Design & Engineering Tactics

Introduction

This collection of design and engineering tactics is not intended to be comprehensive, but rather highlight the innovative, nonmandatory tactics that accommodate or encourage walking. They are grouped into four categories: design guidance, traffic-analysis techniques, intersection elements, and signal treatments.

- Design guidance focuses on physical layouts and elements of streets, sidewalks, and crossings.
- Traffic-analysis techniques count and account for pedestrians in traffic analysis.
- Intersection elements list physical additions to road crossings that improve safety.
- Signal treatments list the types and timing plans of traffic lights that can improve the safety of walkers. We do not include pedestrian countdown signals, although we recommend that communities adopt them. Why? Countdown signals are now standard within the Manual on Uniform Traffic Control Devices (MUTCD), which means that departments of transportation are already obliged to use countdown signals whenever they add or replace pedestrian signals.

This chapter includes some Federal Highway Administration–recommended treatments; the full list of federal "proven countermeasures," or safety elements, can be found at http://safety.fhwa.dot.gov/provencountermeasures/

A pedestrian crossing island with accessible-design features including a level, cut-through pedestrian path and dectable warnings in the form of truncated domes, New York, NY. *Source: Gerard Soffian*

Pedestrian-friendly sidewalk and streetscape infrastructure in Santa Barbara, CA. *Source: Ken Lund, Flickr*

Adopt **Context-Sensitive** Street Design Guidelines

Definition Context-sensitive street design guidelines require a collaborative approach to transportation planning. They need a shared stakeholder vision, comprehensive understanding of contexts, and design flexibility to balance the transportation needs of multiple modes while enhancing community and natural environments.

Benefits

- Helps integrate land use and transportation planning
- Helps preserve environmental, scenic, aesthetic, historic, and natural resources
- Accommodates all road users
- Generally improves safety
- Helps make communities more livable
- Increases stakeholder receptiveness
- Increases walking opportunities

Considerations

- Accommodating competing uses within a limited amount of space

Appropriate Contexts

- Local street design guidelines
- State and local departments of transportation strategic-plan and project-management manuals
- Federal and state project-management guidance

Guidance

- Guidelines should address both the planning process and design considerations
- NCHRP Report 642: Quantifying the Benefits of Context Sensitive Solutions provides 15 guiding principles for context-sensitive solutions, including[1]:
    - » Use interdisciplinary teams
    - » Involve stakeholders
    - » Seek broad-based public involvement
    - » Achieve consensus on purpose and need
    - » Address alternatives and all travel modes
    - » Consider a safe facility for users and community
    - » Maintain environmental harmony
    - » Address community and social issues
    - » Address aesthetic treatments and enhancements
- Consider designing roads to meet a target, or desired travel speed, rather than a 'design speed,' or essentially the maximum speed that can be maintained by the design features of the roadway.[2] Consider retrofitting roads to achieve those target speeds

Professional Consensus

- Endorsed within the Federal SAFETEA-LU transportation bill Section 6008. Section 109(c)(2) of title 23, USC context-sensitive solutions[3]
- Endorsed by the Federal Highway Administration Context-Sensitive Solutions program[4]
- Endorsed within the NCHRP Report 642: Quantifying the Benefits of Context Sensitive Solutions[5]
- Endorsed by the Institute of Transportation Engineers within its publication Designing Walkable Urban Thoroughfares: A Context-Sensitive Approach
- Endorsed by Joint AASHTO / FHWA Context Sensitive Solutions Strategic Planning Process[6]

Examples

- NJDOT/PennDOT Smart Transportation Guidebook
- Oregon Neighborhood Street Design[7]
- Seattle, WA
- New York, NY
- Charlotte, NC
- Elk Grove, CA

A rendering of the Manayank Bridge Path project, to be funded by the Pennsylvania Community Transportation Initiative, which supports Smart Transportation goals. *Source: John Boyle, Bicycle Coalition of Greater Philadelphia*

Case Study: PA and NJ

In 2008, the Pennsylvania and New Jersey departments of transportation, in collaboration with the Delaware Valley Regional Planning Commission, published *The Smart Transportation Guidebook*. The publication provided the framework for updating all other DOT processes around six tenants: Adapt solutions to the context, tailor the approach, plan projects with community collaboration, accommodate alternative transportation modes, use sound professional judgment, and scale the solution to the size of the problem. The guidebook played a strong role in shaping updates to PennDOT's Design Manual Part 1 and 2. The updated procedures emphasized design flexibility based on surrounding land uses and street users. The new design processes now encourage engineers to consider the needs of all road users in addition to their surrounding land uses and integrate them into designs.[8] As a result, more than one project could be reevaluated using Smart Transportation principles and redesigned for vehicle speeds and street geometry more suitable to the cyclists and pedestrians who would be sharing the roadway.[9]

1. Stamatiadis, Nikiforos; Kirk, Adam; Harman, Don; Hopwood, Theodore; Pigman, Jerry. NCHRP Report 642: Quantifying the Benefits of Context-Sensitive Solutions. Transportation Research Board of the National Academies. June 30, 2009. http://contextsensitivesolutions.org/content/reading/nchrp_report_642__ndash__quanti_/resources/nchrp_rpt_642.pdf/
2. Federal Highway Administration. Speed Concepts: Informational Guide. September 2009. http://safety.fhwa.dot.gov/speedmgt/ref_mats/fhwasa10001/
3. Federal Highway Administration. http://www.fhwa.dot.gov/context/what.cfm
4. Federal Highway Administration. Context Sensitive Solutions. http://contextsensitivesolutions.org/
5. NCHRP Report 642: Quantifying the Benefits of Context Sensitive Solutions. Transportation Research Board of the National Academies. http://contextsensitivesolutions.org/content/reading/nchrp_report_642__ndash__quanti_/resources/nchrp_rpt_642.pdf/
6. Center for Transportation and the Environment. Results of Joint AASHTO/FHWA Context Sensitive Solutions Strategic Planning Process Summary Report March 2007. http://contextsensitivesolutions.org/content/reading/results_of_joint_aashto_fhwa_co_/resources/portlandsummary_final_050107.pdf/
7. Neighborhood Streets Project Stakeholders. Neighborhood Street Design Guidelines. An Oregon Guide for Reducing Street Widths. November 2000. http://www.oregon.gov/LCD/docs/publications/neighstreet.pdf?ga=t
8. Hare, Brian. Chief of Design Services Division. PennDOT Personal correspondence. September 28, 2011.
9. Ibid.

Adopt **Accessible & Attractive Streetscape** Design Guidelines

Definition The shape and amenities of sidewalks, crosswalks, and plazas are often determined by streetscape design guidelines. These guidelines can require that walking infrastructure is accessible to all persons regardless of ability or stature, and they can help create a safe, pleasant place for people to walk, sit, stand, and move around.

