the streetside include off-street bicycle facilities, pedestrian travelways, landscaping (such as grass buffers or tree wells), and frontage zones.

The interaction of different modes (automobiles, transit vehicles, bicycles, and pedestrians) can be a complex challenge. Some modes are compatible with one another within the right-of-way, while others need specific guidelines to create a safe and harmonious corridor for the different users.

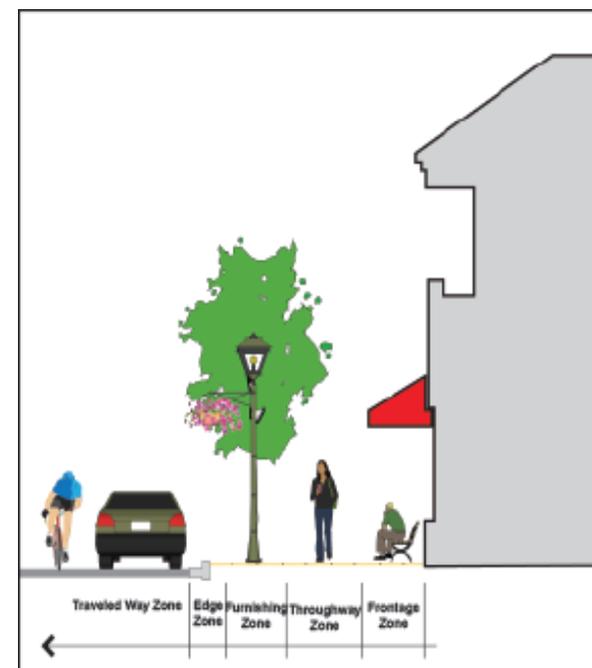


FIGURE 5.1 SOURCE: DALLAS COMPLETE STREETS MANUAL

## Purpose of Complete Streets

### The Purpose of Complete Streets Design

Complete Streets are intended to provide safe and accessible streets for users of all ages and abilities. In major cities and metropolitan areas, Complete Street policies are being designed to guide the future development and redevelopment of major corridors. Houston's Complete Streets Executive order states, "The Complete Street concept takes the following variables into account when providing services:

- People being served at their residence or property by other right-of-way users;
- People of all ages and abilities, including children, older adults and persons with disabilities;
- The function of the road (e.g. local collector and thoroughfare) and the level of vehicular, pedestrian, and bicycle traffic;
- Multi-Modal Classification Street Types"

## Enhanced Efficiency of All Modes

The street network of a community/city/region defines make up the skeleton of how a city is built. How streets are developed, where they are placed and how they connect to the greater transportation network influence how traffic and development interact at both the regional and local level. A well-connected network increases route options for system users. Where conflict points occur - including but not limited to traffic accidents, congestion at specific intersections, or construction - connected networks allow users to utilize existing systems for alternative route options without relatively high cost to the user. Similarly, well connected networks reduce traffic stress placed on a single corridor. How this is achieved is not limited to the roadway, but can be achieved by increasing provided connectivity and accessibility to alternative mobility networks such as off-street trails or strategically placed on-street bicycle facilities. Similarly, transit networks need to be well-connected to other lines, stations, and destination centers which utilize the placement of existing streets. Moreover, transit accessibility of vehicles, pedestrians and bicyclists plays

a large role in the success of the transit system, and as such represent a vital component in system connectivity. In short, Complete Streets represents the multi-modal approach to each individual mode, as well as the connection of each mode within the greater transportation system.

## Implementing Complete Streets

Many techniques which currently promote the concept of Complete Streets predate the City's Complete Street Executive Order. For instance, [Chapter 10 Appendix 2](#) of the [Infrastructure Design Manual](#) maintains current multi-modal (MMC) design considerations. Similarly, the sub-regional mobility studies - of which this report is a part of - systematically evaluate and identify multi-modal network improvements including enhanced connectivity between various modes.

The Complete Streets Executive Order, however, takes the notion of a multi-modal approach to transportation planning a step further emphasizing the importance of final system design and moreover, implementation. As such, the City is in the process of developing its first Complete Street and Transportation Plan (HCSTP) to be completed in 2015. Although the development of the Plan is still in its infancy stages, it is anticipated to provide a framework or blueprint for the City's adoption of future transportation and mobility related policies as the concept of what a Complete Street is within the City of Houston continues to mature.



PHOTO PROVIDED COURTESY CITY OF HOUSTON

## 5.3 Health in the Community

The Houston Mobility Plan and related sub-regional studies focus on encouraging multi-modal corridor design throughout the Houston area. By doing so, each study area has the potential to grow and redevelop into an environment that is friendly for both auto and non-automobile users. This process can be split into near and long-term redevelopment strategies from sidewalk repair (near-term), to multi-modal street reconstruction (long-term). Developing walkable and livable communities produces an additional outcome not traditionally stated within Houston's subregional studies, but is a direct result of an active transportation network : healthier communities.

### Health and Transportation

Can the way we travel to and from destinations impact our health? This is a question that is being raised across the nation as communities seek ways to increase health and decrease risk factors that lead to obesity, asthma, and other chronic diseases resulting from unhealthy food choices and inactivity. Findings from an international survey show that the United States has some of the highest rates of car usage and the lowest rates of walking, biking, and public transportation compared to other industrialized countries. These factors were also found to directly correlate with obesity rates and related lack of physical activity.<sup>1</sup> Overall population health reflects these trends, where over two-thirds of Houston adults and almost one-third of children are overweight or obese, and thus at increased risk for a range of health conditions such as heart disease and diabetes.<sup>2</sup>

According to the US Surgeon General report on physical activity and health, "30 minutes of

moderate physical activity, 5 days a week, even when performed in short sessions of activity, is enough to provide health benefits such as reduction in obesity levels, coronary heart disease and hypertension."<sup>3</sup> Therefore, a simple shift away from driving and toward a more active commute – such as walking, walking to transit or bike riding – provides an opportunity for increased physical activity which may result in a decrease in certain risk factors often associated with limited exercise.<sup>4</sup>

In a study published in the American Journal of Preventative Medicine, key indicators recommended for increased physical activity include building and enhancing sidewalks, providing efficient bicycle lanes, and promoting more efficient transit service.<sup>5</sup> Similar evidence also indicates that individuals living in areas with a more complete, walkable network are more likely to walk to nearby amenities and transit stations. These individuals walk an average of 35-45 additional minutes per day than individuals living in less walkable environments.<sup>6</sup>

The desire for increased opportunities for physical activity through walking, biking and transit is also evident from Northwest public comments collected during the study. Whether expressed desires were for recreational, commute, or utilitarian purposes, one underlying concept remains the same: these are all active forms of transportation or travel.