Benefits

- Increases accessibility for all people on the street, especially those with visual or mobility impairments
- Creates safe, accessible, and convenient walking connections
- Encourages walking for all ages and abilities
- Supports transit use for all ages and abilities
- Helps create an appealing and comfortable streetscape

Considerations

- Accommodating competing uses within a limited amount of space
- Accommodating curbside parking

Appropriate Contexts

- Any jurisdiction that is responsible for the design of the streetscape beyond the portion of the right-of-way used for vehicle purposes

Guidance

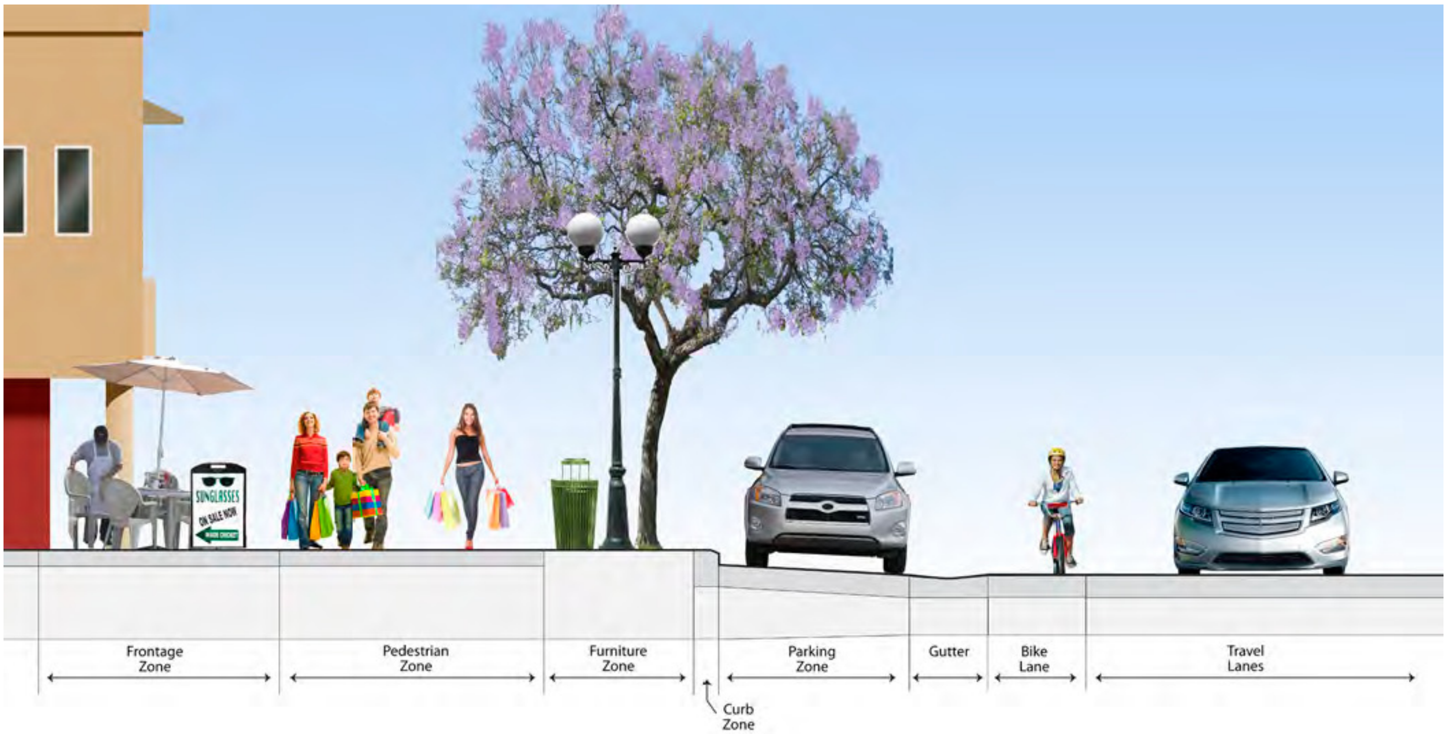
- Create a community advisory committee to meet regularly with guidelines staff during the creation of pedestrian-environment design guidelines
- Reach out to the general public for input through community meetings, surveys, and an interactive website
- Collaborate with technical agency staff to ensure feasibility of proposed guidelines
- Guidelines should:
  - » Incorporate proposed Public Rights-of-Way-Accessibility Guidelines (PROWAG) to ensure universal access
  - » Minimize pedestrian risk from vehicles
  - » Address pedestrian concerns, like safety, lighting, shade, seating, and sidewalk clearances and crossings
  - » Create safe public space and seating
  - » Address ecological concerns, including on-site stormwater management and the creation of local habitats where feasible
  - » Create safe access to transit
- Guidelines should address aesthetic and accessibility concerns simultaneously where feasible, as exemplified in these San Francisco Better Streets suggestions[1]:
  - » Add street trees, landscaping, stormwater facilities, and furnishings to:
    - Projects that dig up sidewalks
    - Traffic-calming projects
  - » Include curb extensions in curb-ramp construction projects
  - » Add pedestrian-oriented lighting when upgrading roadway lighting
  - » Consolidate utilities, parking meters, signs, and poles to widen sidewalk clearances on any streetscape-improvement project
  - » Include public art on projects that create new structures in the right-of-way

Professional Consensus

- In the absence of national academic or association standards, jurisdictions are looking to best practices of other jurisdictions

Examples

- San Francisco, CA: The Better Streets Plan
- Seattle, WA: Seattle Design Guidelines
- New York, NY: NYCDOT Street Design Manual
- Los Angeles County, CA: Model Design Manual for Living Streets



This street cross section illustrates how streetscape elements can be integrated to create pleasant, safe environments for multiple modes of travel. *Source: Michele Weisbart, Model Design Manual for Living Streets*

1. San Francisco Planning Department. The Better Streets Plan. December 2010. 5-4. http://www.sf-planning.org/ftp/BetterStreets/docs/FINAL_5_Street_Designs.pdf

Narrow or **Reduce** Travel Lanes

Definition Streets frequently have more space allotted to cars than is necessary. This tactic entails redesigning new or existing roadways to reduce the width and number of travel lanes wherever possible. Techniques for achieving this include "road diets" and reducing travel-lane widths. A "road diet" typically refers to converting a roadway with two lanes in each direction to one lane in each direction with a center turning lane and bike lanes on the side.

Benefits

- Provides more roadway width for sidewalks and bicycle lanes
- Often shortens crossing distances for pedestrians
- Creates more space for medians, bike lanes, on-street parking, transit stops, and landscaping
- Improves pedestrian and cyclist safety
- Makes more efficient use of underused pavement
- May slow vehicular speeds

Considerations

- Be cautious of 9'–10' travel lanes in the following contexts:
  - Four-lane arterial roads
  - Four-leg stop-controlled arterial intersections[1]
  - High-speed roadways with narrow shoulders[2]
  - High-speed curvy roadways[3]
  - Locations with high volumes of buses and/or trucks

Appropriate Contexts

- Roadways with average daily traffic (ADT) of 20,000 vehicles or less may be good candidates for a road diet
- The American Association of State and Highway Transportation Officials recommends the following minimum travel lane widths by context[4]:
  - Freeways: 12'
  - Urban and suburban arterials: 10'
  - Rural arterials: 11'
  - Collector roadways: 10'
  - Local roads: 9'
  - Reduced-speed urban areas (45 mph and under): 10'
  - Urban and suburban commercial centers: 9'[5]
  - Urban and suburban commercial neighborhoods: 9'–11'

Guidance

- Travel-lane widths should not be based on the widest width allowable, but on the narrowest safe width
- Evaluate transit routes, the number and design of intersections along the corridor, the number of driveways, and operational characteristics before implementing a road diet
- Consider designing local streets that are too narrow for two full lanes to accommodate alternating two-way traffic
- Analyze and understand the effects of the proposed change, and obtain input from the community stakeholders
- Include contextual safety improvements in the project, such as intersection turn lanes, signing, pavement markings, signals or stop signs, transit stops, medians, sidewalk improvements, and bike lanes

Professional Consensus

- AASHTO permits lane-width minimums of 10' on urban arterial and collector roadways with posted speed limits of 45 mph or less and 9' lane-width minimums on local roads[6]
- Endorsed by Federal Highway Administration
- Endorsed by PennDOT/NJDOT's Smart Transportation Guidebook, which encourages designers to "make full use of the normal range of travel lane widths....depending on context and project goals."