Improvements to the built environment through the integration of complete streets at the neighborhood level can improve access to healthy food and encourage physical activity. The Harris County Food System report, published in October of 2013, highlights the need of better access to healthier food options. The study found the location of food stores and their accessibility via public transportation greatly impacts a family's access to healthy foods. For families or individuals without a car, public transportation – including safe sidewalks and bike routes - is necessary for accessing food, services, and recreation. Study findings indicate that over half (54%) of residents in one Harris County community

#### *Houston & Harris County Statistics<sup>2</sup>*

##### *Inefficient Physical Activity*

- *Adults 53%*
- *Children 77%*

##### *Obese or Overweight*

- *Adults 63 %*
- *Children 34%*

traveled over six miles to a grocery store, while two-thirds residents in a second community traveled over one mile to a grocery store, with an additional 20% traveling over six miles. The report identified issues that impact community health that could lead to childhood obesity, and also provided policy recommendations that would make healthy choices easier for community residents, including improvements to the built environment.

This paradigm shift in transportation as it relates to health, is fitting for the purposes of the Northwest Sub-regional Mobility Study, as well as similar sub-regional studies, and reinforces the benefits of the Complete Streets policy. In short, a well-functioning transportation network not only moves people, but also provides healthy and safe transportation options that benefit all users of the network.

#### Example Initiatives Include:

- Community Transformation Initiative (CTI): Aimed at enhancing community livability through enhancing connectivity, walkability, increasing access, etc. for all area residents.
- Healthy Living Matters (HLM): mission is to mobilize policy action to curb childhood obesity in Harris County which includes measures such as active living. Report: [http://www.healthylivingmatters.net/why\\_does\\_healthy\\_living\\_matter/reports](http://www.healthylivingmatters.net/why_does_healthy_living_matter/reports)



PHOTO PROVIDED COURTESY KHA

<sup>1</sup> Pucher, J. and C. Lefevre. 1996. *The Urban Transport Crisis in Europe and North America*. London: Macmillan Press Ltd.

<sup>2</sup> Institute for Health Policy at The University of Texas School of Public Health, Houston Health Survey, 2010

<sup>3</sup> US Department of Health and Human Services. *Physical Activity and Health: A Report of the Surgeon General*. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Promotion; 1996, Available at <http://www.cdc.gov/nccdphp/sgr/sgr.htm>, accessed 14 August 2008.

<sup>4</sup> Transit and Health: Mode of Transport, Employer-Sponsored Public Transit Pass Programs, and Physical Activity. *Journal of Public Health Policy* (2009) 30, S73-S94.

<sup>5</sup> Brennan-Ramirez, Laura K. et al. (2006). "Indicators of Activity-Friendly Communities: An Evidence-Based Consensus Process." *American Journal of Preventive Medicine*, Volume 31, Issue 6

## 5.4 Bicycle User and Facility

Houston is seeing a shift in how we view the bicycle user as part of the overall transportation system. Just as street design considerations do not take a “one-size fits all” approach to vehicular movement, bicycle movement varies as well. For example, what type of facility is most appropriate for a child traveling to school on a bike versus a working professional traveling to work? How might this consideration vary if the user is enjoying a leisurely bike ride (i.e. recreational user) versus someone who might be on a daily commute where speed and time play a major factor in route consideration?

### User Types

Like other topics explored, the recognition of bicycle user types and variations in bicycle facility considerations is taking place across the United States. In accordance with the American Association of State Highway and Transportation Officials (AASHTO)<sup>1</sup>, bicycle users are best defined by level of biking experience and comfort on a specified roadway categorized in the table below.

#### AASHTO Bicycle User Types

Type	<b>Type A</b> Advanced/Experienced	<b>Type B</b> Basic Adult	<b>Type C</b> Children
			
Values	<ul style="list-style-type: none"> <li>• Convenience</li> <li>• Speed</li> <li>• Direct access to destination</li> </ul>	<ul style="list-style-type: none"> <li>• Comfortable experience</li> <li>• Low stress</li> </ul>	<ul style="list-style-type: none"> <li>• Lower complexity decision environment</li> </ul>
Comfortable Riding on...	<ul style="list-style-type: none"> <li>• Safety on all street types</li> <li>• High traffic</li> <li>• High speeds</li> </ul>	<ul style="list-style-type: none"> <li>• Designated facilities</li> </ul>	<ul style="list-style-type: none"> <li>• Residential streets</li> <li>• Busier streets with well-defined bike travel areas</li> <li>• Off-street bike paths</li> </ul>
Confident “claiming” a narrow lane?	Probably	No	No
Understand traffic principles	Yes	Yes	No

## Facility Types

The City of Houston does not currently maintain a formal process for evaluating what streets should be included in the Master Bike Plan. Similarly, the user types of the system - as previously defined - are also not systematically evaluated by facility type within the greater transportation network. Instead the city evaluates facility type on a case-by-case basis. The City recognizes that bike facility types most appropriate for a given corridor may vary, and as such, the current Master Bike Plan should be improved upon to consider all users of the system. Although not currently available, an update to the Master Bike Plan is expected in 2015 and is anticipated to provide a general framework to system design and future update of the resulting network map. The following classifications summarize the facility types currently endorsed by the City of Houston's Master Bike Plan:

### Bike Lanes

- A bike lane is the portion of the roadway adjacent to the travel lane that is designed by striping, signing, and pavement marking for the preferential or exclusive use of the cyclist.
- There is no parking allowed in this lane unless otherwise indicated.

### Signed-Shared Roadway

- A signed-shared roadway is designated for bicycle or motor vehicle use. The shared lane is not for simultaneous use of both vehicles. Motor vehicles traveling at a greater speed than cyclist can pass cyclist as any other slow moving vehicle using the adjacent lane.
- There are special pavement markings and signs along this lane to remind both cyclist and motorist to share the road.
- These roadways typically have lower travel speeds and traffic volumes, and also provide convenient routes to destinations.
- Shared-use lanes should not be used on roadways with speed limits below 40 mph.

### Signed Bike Routes

- A signed bike route is a roadway that has been designated by signing a corridor as a preferred route for bicycle use.
- Parking may be allowed on this route and cyclist will ride to the left and around parked cars.
- Ideally these routes would still have favorable conditions for bicycling, such as low vehicle volumes, low travel speeds, or wide shoulders.
- Route signs should be placed at locations where the bike route turns at an intersection and where bike routes cross one another.
- With proper wayfinding, Bike Routes assist with guiding cyclist to more dominate roadways with safer pedestrian and bike crossings.

### Trails/Shared-Use Paths

- A bikeway that is physically separated from motorized vehicular traffic by an open space or barrier, and can be located:
  - Within a highway right-of-way
  - Within an independent right-of-way, such as a retired railroad corridor
  - Along bayous and drainage easements
- Also known as "Hike and Bike Trails"
- Off-street shared-use paths attract a mix of users with a wider range of skill levels and riding speeds.
- The use of a centerline stripe is recommended on pathways with high use to designate two directions of travel.
- Shared-use paths, or sidepaths, may be located adjacent to roadways when sufficient right-of-way is present to provide additional separation from motorists. These sidepaths should follow the same design criteria as shared-use paths in independent rights-of-way.

Other definitions, however, may prove relevant to the City as it continues to grow and mature its understanding of the bikeway user. Additional facility types for consideration include:

### **Bicycle Boulevard**

- Bicycle boulevards are designed to give priority to bicycle traffic.
- Local roads with low volumes and speeds that provide an alternative to, but running parallel with major roads.
- Offer convenient access to land use destinations.
- Signs and pavement markings are used as way finding for bicyclists.

### **Cycle Track**

- Bicycle highways intended for commuting traffic.
- Protected cycle tracks are recommended on major arterials with high travel speeds, high traffic volumes and multiple lanes, and offer protection for less confident riders.
- Two-way cycle tracks may be considered when there is not enough room to accommodate one-way cycle tracks on both sides of the street. Two-way cycle tracks may be considered to optimize the ROW in an existing street configuration where a single element is removed, such as a row of on-street parking.
- Advance timing of signalization is recommended for cycle track facilities at signalized intersections and is a recommended best practice to reduce potential conflicts with turning vehicles.

### **Buffered Bike Lanes**

- Buffered bike lanes are beneficial for streets with high travel speeds, high travel volumes, or high truck traffic.
- These facilities may be accomplished by reconfiguration existing roadways that under capacity and have more travel lanes than needed. Buffers should be delineated by two solid white lines at least 2 feet apart; if wider than 3 feet, diagonal hatching

should also be marked.

Other treatments for consideration pertain to increasing awareness of the user and motor vehicle alike and are not focused necessarily on one bicycle facility type. Instead, provided recommendations – where appropriate – are for universal consideration.

### **Highlighted Conflict Points – Bike Facility Caution**

- Colored pavement for bicycle use, typically green in color, may be used to increase the visibility of facilities in potential areas of conflict with motor vehicles. Colored pavement is commonly applied at intersections or driveways, in areas where motor vehicles are likely to cross over a bike lane into an adjacent turn lane or property.

### **Yield to Bike Signage**

- “Yield to Bikes” signage should be used to reinforce bicycles’ right-of way at colored bike lane areas.

## Bike Facility Design/Considerations

The appropriate design for a corridor considers certain factors such as daily traffic volume, travel speed, and related context as it pertains to area attractors and neighborhood context. However, regardless of what is desired, a corridor only maintains a certain number of feet in which it must accommodate vehicular, bike and pedestrian traffic as discussed in previous section of this Report. As such, the following questions should be considered when determining the development of a bicycle facility:

- Is the roadway a new construction?
- Is the roadway being repurposed?
- Is the roadway being reconstructed?

In short, a simple set of variables to select the most appropriate bicycle facility does not always encapsulate the complexity of Houston's streets as they pertain to facility feasibility.

### 1. New Construction

New roadway construction projects can typically follow the City's standard cross-sections as found in the [COH Mobility Plan Street Paving Design Requirements](#), which include options for bicycle facilities based on the multi-modal classification of the corridor.

### 2. Repurpose

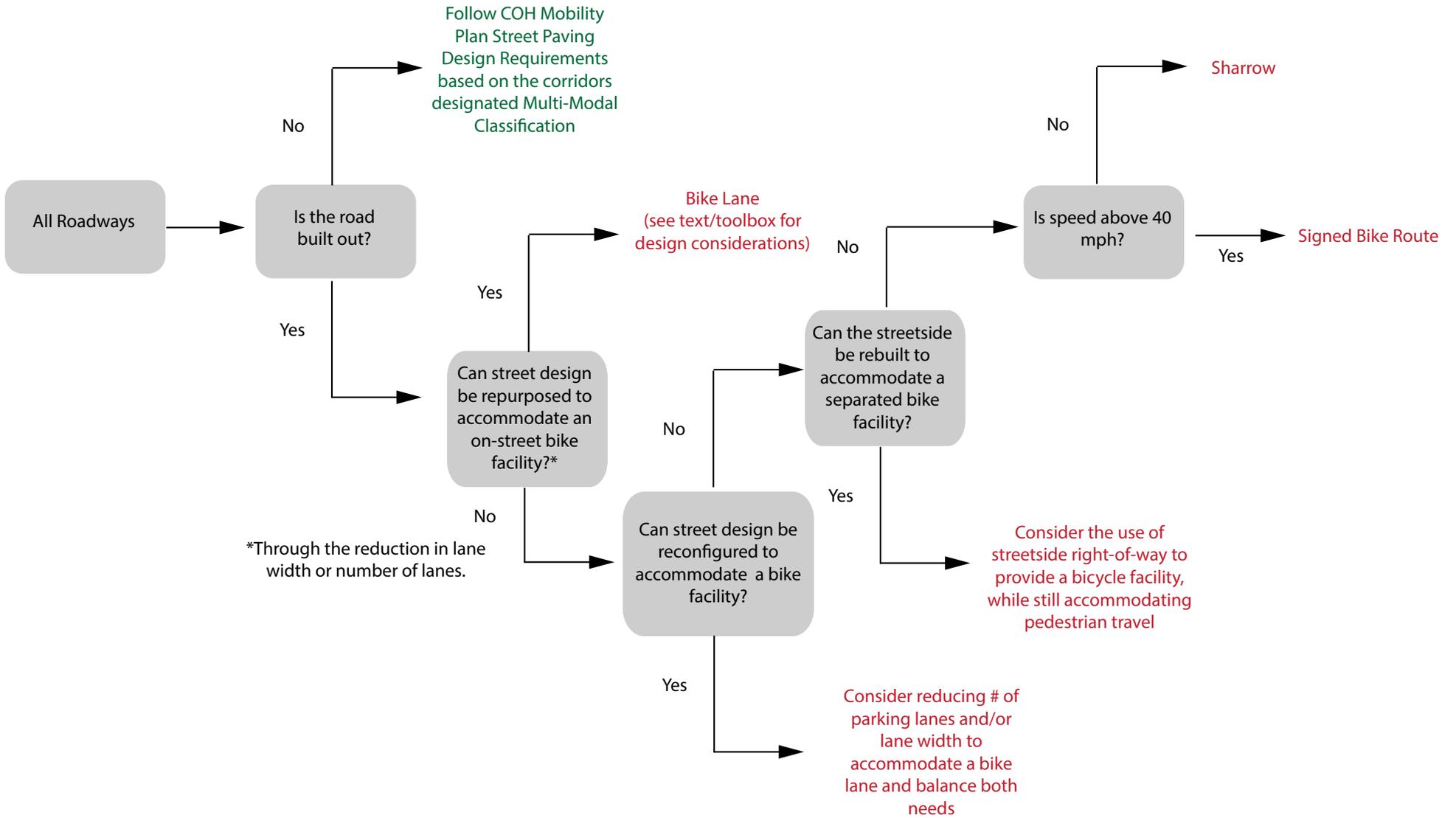
Repurpose projects typically require modifications to existing cross section where additional amenities - such as a bike lane - may be added to the roadway without removing a lane of traffic. This type of modification may occur where lanes are wider than needed.