Examples

Many cities stripe 10' lanes on urban arterials, including:

- Arlington, VA
- Charlotte, NC
- Eugene, OR
- Portland, OR
- Santa Monica, CA
- Burbank, CA
- New York, NY

Before restriping narrower travel lanes on 27th Street, in Oakland, CA, workers first sketched out the new street dimensions. *Source: Eric Fischer, Flickr*

1. Potts, Ingrid B.; Harwood, Douglas H.; Richard, Karen R. Relationship of Lane Width to Safety for Urban and Suburban Arterials. TRB 2007. Annual Meeting Submission.
2. Federal Highway Administration Office of Safety. Lane Widths. http://safety.fhwa.dot.gov/geometric/pubs/mitigationstrategies/chapter3/3_lanewidth.htm
3. Federal Highway Administration Office of Safety. Lane Widths. http://safety.fhwa.dot.gov/geometric/pubs/mitigationstrategies/chapter3/3_lanewidth.htm
4. PennDOT, NJDOT. Smart Transportation Guidebook. March 2008. 45. http://www.smart-transportation.com/assets/download/Smart%20Transportation%20Guidebook.pdf
5. A member of the Institute of Transportation Engineers is more cautious about 9' lanes, recommending them only on local streets or when adjacent to bike lanes
6. American Association of State Highway and Transportation Officials. A Policy on Geometric Design of Highways and Streets. 2010. 477.

Build a Comprehensive **Sidewalk Network**

Definition Sidewalks are roadways for walkers; they need to be comprehensive, integrated, and connected. Many communities and cities have discontinuous sidewalk systems that need connecting or upgrading to get people where they need to go. To most efficiently use their resources, jurisdictions should survey and analyze existing sidewalks to prioritize sidewalk improvements.

Benefits

- Encourages walking by creating a safe, direct means of getting around on foot
- Connects people and neighborhoods to businesses, schools, and job opportunities by building an integrated and comprehensive sidewalk network
- Encourages social interaction
- Reduces pedestrian conflicts with vehicles
- Provides consistent accessibility for everyone, especially children, seniors, and people with mobility limitations

Considerations

- Construction costs
- May require reclaiming right-of-way from existing front yards and lawns
- Funding for continual maintenance
- May require narrowing of the roadway

Appropriate Contexts

- Urban and suburban residential, commercial, and arterial streets
- Access points and paths to and from transit, schools, parks, and other services

Guidance

- Survey existing conditions
- Track and store existing sidewalk conditions, possibly using a geographic information system (GIS)
- Perform in-field assessments of existing conditions and existing ADA/PROWAG compliance
- Address need for safe and accessible street crossings between sidewalks
- Analyze sidewalk conditions in relation to census and land use data
- Determine appropriate sidewalk widths based on existing volumes of people and adjacent land uses. Zupan and Pushkarev posit sidewalk minimums in Urban Space for Pedestrians[1]
- Prioritization criteria can include:
  - » Potential demand (proximity to pedestrian attractors and corridor function)
  - » Potential pedestrian risk (presence of physical buffers between moving traffic and pedestrians, traffic volumes, traffic speeds)
  - » Existing sidewalk need (level of maintenance and ADA compliance)
  - » Existing population need (health and socioeconomic levels of adjacent population)
- Solicit public input and discussion when creating a matrix to prioritize projects
- Consider alternative, cheaper sidewalk and street designs to achieve infrastructure- and stormwater-management goals
- Create a separate program for community-requested safety and sidewalk improvements
- Install ADA and PROWAG[2]-compliant infrastructure

Professional Consensus

- AASHTO maintains that "Providing people safe places to walk is an essential responsibility of all government entities involved in constructing or regulating the construction of the public right-of-way"[3]
- The policy of the U.S. DOT is that bicycling and walking facilities should be incorporated into all transportation projects unless "exceptional circumstances" exist[4]

Seattle DOT's Sidewalk Development Program connects sidewalk gaps, as exemplified by this project on 39th Avenue South. *Source: Seattle DOT*

Case Study: Seattle

Seattle used a GIS-based approach to prioritize potential sidewalk projects. The city first analyzed sidewalk needs based on the presence and characteristics of existing sidewalks, such as physical buffers, traffic speeds and volumes, and block length. The city then analyzed sidewalks based on three demand analyses—potential pedestrian demand, socioeconomic / health equity, and corridor function—and weighted them by category to determine areas of most need.[5]

Seattle created an alternate Neighborhood Projects Fund to construct projects proposed by residents.[6] Seattle's sidewalk improvements are funded by the city's nine-year $365 million Bridging the Gap levy, supplemented by state or federal grants.[7]

Examples

- Seattle, WA
- Austin, TX
- Charlotte, NC

1. Zupan, Jeffrey M. and Pushkarev, Boris. *Urban Space for Pedestrians*. The MIT Press. Cambridge. 1975. 149. http://www.scribd.com/doc/36643404/Urban-Space-for-Pedestrians
2. U.S. Access Board. Proposed Accessibility Guidelines for Pedestrian Facilities in the Right of Way. July 2011. http://www.access-board.gov/prowac/nprm.htm
3. American Association of State Highway and Transportation Officials. A Policy on Geometric Design of Highways and Streets. 2010.
4. U.S.DOT. "Accommodating Bicycle and Pedestrian Travel: A Recommended Approach—A U.S. DOT Policy Statement on Integrating Bicycling and Walking Into Transportation Infrastructure," Transportation Equity Act for the 21st Century (TEA-21) http://www.fhwa.dot.gov/environment/bikeped/design.htm
5. City of Seattle. Appendix A: Methodology and Analysis. Seattle Pedestrian Master Plan. 2009. http://www.seattle.gov/transportation/pedestrian_masterplan/docs/Methodology_Appendix040209_fixed.pdf
6. Seattle Department of Neighborhoods. 2012 Neighborhood Projects Fund. n.d. http://www.seattle.gov/neighborhoods/btgnsfcrf/
7. Seattle Department of Transportation. Bridging the Gap - Building a foundation that lasts. n.d. http://www.seattle.gov/transportation/BridgingtheGap.htm

Integrate **Transit, Walking,** and **Cycling** into Projects

Definition The needs of transit, cyclists, and pedestrians should be integrated within the design and scope of transportation projects. This can be accomplished by improving infrastructure, modifying design speeds, reconfiguring roadways, and adapting traditional traffic analysis.