### 3. Reconfiguration

When the width of the travel way cannot be widened along a corridor, the City should evaluate whether a roadway's existing lanes can be reconfigured to provide the necessary space for a bicycle facility. Reconfiguration of a travel way may include reducing the total number of lanes when traffic volumes demonstrate an excess of roadway capacity. Another scenario would be to reduce median width to maintain vehicle travel lanes and also introduce a bike facility within the existing roadway width. On-street parking may be a high priority on some corridors and should be evaluated during roadway reconfiguration. It may be necessary to balance both parking and bicycle travel needs using an atypical cross-section. Occasionally, a wide existing streetside zone (the portion of the right-of-way dedicated to pedestrian facilities and amenities) may be repurposed to include both bicycle and pedestrian facilities separated from the roadway. These facilities would include physically buffered bike lanes or raised cycle tracks.

The following flow chart is intended to guide the facility selection process and ensure that a preferred facility is an appropriate choice for a specific corridor. This tool will not automatically provide the best solution for a roadway, but is intended to demonstrate why certain desired bike facilities might not always make sense on the ground. Given the complexities of many roadways, the City should use planning and engineering judgment in order to develop a cross-section that addresses all road users.

Bike Facility Decision Process Figure 5.4



## Houston Bike Related Policies

The paradigm shift in the way Houston views bikes can also be seen in the recent policies embraced by the City which include:

### Complete Streets Policy

The Complete Street Executive Order directs City efforts to achieve complete streets. A complete street is defined as a “public roadway that takes into account all users” including people on bikes. Of the objectives listed within the order, multi-modal classifications are defined – of which, bikes are considered within the modal choice for consideration. Finally, the Complete Streets Executive Order directs the development of a “Houston Complete Streets and Transportation Plan” of which one of the Plan Components must, at a minimum, include the Bikeway/Pedestrian Plan as currently maintained by the City of Houston.

### Safe Passing Ordinance

Chapter 45 Article 2 of the City Codes of Ordinances was adopted by the City in April of 2013. The Ordinance requires motorists to pass or trail a cyclist, pedestrians and other non-vehicular or “vulnerable road users” at a safe distance. Although safe distance is a term defined to take into consideration “road, traffic and weather conditions at the time, in any event, not less than 3’ laterally while passing a vulnerable road user in a passenger car or light truck and not less than 6’ laterally if the operator’s vehicle is a truck (other than a light truck) or a commercial vehicle as defined by the Transportation Code.” The code further requires motorists to be mindful of vulnerable users during turning movements as well as prohibits the use of harassment or intimidation of vulnerable users at any time.

## Houston Bike Education

As the City of Houston continues to evolve in its adoption of bikes into its everyday culture, the need to educate automobile users and bicyclists becomes increasingly important. The City, and other bike advocate organizations, continuously work to educate all roadway users on the importance of proper roadway etiquette. That is to say, both cars and bikes are considered “traffic” while utilizing public roadways. Therefore, all roadway users must abide by laws that dictate what is legal for each user type. How to function on the roadway can vary slightly between a motorized and non-motorized vehicle. As such, it is necessary to not only educate users about their responsibilities, but also the responsibilities of others (i.e. What are automobiles supposed to do when they see a bike, and visa-versa?)



PHOTO PROVIDED COURTESY CITY OF HOUSTON

## 5.5 Sidewalk Design Considerations

### Pedestrians as a Priority

Returning focus to pedestrian amenities is a growing trend around the nation due to the many benefits of active transportation are being publicly endorsed by health officials.

Such benefits include:

- Improve physical and social health
- Reduce personal transportation costs
- Reduce carbon footprint

### Existing Policy

The City of Houston requires that any new or reconstructed sidewalk be built to a 5 foot wide minimum standard. A 6 foot minimum standard is required for any sidewalks located along a transit corridor. Sidewalk improvements above the minimum standard are recommended based on a variety of factors. These factors include land use and context, traffic volumes, and transit availability along a corridor.

### Design Considerations

When designing a sidewalk, the pedestrian zone should be taken into consideration and varies based on the context and intended user of the corridor. The pedestrian zone is defined as the streetside area between the edge of the curb and the property line of the bordering parcel. This provided zone can be broken into four subcategories: 1) edge zone, 2) furnishing zone, 3) throughway, and 4) frontage zone.

#### Edge Zone

The edge zone is comprised of the area between the curb and the furnishing zone. This zone creates a space between the recognized sidewalk area and automobiles. On corridors where on-street parking is permitted, this zone allows for door swing space. It also provides an area for pedestrians to transition between the walkway and their automobile without creating issues for other users.

#### Furnishing Zone

The furnishing zone provides an area for functional and artistic features within the pedestrian zone. It is also used for public services, landscaping, utilities, and as a buffer between pedestrians and the corridor. The functional features within this zone include public services, bicycle racks, utilities, fire hydrants, utility poles, sign poles, traffic signal cabinets and utility cabinets. Additional features that are functional, but also enhance the appeal of this zone are trees, shrubs and planters, landscaping, vendor space, street furniture, and decorative artwork.

The furnishing zone provides many benefits. It increases the tangible and the perceived safety of pedestrians by identifying the division between the street and pedestrian realm. When properly implemented and maintained, a furnishing zone can increase the lure, walkability and safety to pedestrians along a corridor.

### Pedestrian Throughway Zone

The pedestrian throughway is the basic function of the pedestrian zone. It is located between the furnishing and the frontage zone. The throughway is the section of the sidewalk where pedestrians travel. It is critical to keep this zone clear of obstructions (including the condition of the pavement) to allow for safe pedestrian movement. This design element should also account for handicapped and disabled users. Movement of wheelchairs within the throughway zone is a critical design element.

### Frontage Zone

The frontage zone is dependent on the context of uses or location of buildings along the corridor. It can serve as a buffer between the building front (if there is not a setback) and the walkable area. It can also serve as an advertisement area for storefronts. Stationary items can be placed within this area with proper licensing agreements.



PHOTO PROVIDED COURTESY KIMLEY-HORN



PHOTO PROVIDED COURTESY KIMLEY-HORN

## 5.6 Transit Corridor Considerations

### Public Transit for the Public

The perception of bus and light rail as transportation for low-income communities is changing as more young professionals utilize mass transportation. Benefits include:

- Reduce expenses associated with personal automobile
- Reduce time spent in traffic
- Spend commuting time working via personal devices
- Environmentally friendly
- Benefits to personal health

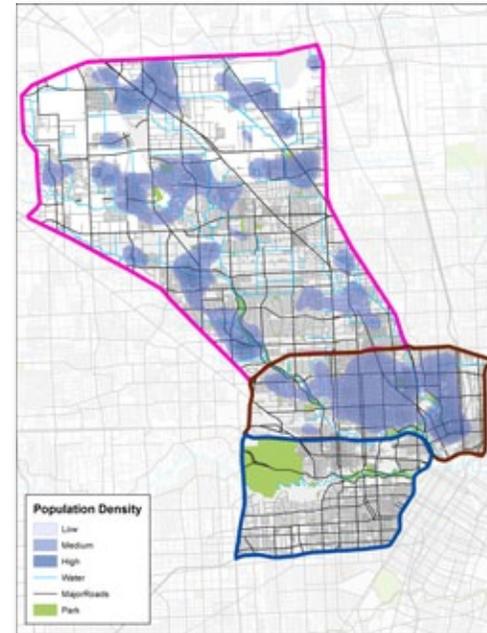
Another user base are persons that emigrated from countries where public transportation is socially acceptable and widely used. As more people understand the benefits associated with public transportation, utilization will increase.

### Increasing the Availability

As congestion continues to increase, transportation funding is an urgent concern within the country and region. Therefore more efficient transportation alternatives have become increasingly attractive. Improving transportation capacity has evolved from simply moving vehicles to moving people. This shift in focus has allowed transportation planners more flexibility in identifying new technologies to increase the capacity of a corridor or a transportation network. Transit service is an efficient method of moving people, but it is not an appropriate solution along every corridor. To identify the specific corridors and areas of Houston where transit can be most successful in capturing riders, the following factors were analyzed and ranked in the Heights-Northside study area:

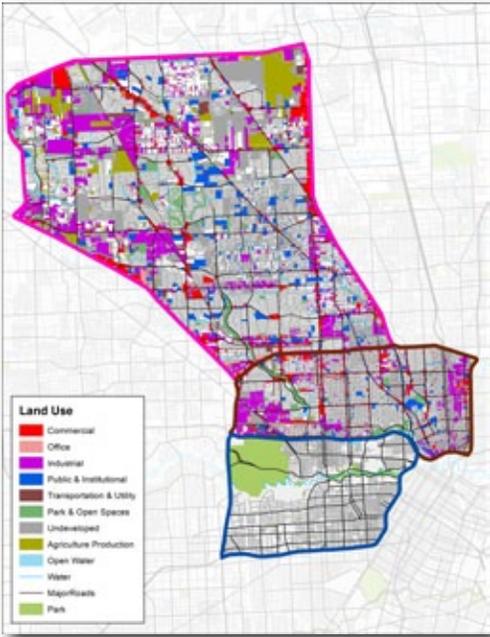
- Residential Density
- Lane Use
- Network Density
- Existing Transit Ridership
- Projected Transit Ridership

Each factor detailed below helps to determine which corridors in the study area can best accommodate transit service, primarily from a ridership perspective. Larger scales of the maps are provided in [Appendix C: Transit Analysis](#).



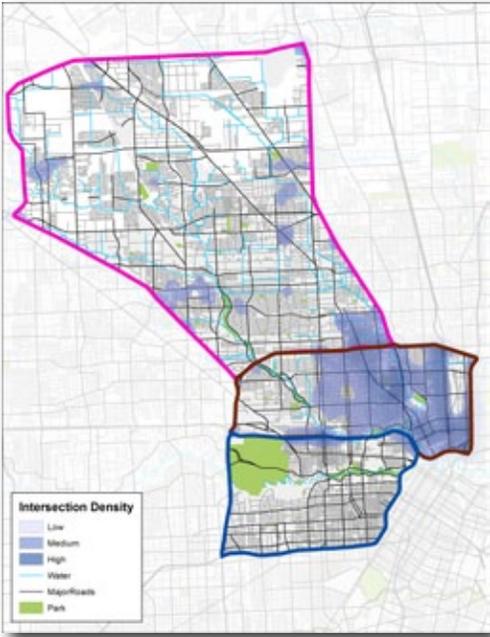
### Residential Density:

Residential density is an important factor for determining transit potential. People who reside in high density areas are more likely to use transit. The corridors that are within or in proximity to medium and high density locations were considered for transit locations.



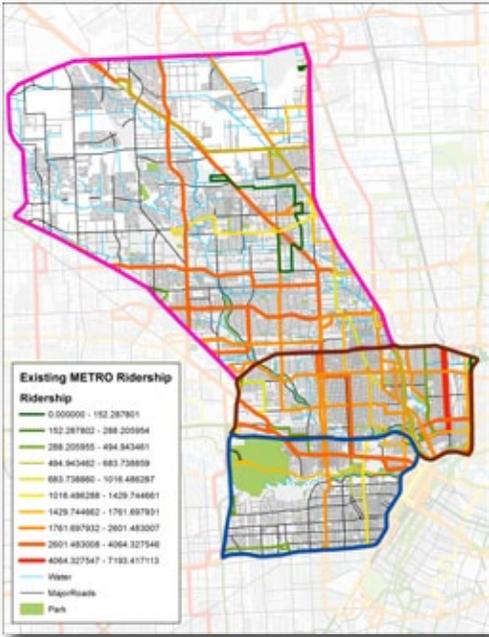
**Land Use:**

Identifying corridors that contain a higher amount of commercial, retail and employment activity is important for transit selection. Destinations for transit riders are shopping centers, grocery stores, and employment centers.



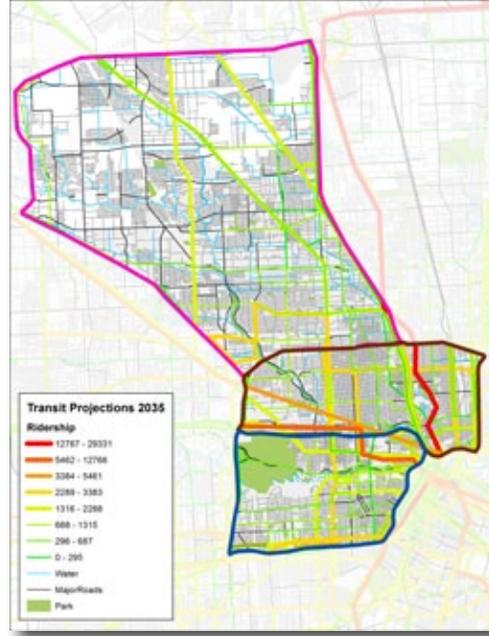
**Network Density:**

The density of the street network affects a person’s ability to walk or bike to their destination. Less dense areas usually result in a more automobile oriented network. Both Heights and the Northside maintain a high network density. Northside, however, has the highest network density in the study area.



**Existing Transit Ridership:**

Examining existing transit patterns is an effective tool to determine potential transit corridors. Some of these routes may already be functioning as significant transit corridors but can be enhanced with improved infrastructure, shorter headways, or enhanced buses to increase ridership.



**Projected Transit Ridership:**

H-GAC currently incorporates transit routes into its 2035 travel demand model. This data is helpful to see where the transit demand is based on future demographic and traffic patterns/ congestion.

Complete Streets is not about moving vehicles only. As you can see from these maps, other forms of transportation have a large impact on the road network. Focusing on moving people (whether it be via automobile, public transit, bicycle, or pedestrian zones) is what is important.

## 5.7 Intersection Design Considerations

### Changing Priorities

A strong multi-modal design results in the safe passage of automobile and non-automobile users through the network. Creating safe realms for these users extends to all parts of the corridor, with increased importance at intersections and other types of crossings where differing modal types overlap. All mode types should feel safe, comfortable, and experience a minimal amount of delay when passing through an intersection. However, enhancing conditions for one mode may negatively impact others. Previous intersection design focused on the quick and efficient movement of automobiles, but as other modes gain popularity (transit/bicycles) this attitude can potentially hinder the efficient flow of the overall network.