Benefits

- Creates safe convenient walking and cycling routes to and from transit and trip generators
- Recalibrates priorities from vehicles to people
- Provides opportunities for walking and cycling, which improves the emotional and physical health of participants
- Increases bus-passenger trips

Considerations

- Traffic-calming and safety improvements may negatively affect bus service and vehicle capacity
- Projects typically span multiple jurisdictions, requiring increased collaboration between traffic engineers, technical specifications, and political priorities
- Transit riders and pedestrians often do not have vocal constituencies to advocate for infrastructure improvements or counteract negative perceptions

Appropriate Contexts

- Roadway repaving and redesign projects
- Specifications for third-party roadway reconstruction (water main or utility work necessitating repaving)
- Community visioning processes and plans

Guidance

- Conduct traffic analysis in terms of person delay rather than vehicle delay to better account for all the people on the road. The Highway Capacity Manual (HCM), which outlines the computational procedures for determining the capacity and quality of service of roadways and intersections, focuses primarily on vehicle delay. HCM does not account for the passenger-efficiency of buses. Any delay should be recalculated from the number of vehicles to the number of passengers traveling through the corridor
- Determine the appropriate design speed of transportation redesigns with the safety and convenience of pedestrians in mind
- Integrate transit priority elements into street redesigns. Complete streets often slow traffic, which improves overall street safety, but can negatively affect bus services on that street. Including bus lanes, signal priority, and other bus-focused elements can ensure that these projects also promote transit use.
- Design safe, convenient infrastructure for the entire door-to-door transit-trip passenger experience, including the routes between the transit stop, stops for travel in both directions (including street crossings), the location of the transit stop, the method of payment, and the transit vehicle itself
- Incorporate Public Rights-of-Way-Accessibility Guidelines (PROWAG) to ensure universal access throughout the infrastructure improvements
- Expand the concept of Complete Streets to the network; consider modes by network and routes rather than requiring every mode to be located on the same street

Professional Consensus

- In the absence of official guidance from national associations or governmental departments, cities are turning to best practices employed by other municipalities

Examples

Individual cities that have integration policies include:

- San Francisco, CA: The Better Streets Plan
- New York, NY: NYCDOT Sustainable Streets

Select Bus Service on First and Second Avenues in New York, NY. *Source: Noah Kazis, Streetsblog New York, streetsblog.org*

Case Study: New York

In 2009, NYC Department of Transportation (NYCDOT) and MTA New York City Transit (NYCT) teamed up to design and implement the M15 Select Bus Service (SBS) line along First and Second Avenues in Manhattan. The SBS project, which was modeled after bus rapid transit to provide subway-like service with buses, aimed to meet goals previously outlined in Mayor Bloomberg's PlaNYC sustainability plan and NYCDOT's strategic plan, as well as NYCT's Capital Plan. This SBS project gave NYCDOT and NYCT the opportunity to reexamine existing infrastructure in order to improve transit and all modes on two major Manhattan thoroughfares.

The First and Second Avenue SBS project redesigned streets from lower Manhattan to 125th Street, reducing the number of lanes available for general traffic in certain sections in order to provide consistent dedicated bus lanes and off-board fare collection. (A transit signal-priority system that grants SBS buses an extended green light at intersections will also be activated on parts of the route.) The project also included pedestrian islands at selected intersections and parking-protected or curbside bike lanes from Houston Street to 34th Street on both avenues.[1] Since 2010, the bicycle facilities have been and continue to be extended substantially.[2, 3]

By integrating transit and transportation planning, NYCDOT and NYCT were able to improve safety and efficiency for almost everyone on the roadways. (By not providing accessible pedestrian signals, however, some of these new streetscape features can act as barriers to people who are blind.) In the year since service began in October 2010, bus ridership increased by 9% and bus speeds improved by 15% to 18%. Traffic injuries fell by 21% in roadway sections with full treatment redesigns, and bicycle volumes increased by 18% to 177%, while traffic speeds and volumes remained about the same.[4]

1. The City of New York. Bus Rapid Transit. http://www.nyc.gov/html/brt/html/routes/first_ave.shtml
2. New York City Department of Transportation. First Avenue Complete Street Extension. Presentation to Community Board 8. September 7, 2011. http://www.nyc.gov/html/dot/downloads/pdf/201109_1st_2nd_aves_bicycle_paths_cb8.pdf,
3. New York City Department of Transportation. First and Second Avenues Complete Street Extension. Presentation to Community Board 11. December 6, 2011. http://www.nyc.gov/html/dot/downloads/pdf/20111206_1st_2nd_aves_bicycle_paths_cb11.pdf
4. New York City Department of Transportation and Metropolitan Transportation Authority New York City Transit. Select bus service M15 on First and Second Avenues: Progress Report. November 2011. http://www.nyc.gov/html/brt/downloads/pdf/201111_1st2nd_progress_report.pdf

Create **Slow Zones**

Definition Slow zones consist of engineered traffic-calming measures such as speed humps, roundabouts, curb extensions, signs, optimized signal timing, and street markings to slow vehicles down to 20 miles per hour (mph) within clearly defined areas.

Benefits

- Slows vehicular traffic
- Reduces casualties and collisions substantially (e.g., 42% in London)[1]
- Reduces number of casualties and collisions on adjacent streets[2]
- Reduces severity of traffic injuries
- Reduces cut-through traffic
- Encourages walking and cycling by creating a safer, more welcoming streetscape
- Potentially adds greenery and amenities to the streetscape
- Improves safety for all street users, regardless of age or ability

Considerations

- Access for commercial deliveries
- Access for emergency vehicles
- Access for those with mobility or vision disabilities
- Access for transit
- Potential loss of curbside parking

Appropriate Contexts

- Residential and local streets
- Town centers
- School campuses and surroundings
- Private property, planned communities, and resorts
- Parking lots and surroundings of shopping centers and outdoor markets
- Areas without major through traffic or thoroughfares
- Urban areas with excessive speeds[3]
- Areas with high numbers of recorded accidents involving children[4]
- Areas with high numbers of existing or expected pedestrians and/or cyclists[5]

Guidance

- Begin by building support among a diverse set of stakeholders
- Consult with all relevant stakeholders, including emergency services, police, local residents, transportation and public-health professionals, and driver organizations throughout all project stages
- Create a public-involvement process to incorporate residents' input on the type and location of proposed traffic-calming measures
- Establish a 20 mph speed limit across a district and not just an individual road[6]
- Each zone entrance should have signs showing clearly that drivers are entering a reduced speed zone
- Install appropriately designed traffic measures at regular intervals about 200' apart[7]
- Coordinate signal timing to move vehicles in a slow, steady pace
- Install traffic-calming measures systematically, such as:[8]
  - Vertical measures: raised intersections, speed tables, speed humps
  - Horizontal measures: curb extensions, chicanes, and realigned intersections
  - Road narrowing: gateways, curb extensions, reduced pavement or lane width, and intersection narrowing
- Accompany traffic-calming measures with plantings or street furniture to distinguish the roadway treatments, create a more walkable area, and encourage lower speeds[9]
- Incorporate Public Rights-of-Way-Accessibility Guidelines (PROWAG) to ensure universal access in traffic-calming treatments
- Create a public-service education campaign to reduce vehicle speeds
- Measure crash data and vehicle speeds before and after implementation to demonstrate the benefits of speed zones[10]

Mayor Michael Bloomberg announcing the city's expanded Slow Zones program. *Source: New York City Department of Transportation*

Professional Consensus

- Recommended by the Centers for Disease Control and Prevention[11]
- The AASHTO Guide for the Planning, Design and Operation of Pedestrian Facilities includes Reduced Speed Zones, but only within the context of Chapter 2.5.4 Chapter Traffic Control and Crossings Near Schools

Examples

- Hoboken, NJ
- New York, NY

Case Study: New York

In November 2011, the New York City Department of Transportation (NYCDOT) launched its first Neighborhood Slow Zone pilot program in the Claremont neighborhood of the Bronx. The area was selected for its relatively high frequency of serious traffic crashes and for its definable boundaries that could be easily marked for a zone. The goal of the program was to slow down the speed limit from 30 mph to 20 mph in order to reduce number and severity of traffic crashes within the zone.[12]

To do so, NYCDOT installed blue "gateway" signs at each of the 14 street entrances to the zone. Within the quarter-square-mile area, NYCDOT added 28 signs marking the 20 mph speed limit, nine speed bumps in addition to the existing five, and 45 "20 mph" road markings.[13]

NYCDOT's launch of the Claremont pilot coincided with the start of its new application process allowing communities throughout the city to request their own slow zones. NYCDOT evaluated community applications for slow zones using criteria such as severity crashes per mile, the number of schools and senior- and day-care centers, and the presence of truck and bus routes. The agency will work with communities to design the slow zone traffic-calming measures before presenting the proposals to Community Boards for approval and implementing them.[14] NYCDOT then announced the launch of 13 slow zones throughout New York City slated for implementation in 2012.[15]

1. Grundy, Chris; Steinbach, Rebecca; Edwards, Phil; Green, Judith; Armstrong, Ben; Wilkinson, Paul. Effect of 20 mph traffic speed zones on road injuries in London, 1986–2006: controlled interrupted time series analysis. British Medical Journal. 2009; 339:b4469 http://www.bmj.com/content/339/bmj.b4469.full?maxtoshow=&HITS=10&hits=10&RESULTFORMAT=&fulltext=%25252220+mph%252522&searchid=1&FIRSTINDEX=0&sortspec=date&resourcetype=HWCIT
2. Ibid.
3. Department for Transport. Local Transport Note 01/07. Traffic Calming. March 2007. 36. http://assets.dft.gov.uk/publications/local-transport-notes/ltn-1-07.pdf
4. Ibid.
5. Ibid.
6. Department for Transport. Local Transport Note 01/07. Traffic Calming. March 2007. 34. http://assets.dft.gov.uk/publications/local-transport-notes/ltn-1-07.pdf
7. Ibid. 36.
8. O'Fallon, Carolyn; Sullivan, Charles. Slow zones: their impact on mode choices and travel behavior. NZ Transport Agency research report 438. March 2011. http://www.nzta.govt.nz/resources/research/reports/438/docs/438.pdf
9. Ibid.
10. Department for Transport. Local Transport Note 01/07. Traffic Calming. March 2007. 35. http://assets.dft.gov.uk/publications/local-transport-notes/ltn-1-07.pdf
11. Centers for Disease Control and Prevention. CDC Transportation Recommendations. http://www.cdc.gov/transportation/recommendation.htm
12. New York City Department of Transportation. About DOT Press Release # 11-97. November 21, 2011. http://www.nyc.gov/html/dot/html/pr2011/pr11_97.shtml
13. Ibid.
14. New York City Department of Transportation. About DOT Neighborhood Slow Zones. http://www.nyc.gov/html/dot/html/about/slowzones.shtml
15. The City of New York. News from the Blue Room. PR-258012 July 10, 2012.

Turn **Underutilized Asphalt** into Grass and Other Uses

Definition Underutilized, excessive roadway and/or parking space can be reassigned to pedestrian and/or bicycle uses. Underutilized or excessive roadways have more travel lanes (or parking spaces) than necessary for the number of cars using them. New uses of roadway or parking space could include public plazas with planters and seating areas, buffered bicycle lanes, and widened sidewalks.

Benefits

- Encourages walking and cycling
- Creates new public space
- Improves safety for pedestrians as well as drivers and their passengers
- Potentially provides an economic boost in areas with more space allotted to pedestrians
- Potentially improves traffic circulation in and around redesigned areas
- Potentially improves access to open space

Considerations

- Funding traffic analysis to assess existing conditions and predict potential impacts of roadway adjustments, which could be reduced with pilot projects using temporary materials
- Community or political resistance to unfamiliar configurations of street space
- Funding ongoing maintenance requirements

Appropriate Contexts

- Underutilized vehicular roadways in areas with high pedestrian volumes, such as
  - Central business districts
  - Main Streets and downtowns in smaller cities
  - Near parks, playgrounds, schools, senior citizen communities
- Unusual intersection configurations
- Underutilized arterial streets alongside popular destinations like malls or recreation centers
- Proximity or relevance to local groups or business improvement districts to take on programming and maintenance responsibilities for newly created public spaces
- Underutilized surface lot and curbside parking space

Guidance

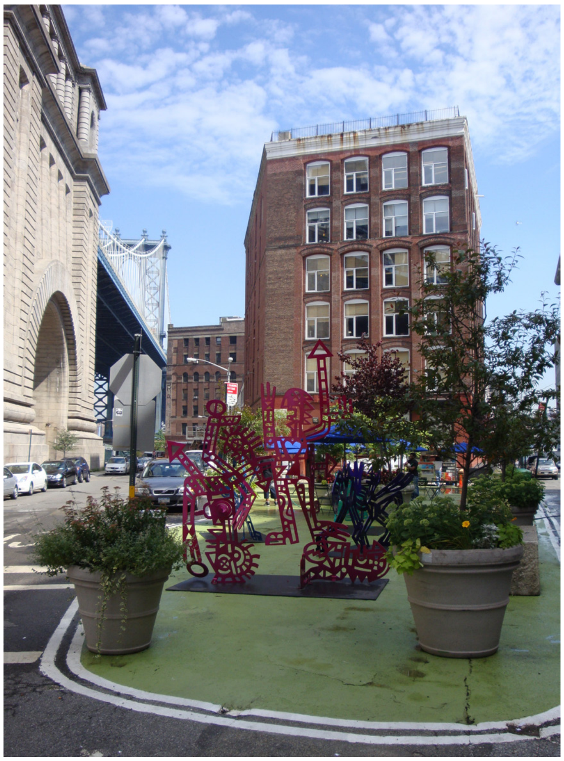
- Analyze existing and proposed traffic conditions
- Communicate and coordinate with local stakeholders for their support and design input throughout the design and planning process
- Implement traffic changes using temporary materials to test the performance of plaza space so that redesign changes can be made or removed before investing resources to construct a capital project
- Be sure the design of plazas or public space considers the needs of people with disabilities, including defining the space in a manner that is identifiable and detectable by pedestrians who are blind
- Partner with a local organization or city department to provide ongoing maintenance and programming for the new public space
- Provide movable street furniture and additional greenery where possible
- Continually monitor before and after conditions for traffic and safety impacts, economic impacts, and real estate values in and around the project

Professional Consensus

- Traffic lane reductions are based on standard AASHTO guidelines, Highway Capacity Manual software procedures, and the Manual on Uniform Traffic Control Devices
- NACTO Urban Bicycle Design

Examples

- Portland, OR: Greenways
- San Francisco, CA: Castro Commons
- New York, NY: Green Light for Midtown



Pedestrian plaza filled with sculptures by Eleanora Kupencow in DUMBO, Brooklyn, NY. *Source: New York City Department of Transportation*

Case Study: New York

The New York City Department of Transportation (NYCDOT) removed two of four vehicular lanes along Broadway between Columbus Circle and Union Square in Midtown Manhattan (a distance of 2 miles) and built a buffered bicycle lane and pedestrian plazas using temporary materials like textured paint and roadway markings in the newly freed roadway space. This reallocation of street space was one of many traffic-flow adjustments through Midtown Manhattan that included left-turn restrictions at specific intersections, new turn-only lanes, and the closing off of Broadway to traffic within Times Square, Herald Square, and Madison Square.

NYCDOT conducted a feasibility analysis that indicated these proposed changes would improve traffic flow on Sixth and Seventh Avenues and increase safety along Broadway. Closing sections of Broadway at these major avenues shortened crossing distances for pedestrians and helped streamline traffic into more predictable patterns to reduce crash rates and pedestrian-vehicular conflicts. NYCDOT collected extensive data on travel times, traffic volumes, pedestrian volumes, and traffic accidents in the months just prior and following project implementation—including data from GPS units in taxis.