Modes for consideration within the scope of intersection design include automobile, pedestrian, bicycle, and bus transit. Although other alternative modes of transportation may exist, the provided represent the most commonly used forms of traffic within the City of Houston and serve as a baseline for discussion of alternative design options.

### Multi-modal Intersection Design

The following section explains the fundamentals of multi-modal intersection design and describes the concepts of how automobiles, bicycles, pedestrians and transit vehicles can be accommodated in the design of an intersection.

At any given time, multi-directional movement is occurring at all intersections. Conflict occurs where users of the network collide. As provided in [Figure 5.5](#), an intersection maintains a number of known conflict points. To reduce known conflict, certain design tools are available for consideration. For instance, the design of an intersection that accommodates vehicular turning movements where pedestrian and bicycle traffic are expected, may include certain design consideration that help demarcate how each mode

type should transition through an intersection. Such treatments include a pedestrian only phase within a signal cycle that preempts vehicular movement by a few seconds. This provided phase helps reduce potential collision between vehicular right-hand-turning movements and a pedestrian utilizing a crosswalk. Additionally, colored pavement or striping is often used at intersections for bicycles clearing demarcating the placement of bike vs. vehicular movement understood by both the bicyclist and motorist alike. Such design considerations help define how traffic (whether motorized or non motorized) are expected to behave.

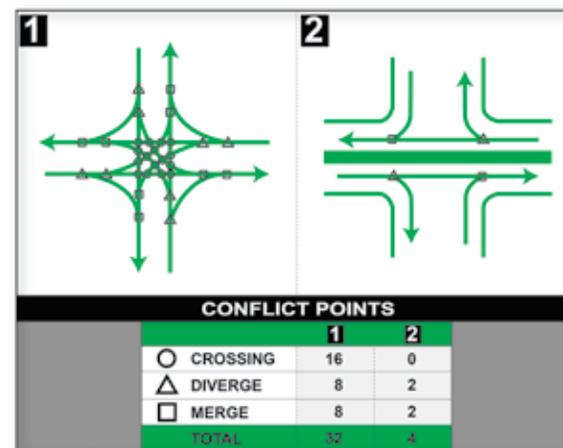


FIGURE 5.5

Other design tool examples for consideration include:

- Pedestrian signals
- Continued markings for bicycles at intersections
- Additional signage
- Designated crosswalks
- Proper bus stop placement
- Advanced stop lines
- Intersection median barriers
- Right-turn-on-red restrictions

Due to limited right-of-way, not all modes of transportation can be accommodated in a one-size-fits-all design for all intersections. The amount of traffic, speed of the roadway and the safety of the user must be addressed on a project basis. However, individual intersections should be evaluated not in silo, but in conjunction with the greater transportation network to ensure a consistent flow of all mode types within respective networks and greater transportation system. Modes with higher priority will typically take precedence in the design features of the corridor, but should not reduce the actual safety of other modes. If this should occur, priority of the modal needs on the corridor should be reevaluated.

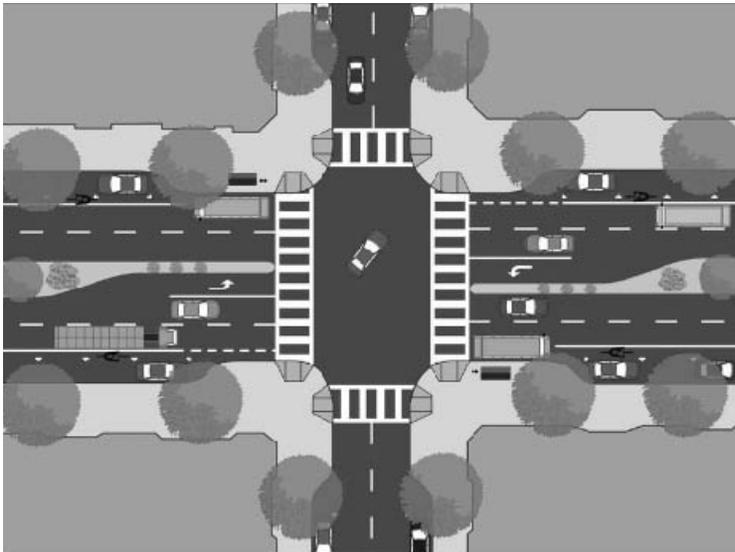


FIGURE 5.6 SOURCE: DIGITAL MEDIA PRODUCTIONS

## Pedestrians

Pedestrian traffic represents the most basic form of transportation that is free of cost for the user. Intersections, or crossings in general, pose a particular challenge to pedestrian safety. Crosswalks serve two main purposes: 1) guiding pedestrians to locations where they will be visible when crossing the street, and 2) alerting drivers of pedestrian movements. At intersections, several elements affect pedestrians:

- Visibility at curbs
- ADA accessibility
- Crosswalks
- Pedestrian signals
- Pedestrian crossing refuges
- Traffic control types



PHOTO COURTESY OF KIMLEY-HORN

Several different tools can be used as visual indicators of pedestrian movements, including items such as:

- Pavers can be a different color of brick or material on the ground to indicate the path the pedestrian will be following.
- Raised crossings are also a physical technique that marks defined pedestrian realm at an intersection or crossing.
- In-street YIELD TO PEDESTRIAN signs is a way of alerting drivers of possible activity before arriving at the intersection.
- Pedestrian signalization helps demarcate when a pedestrian is crossing an intersection or, if timed correctly can grant priority of crossing to the pedestrian



PHOTO COURTESY OF KIMLEY-HORN

a

## Transit

Proper **bus stop placement** is an important element in the design of intersections (See [Figure 5.7](#)). Bus stops should be located at the far-side stop of an intersection reducing wait times of drivers attempting to make right-hand turns which can become blocked at near-side stop configurations. Far-side stop configurations also help eliminate potential conflict points between vehicles as motorists attempt to jump lanes to gain access around buses for right-hand turning movements. **Mid-block stops** are least desirable and result in the highest use of curb space hindering both through and right-hand turn movements.

Other important factors to consider include the trade-offs between transit vehicles and other modes of transportation. Automobiles, bicyclists and pedestrians can potentially converge at the same intersection, and the interaction of these users is defined by the intersection design. Transit vehicles are usually large and their movements can dominate the area. Planning for the turning radius of the vehicle can assist in making their movements safe and efficient.

Where it is possible, **transit-only lanes** at intersections provide transit vehicles a dedicated space to bypass traffic, and can typically be shared with bicyclists.

**Transit priority treatments** provide an early green signal, or hold a green signal, for transit vehicles to cross an intersection with minimal delay. Use of this method should be evaluated based on how it will affect the overall network system.



PHOTO COURTESY OF KIMLEY-HORN

## Bike

How to create a safe environment for a bicyclist can range based on confidence and skill level. Complete separation of a facility is recommended along high speed corridors where the user might have some experience (Class B User), but prefers the comfort and increased safety associated with a buffered path. Separated bike paths are recommended where the user is highly inexperienced (Class C User). Such examples include sections of corridors along a safe-route to school program or corridors leading to popular park or community center destinations.