According to this data, the project is delivering on its expectations. Findings show that travel speeds for northbound trips throughout West Midtown improved 17% while southbound trips fell by 2%. Travel speeds for eastbound trips increased by 5% and westbound trips by 9%. Injuries to motorists and passengers in the project area decreased by 63%, and pedestrian injuries fell by 35%. The number of people walking in Times Square grew by 11%, and pedestrian volumes increased by 6% in Herald Square. The number of pedestrians walking in the roadway on Seventh Ave. decreased by 80% in Times Square.[1]

1. New York City Department of Transportation. Green Light for Midtown Evaluation Report. January 2010. http://www.nyc.gov/html/dot/downloads/pdf/broadway_report_final2010_web2.pdf

Build **Pedestrian** and **Cyclist Bridges**

Definition These are bridges designed exclusively for pedestrians and bicyclists where at-grade solutions can't be found—often over railways, waterways, or highways—that provide needed transportation links for walkers and cyclists.

Benefits

- Encourages walking and cycling
- Connects areas and transportation networks separated by barriers such as waterways, railways, or highways
- Encourages activities and economic development in previously isolated areas
- Provides an alternative to at-grade crossings
- Creates a potential architectural attraction
- Potentially minimizes travel time

Considerations

- Potential negative impact on vitality of adjacent land uses
- Construction costs
- Time and money for alternatives analysis, design, and environmental-review processes
- Ensuring security
- Considering design safety
- Pedestrian and cyclist convenience and compliance: An Institute of Transportation Engineers study determined 70% of pedestrians would use an overcrossing if the travel time were equal to that of an at-grade crossing, while very few would use an overcrossing if it took 50% longer to use than an at-grade crossing[1]

Appropriate Contexts

- Where physical barriers such as waterways and highways cut off neighborhoods or nonmotorized transportation networks
- Where existing at-grade crossings have a history of pedestrian crashes, or don't meet ADA standards
- Where large numbers of school children cross busy streets
- Where seniors or mobility-impaired pedestrians need to cross a major roadway
- Where railway agencies prohibit at-grade railroad crossings
- Integrated into new transit and/or rail bridges

Guidance

- Exhaust at-grade solutions first, as those are often more walkable and less expensive
- Locate bridges so that they are on the normal path of pedestrian travel with the least amount of vertical difference possible
- Connect bridges to current or future pedestrian/bicyclist destinations, like transit hubs, parks, schools, job centers, arenas, and neighborhoods
- Design logical, direct, clearly marked access points to and from the bridge
- Provide access options for different modes and mobility levels, such as ADA ramps and stairs with a bike gutter
- Retrofit nearby routes and intersections to accommodate pedestrians and cyclists
- Design bridges wide enough for expected numbers of pedestrians and cyclists
- Incorporate PROWAG into design elements
- Provide adequate lighting for safety and security of bridge users
- Consider screens to prevent falling debris
- Provide at least an 8' clearance for emergency or maintenance vehicles
- Budget for ongoing maintenance

Professional Consensus

- AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities[2]
- Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG) [3]
- Institute of Transportation Engineers' Improving Pedestrian Environments Through Innovative Transportation Design[4]
- Pedestrian/Bicycle Overcrossings: Lessons Learned[5]

Examples

- Chicago, IL: BP Bridge
- New York, NY: 78th Street Pedestrian Bridge
- Omaha, NE and Council Bluffs, IA: Bob Kerrey Pedestrian Bridge
- Pittsburgh, PA: Hot Metal Bridge
- Portland, OR: Portland-Milwaukie Light Rail Bridge
- Winnipeg, MB: Esplanade Riel

BP Bridge in Millennium Park, Chicago, IL. *Source: Chris Metcalf, Flickr*

78th Street pedestrian bridge, New York, NY. *Source: New York City Department of Transportation*

1. American Association of State Highway and Transportation Officials. Guide for the Planning, Design, and Operation of Pedestrian Facilities. 2004. 96.
2. AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities. 2004. 94–96.
3. U.S. Access Board. Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way. July 2011. http://www.access-board.gov/prowac/nprm.htm
4. Institute of Transportation Engineers. Improving Pedestrian Environments Through Innovative Transportation Design. 2005. http://www.ite.org/activeliving/ImprovingPedestrian.pdf
5. Renfro, Rory. Pedestrian/Bicycle Overcrossings: Lessons Learned. Portland State University, 2007. http://web.pdx.edu/~jdill/Files/Renfro_Bike-Ped_Overcrossings_Report.pdf

Redesign **Arterial** Streets for **Pedestrians**

Definition Arterial streets, typically multilane thoroughfares designed to speed cars from one destination to another, are often hazardous to people on foot. The Tri-State Transportation Campaign found that 60% of pedestrian deaths in the tri-state region of New York, New Jersey, and Connecticut took place on arterial roadways.[1] Redesigning arterial streets for pedestrians involves adapting roadway geometry (including reducing or narrowing travel lanes), traffic-signal plans, and adjacent land uses of multilane thoroughfares to better accommodate non-automobile uses and create a safer, pedestrian-friendly environment.

Benefits

- Improves safety for pedestrians, cyclists, and drivers[2]
- Creates a unique local identity to compete with malls and big-box retail
- Increases economic activity through quality public environment
- Encourages active lifestyles through better walking and cycling infrastructure
- Increases property values

Considerations

- Arterial roads are often managed by multiple jurisdictions along their length, which complicates funding as well as design and decision processes
- Changing driving behavior to reduce speeding and increase yielding to pedestrians on car-oriented thoroughfares is a challenge[3]
- Accommodating safety redesigns with vehicle volumes

Appropriate Contexts

- Arterial roads with transit stops and limited walking infrastructure
- Arterial roads lined by retail

Guidance

- Interest communities and cities in redesign possibilities with a public visioning meeting, design charette, or design competition
- Work with business improvement districts; since pedestrian-friendly environments see higher retail profits, use funds for street restructuring
- Create mid-block neckdowns and crosswalks
- Create safe crossings with signals or medians
- Narrow roadways wherever traffic volumes and safety allow
- Build pedestrian crossing islands
- Widen medians into transit stops and/or landscape the median
- Widen sidewalks where needed or desired
- Plant street trees to act as a buffer between pedestrians and traffic
- Construct a buffered bicycle path or shared-use greenway
- Consolidate and minimize the number of driveways to reduce turning conflicts
- Program temporary uses in parking lots at off-peak hours
- Create pocket parks in open or vacant space between retail buildings
- Connect pocket parks on one side of the street to the other through crosswalks, mid-block chokes, and medians
- Rezone adjacent land uses for denser development

Professional Consensus

- Transportation for America, a national coalition for transportation reform, analyzed data from the National Highway Traffic Safety Administration's Fatality Analysis Reporting System. Its 2011 Dangerous by Design report revealed that more than 52% of the 47,067 pedestrians killed over a 10-year period died on principal or minor arterial roads. Nearly 60% of the 34,260 pedestrian deaths in urban areas occurred on arterial roads.[4] The report cited that streets that were safest for pedestrians were also safest for drivers[5] and recommended retrofitting high-crash roads for safety.[6] The MAP 21 federal transportation bill identifies pedestrian and bicycle crashes as part of the mandatory Highway Safety Improvement Program.
- Endorsed within Designing Walkable Urban Thoroughfares: A Context Sensitive Approach, a guidebook published by the Institute of Transportation Engineers and the Congress for the New Urbanism