Intersections where Class B and C users are anticipated should be designed with the same concepts in mind. Green paving or striping can help guide novice users through an intersection. For more advanced users (Class A Users), simple treatments such as Bicycle Boxes allow bicycle traffic to be placed in front of vehicular traffic. When the signal turns green, bicycle traffic may then preempt

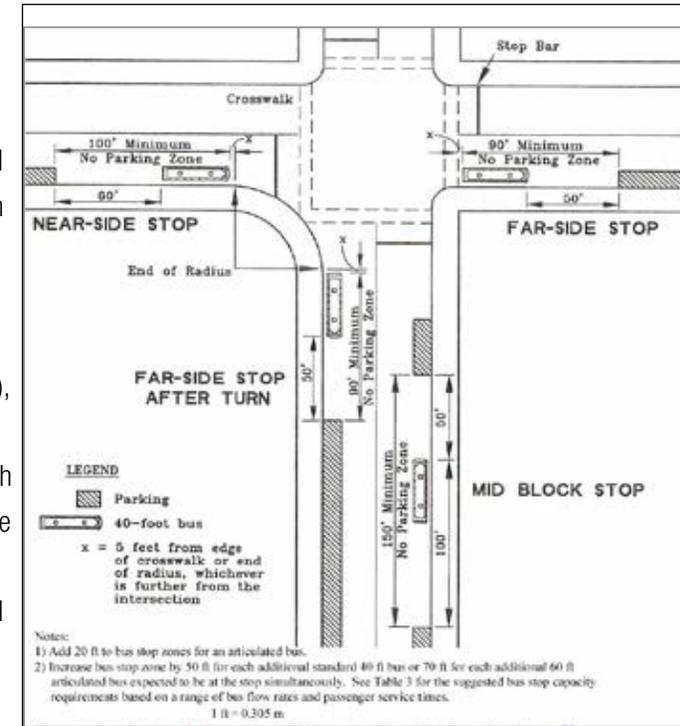


FIGURE 5.7 SOURCE: ITE MANUAL



PHOTO COURTESY OF KIMLEY-HORN

vehicular movement for all through, right and left hand turns reducing unnecessary conflict points with the automobile. **Associated design features for bicycle crossings** include designated crossings, signage, designated holding patterns, stop bars, right-turn protection, and signalization.

## Chart

Figure 5.8 is a chart that identifies pedestrian and bicycle features at signalized intersections that can be used to create safe and functional intersections.

Shorter and more visible crosswalks	<ul style="list-style-type: none"> <li>• Crosswalks on all approaches;</li> <li>• Longitudinal markings (possible use of colored and/or textured paving);</li> <li>• Reduced overall street widths by reducing the number of travel and turn lanes, or narrowing travel lanes;</li> <li>• Curb extensions with pedestrian push buttons on extensions; and</li> <li>• Median refuges on wide streets (greater than 60 feet) with median push buttons.</li> </ul>
Priority for pedestrians, bicyclist, and accessibility	<ul style="list-style-type: none"> <li>• Shorter cycle lengths, meeting minimum pedestrian clearances (also improves transit travel times);</li> <li>• Longer pedestrian clearance times (based on 3.5 feet/sec. to set flashing (clearance) time and 3.0 feet/sec for total crossing time);</li> <li>• Reduced conflicts between pedestrians and turning vehicles achieved with: <ul style="list-style-type: none"> <li>○ Pedestrian lead phases;</li> <li>○ Scramble phases in very high pedestrian volume locations;</li> <li>○ Restricted right turns on red when pedestrians are present during specified hours; and</li> <li>○ Allowing right turns during cross-street left turn phases reduces the number of right turn conflicts during pedestrian crossing phase.</li> </ul> </li> </ul>
Low speed channelized right turn lanes	<ul style="list-style-type: none"> <li>• Adequate sized islands for pedestrian refuge;</li> <li>• Raised pedestrian crossing/speed table within channelized right turn lane; and</li> <li>• Signal control of channelized right turn in high pedestrian volumes locations.</li> </ul>
Improved pedestrian information	<ul style="list-style-type: none"> <li>• Pedestrian countdown timers; and</li> <li>• “Look Before Crossing” markings or signs.</li> </ul>
Bicycle features	<ul style="list-style-type: none"> <li>• Bicycle lanes striped up to crosswalk (using “skip lines” if vehicular right turns are allowed);</li> <li>• Bicycle detectors on high volumes routes, or bicyclist-accessible push buttons;</li> <li>• Adequate clearance interval for bicyclist;</li> <li>• Colored paving in bicycle/vehicle lanes in high-conflict areas; and</li> <li>• “Bike Boxes” (painted rectangle along right hand curb or behind crosswalk) to indicate potential high-conflict area between bicycles continuing through an intersection and right turning vehicles, and to allow bicyclist to proceed through intersection or turn in advance of vehicles.</li> </ul>
High-priority transit thoroughfare elements	<ul style="list-style-type: none"> <li>• Adaptive Transit Signal Priority (TSP) when transit detected;</li> <li>• Extended green phase on bus route (rapid transit signal priority);</li> <li>• Truncated green phase for cross street;</li> <li>• Re-order phasing to provide transit priority (transit priority not to be given in two successive cycles to avoid severe traffic impacts);</li> <li>• Other bus priority signal phasing (sequencing)</li> <li>• Queue jump lanes and associated signal phasing; and</li> <li>• Curb extension bus stops, bus bulbs.</li> </ul>
Accessibility and space for pedestrians	<ul style="list-style-type: none"> <li>• Properly placed pedestrian actuation buttons, with audible locator tones;</li> <li>• Detectable warnings;</li> <li>• Two curb ramps per corner depending on radius of curb return and presence of curb extensions;</li> <li>• Clear pedestrian paths (and shoulder clearances) ensuring utilities and appurtenances are located outside pedestrian paths;</li> <li>• Vertical and overhang clearance of street furnishings for the visually impaired;</li> <li>• Properly placed signal poles and cabinets: <ul style="list-style-type: none"> <li>○ Behind sidewalks (in landscaping or in building niches);</li> <li>○ In planting strips (furnishing zone); and</li> <li>○ In sidewalk, at least three feet from curb ramps.</li> </ul> </li> </ul>
Traffic operations for safe speeds and pedestrian convenience	<ul style="list-style-type: none"> <li>• Target speeds between 25-35 mph;</li> <li>• Signal progression at target speeds; and</li> <li>• Fewer very long/very short cycle lengths.</li> </ul>
Higher priority on aesthetics	<ul style="list-style-type: none"> <li>• Textured and colored material within the streetside;</li> <li>• Colored material within crosswalks, but avoid coarse textures which provide rough surfaces for the disabled;</li> <li>• Attractive decorative signal hardware, or specialized hardware; and</li> <li>• Attention to landscaping and integration with green street stormwater management techniques.</li> </ul>

FIGURE 5.8

## 5.8 Integration of Modal Types

The following examples are generalized conceptual illustrations of different intersection configurations, along with an existing aerial photo. These images are potential solutions. Detailed engineering must be completed before any option can be considered.