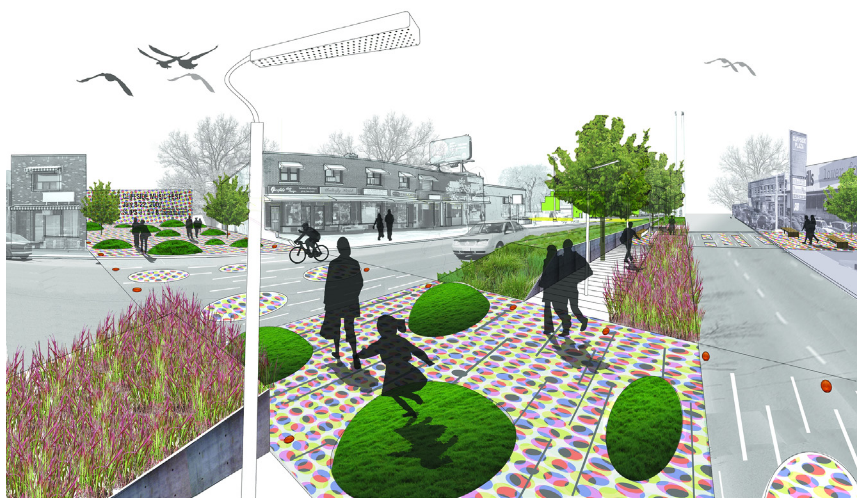
Examples

- Orlando, FL
- Toronto, ON

Case Study: Toronto

Kingston Road, a six-lane highway in Toronto, Ontario, became the subject of several "revisioning" sessions. The first of these visions emerged from a two-week design charette sponsored by *Canadian Architect* magazine and the City of Toronto in 2006, which recommended an incremental design strategy. The vision include pocket parks connecting crosswalks and medians, and temporary uses set in urban parking lots to create a denser public space and help bridge the six-lane roadway.[7]

The city of Toronto then sponsored its own study with recommendations to rezone adjacent land uses for denser development and redesign the roadway to accommodate bicycles and pedestrians to be adopted in Toronto's official five-year plan.[8]



A rendering of a Kingston Road revisioning in Toronto, ON. Redesign elements include pocket parks, crosswalks, occupiable medians, and temporary parking lot activities. *Source: Chris Hardwicke, Sweeny Sterling Finlayson &Co*

1. Tri-State Transportation Campaign. Most Dangerous Roads for Walking And How States Can Make Them Safer. January 2010. 2. http://www.tstc.org/reports/Most_Dangerous_Roads_2009.pdf
2. Dumbaugh, Eric; Li, Wenhao. Design for the Safety of Pedestrians, Cyclists, and Motorists in Urban Environments. *Journal of American Planning Association*. Vol. 7, No. 1, Winter 2011.
3. Alverez, Lizette. "On Wide Florida Avenues, Running for Life." *New York Times*. August 15, 2011. http://www.nytimes.com/2011/08/16/us/16pedestrians.html?pagewanted=all
4. Ernst, Michelle. Dangerous by Design: Solving the Epidemic of Preventable Pedestrian Deaths. Transportation for America. 2011. 25, 26.
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6. Ernst, Michelle. Dangerous by Design: Solving the Epidemic of Preventable Pedestrian Deaths. Transportation for America. 2011. 30.
7. Hardwicke, Chris. Creating Walkable Environments along Suburban Arterial Roads. Case study: Cliffside Neighbourhood, Kingston Road, Toronto. Walk21 Toronto Conference Papers. 2007. http://www.walk21.com/conferences/conference_papers_detail.asp?Paper=369&Conference=Toronto
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Collect **Pedestrian Data**

Definition This refers to a systematic approach of counting pedestrians and walking activity within a defined area or jurisdiction. Data-collection methods are continually evolving but typically include manual counts, automatic recording technologies, origin-destination surveys, geographic-information-systems (GIS) analysis of census and land-use data, as well as intercept surveys. Databases of pedestrian information should catalog pedestrian crash locations and stratify crash details by crash type, time of day/year, weather conditions, demographics, and other variables.

Benefits

- Establishes performance measures to evaluate pedestrian policies and programs
- Helps in comparing and prioritizing proposed projects
- Provides justification for grants and further funding
- Helps justify continued need for pedestrian access and infrastructure
- Documents trends in walking activity, safety, and facilities
- Helps link walking with transit[1]
- Determines peak hour and seasonal adjustment factors that can be used to estimate pedestrian volumes
- Identifies locations for walking-infrastructure improvements
- Helps integrate nonmotorized modes into multimodal transportation models and analyses[2]
- Highlights exposure of most vulnerable pedestrians (elderly, school children, people with disabilities)
- Identifies clusters of crash locations

Considerations

- Funding for staff resources and equipment
- Organizing and training for volunteers or staff[3]
- Data results that reveal low numbers of walkers[4]

Appropriate Contexts

- Proposed project areas
- Project areas before and after implementation
- High-volume street nodes, corridors, and cordons
- Central business districts
- Multiuse paths and trails

Guidance

- Create pocket parks in open or vacant
- Clearly state data-collection goals both internally and to the general public
- Establish a tailored data-collection methodology that reflects local needs and counts both systematic and peak uses of walking infrastructure
- Consider incorporating cost-reducing strategies such as
  - » Installing automated pedestrian-counting technology like infrared and video counts (e.g., Eco-Counter and Miovision),
  - » Using volunteers
  - » Integrating nonmotorized modes into existing vehicular data collection[5]
- Assign dedicated staff or a project manager to set up data-collection equipment, staff locations, tabulate results, and share findings
- Supplement automatic count data with
  - » Manual counts
  - » 24-hour counts at select locations and dates to show infrastructure use
  - » Origin/destination surveys
  - » GIS census analysis to identify factors that influence bicycling and walking[6]
  - » Models to extrapolate pedestrian volumes across a larger geographical distribution
- Collect and analyze data on a regular basis
- Publicly publish the results

A typical sidewalk in San Francisco, CA. *Source: Taylor Hand, Flickr*

Professional Consensus

- Endorsed within the U.S. DOT Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations[7]
- Endorsed by Alta Planning & Design through its National Bicycle and Pedestrian Documentation Project[8]
- Endorsed by the Pedestrian and Bicycle Information Center

Examples

- San Francisco, CA
- Seattle, WA

Case Study: San Francisco

In addition to conducting manual pedestrian counts and installing automatic counters at select locations, the San Francisco Municipal Transportation Agency (SFMTA) recently created a pedestrian-volume model to extrapolate walking activity across a larger swath of the city. SFMTA first conducted manual and automated pedestrian counts at 50 study intersections with a variety of characteristics, from which the SFMTA estimated the average number of pedestrians crossing at each intersection over the course of a year. Then the agency used linear regression modeling to identify statistically significant relationships between the land use, transportation system, local environment, and socioeconomic characteristics near each intersection and that intersection's annual pedestrian-volume estimate.

The significant factors were used to create a model that determined pedestrian volumes were positively associated with the number of households and jobs near each intersection. The model also found significantly higher pedestrian volumes at intersections in high-activity zones with metered on-street parking, in areas with fewer hills, near university campuses, and traffic signals. Results are being used by city agencies to inform citywide pedestrian safety-policy and investment.[9]

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5. Schneider, Robert; Patton, Robert; Toole, Jennifer; Raborn, Craig. Pedestrian and Bicycle Data Collection in United States Communities: Quantifying Use, Surveying Users, and Documenting Facility Extent. Federal Highway Administration. January 2005. 4. http://www.pedbikeinfo.org/pdf/casestudies/PBIC_Data_Collection_Case_Studies.pdf
6. National Bicycle and Pedestrian Documentation Project. http://bikepeddocumentation.org/
7. LaHood, Ray. United States Department of Transportation. Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations. Signed March 11, 2010. http://www.fhwa.dot.gov/environment/bicycle_pedestrian/overview/policy_accom.cfm
8. National Bicycle and Pedestrian Documentation Project. http://bikepeddocumentation.org/
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Integrate **Pedestrian LOS** Criteria into Traffic Analyses

Definition Traditional traffic analysis evaluates the adequacy of a road design to meet vehicular travel demand using a quantitative measurement of delay called level of service (LOS). For many years, traffic-analysis procedures didn't adequately address pedestrian travel demand in these road-design evaluations. The current Highway Capacity Manual (HCM) addresses this analysis gap with new multimodal LOS methodology. HCM's multimodal LOS methodology, however, doesn't include a lot of the factors that might influence walkability, such as adjacent land uses and sidewalk amenities.[1] As a result, some traffic engineers have independently created pedestrian level-of-service criteria to rate road designs for pedestrians, usually using an alphabetical scale from A to F.