### Heights at 11th Street Michigan U turn concept



FIGURE 5.9: HEIGHTS AT 11TH ST. EXISTING AERIAL PHOTO

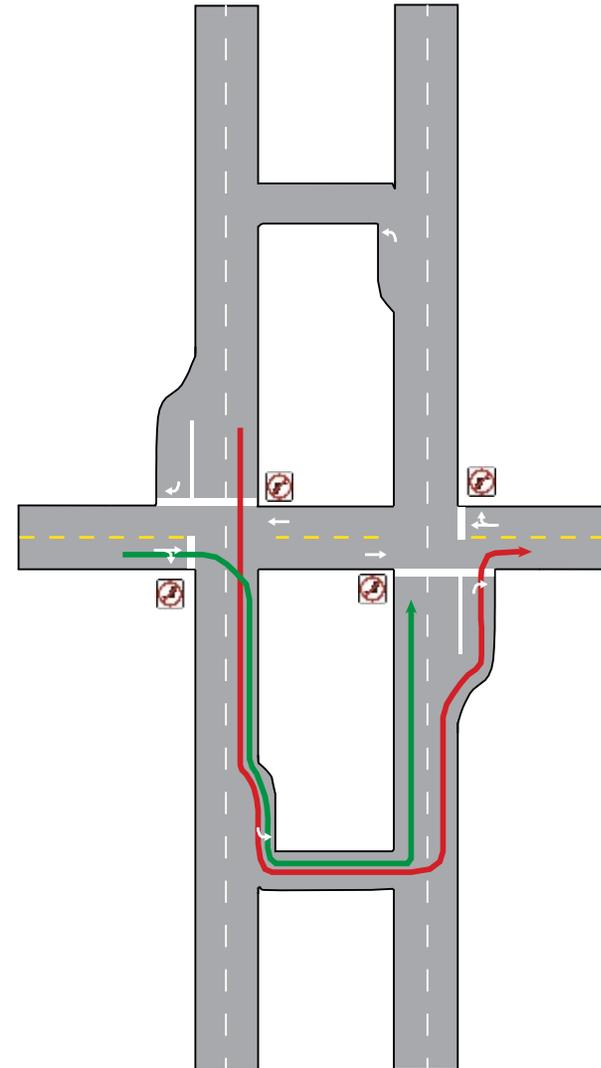


FIGURE 5.10 SAMPLE MICHIGAN U-TURN INTERSECTION

# Roundabout Concept

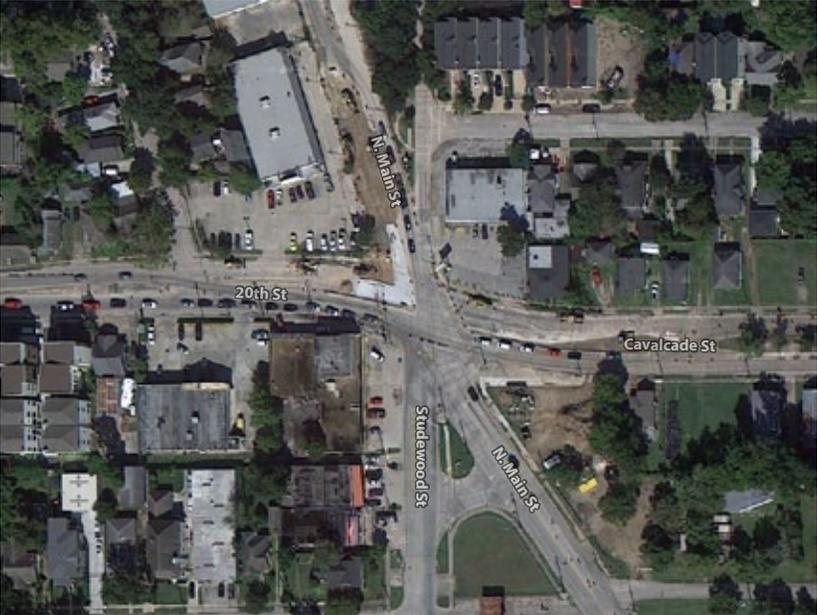


FIGURE 5.11: 20TH/CAVALCADE AT MAIN AERIAL PHOTO



FIGURE 5.12: AIRLINE AT GIBBS/LINK AERIAL PHOTO

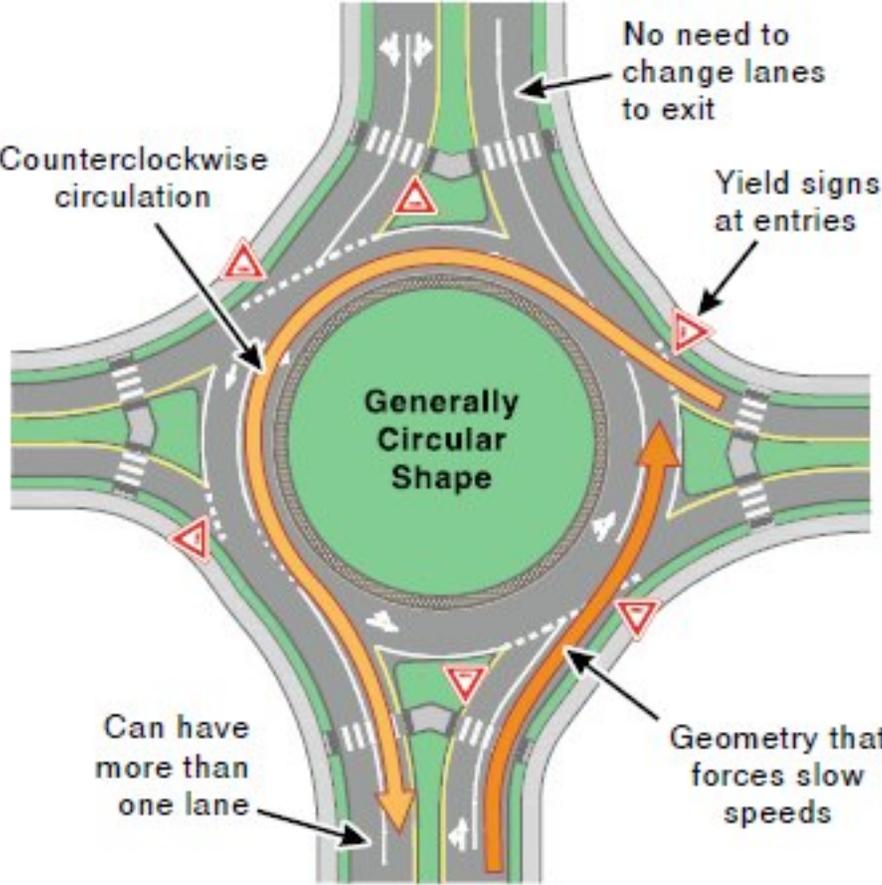


FIGURE 5.13: SAMPLE ROUNDABOUT CONCEPT

**This Page Intentionally Left Blank**