Benefits

- Creates a consistent, systematic way to evaluate existing conditions
- Allows comparison and evaluation of different improvements
- Provides an objective way to identify needs and prioritize improvements
- Establishes minimum level of service standards
- Clarifies baseline conditions for proposed mitigations
- Helps jurisdictions mandate walking-infrastructure standards in private developments and public infrastructure

Considerations

- Lack of comprehensive data collection on existing walking conditions
- Pedestrian criteria is often hard to quantify in software analysis
- Walking criteria might not account for specific contexts, e.g., a slower-is-better approach to traffic speeds along a shopping street
- Do-it-yourself walking criteria can be difficult to compare across jurisdictions or integrate into standard analyses

Appropriate Contexts

- Transportation master plans
- Pedestrian master plans
- City and state environmental-impact analyses
- Community-based neighborhood plans

Guidance

- Create a public-outreach process to solicit and incorporate the perspectives of residents, business owners, advocacy groups, and other stakeholders
- Create walking audits with numbered evaluations of criteria that can supplement or be added to pedestrian LOS evaluations
- Include standard categories of pedestrian LOS evaluation, such as:
  - Directness
  - Continuity
  - Street crossings
  - Visual interest and amenities in walking areas and adjacent land uses
  - Security
  - Physical conditions of paths or sidewalks
- Vary evaluation techniques by:
  - Analysis scope (citywide, neighborhood, district)
  - Evaluation category
  - Whether a proposed development is project- or site-specific
- Consider adjusting thresholds for criteria based on the specific pedestrian needs of defined areas or area types (residential, commercial, industrial, etc.)
- Require that traffic-impact studies for significant developments include a pedestrian-impact assessment using this pedestrian LOS criteria

Crowded sidewalks in Seattle, WA. *Source: Brian Teutsch, Flickr*

Case Study: Kansas City

When creating its 2003 Walkability Plan, the Kansas City Planning and Development Department modeled its pedestrian-system evaluation criteria on the concept of automobile level of service or LOS. Level of service is a measurement of delay ranging from A to F. Kansas City created pedestrian level-of-service criteria that measured directness, continuity, street crossings, visual interest and amenities, and security.

While evaluation techniques varied by the level of analysis (citywide, neighborhood, district) and from methods used for project- or site-specific developments, all the evaluations considered these five basic pedestrian levels of service criteria. The city then adjusted the minimum standard for each criteria according to the specific pedestrian needs of each area, based on input from City of Kansas City Departments of Planning and Development and Public Works, public opinion, and professional practice. Citywide evaluations used crime data to determine safety levels and geographic-information-system (GIS) maps to evaluate the directness and continuity of the municipal sidewalk network. Neighborhood and district evaluations relied on community surveys and walking audits to measure existing conditions and needs for the five pedestrian LOS criteria.

Pedestrian LOS criteria for project- and site-specific developments are measured with ratios and checklists clarified by the project boundaries. For instance, directness is based on a ratio of the actual distance from trip origin to trip destination divided by the minimum distance between those two points for locations and routes within the project area. Kansas City's Walkability Plan then recommended that traffic-impact studies, required for significant proposed developments, be modified to include a pedestrian-impact assessment using the city's pedestrian LOS criteria. Incorporating a pedestrian traffic-impact analysis into traffic-impact studies would promote consideration of pedestrian mobility in design plans and pedestrian-impact mitigations in proposals. It would also provide the city with the legal authority to require pedestian improvements to serve the development.[2]

Professional Consensus

- In the absence of official guidance from national associations or governmental organizations, cities are turning to best practices employed by other municipalities.

Examples

Other cities that have created their own pedestrian level-of-service criteria include:

- Charlotte, NC
- Fort Collins, CO
- Kansas City, MO
- Montgomery County, MD

1. Transportation Research Board of the National Academies. HCM2010: Highway Capacity Manual. Volume 3: Interrupted Flow. Chapter 17: Urban Street Segments. December 2010. 17–50.
2. City Planning & Development Department. Walkability Plan. City of Kansas City, Missouri. March 20, 2003. http://www.kcmo.org/idc/groups/cityplanningdevelopmentdiv/documents/cityplanninganddevelopment/walkability.pdf

Analyze **Person Delay** Instead of Vehicle Delay

Definition In Highway Capacity Manual (HCM) traffic analysis, "person delay" is defined as the total time required to move individuals, as opposed to their vehicles, through a particular lane of an intersection. This approach to analyzing traffic through intersections is more transit- (and pedestrian-) friendly than measuring vehicle delay.

Benefits

- Helps give people an alternative to cars for personal travel
- Captures the overall impact of a project and its mitigation strategies on travelers, regardless of their mode of travel
- Creates an evaluation method that better recognizes the efficiencies of transit, potentially allowing a bus lane to be a mitigation for the traffic impacts of a proposed development
- Helps justify transportation improvements toward transit-friendly designs

Considerations

- Calculating person-delay is not traditionally done in HCM traffic-analysis procedures, and isn't calculated automatically by Highway Capacity Software[1]

Appropriate Contexts

- The environmental-review process for proposed actions that might change the roadway capacity for surface transit (buses):
  - Any proposed action, or its mitigation, that might increase surface transit capacity (e.g., a bus-rapid-transit project that might dedicate a traffic lane exclusively to buses)
  - Any proposed mitigation that might reduce traffic capacity on a street accommodating bus service

Guidance

- Calculate person delay by multiplying the highway capacity software-derived volumes for each vehicle type by vehicle occupancy (e.g., bus passengers), and then by the intersection-based average vehicle delay in each lane group
- In the absence of bus-lane delay calculation in Highway Capacity Software, measure delay from the right-turn lane, since right turns originate from the bus lane in a typical configuration
- Multiply person delay for people traveling in cars using the average vehicle occupancy of cars in that corridor; work trips are about 1.1 or 1.2 people per vehicle while other trip types are closer to 2.0

Professional Consensus

- The 2010 Best Practices in the Use of Micro Simulation Models report prepared by AECOM for AASHTO highlighted calculation of person delay as a desired feature of micro-simulation models[2]
- The 2008 NCHRP Report 618, Cost-Effective Performance Measures for Travel Time Delay, Variation, and Reliability, recommends mobility and reliability measures that include factors "using units such as persons"[3]
- Volume IV of the 2007 FHWA Traffic Analysis Toolbox, Guidelines for Applying CORSIM Microsimulation Modeling Software, lists person delay within its selection of potential measures of effectiveness for project analysis[4]

Examples

- New York, NY: City Environmental Quality Review
- Santa Monica, CA: Comprehensive plan update

Bus passengers in New York, NY. *Source: Noah Kazis, Streetsblog New York, streetsblog.org*

Case Study: New York

New York City Department of Transportation (NYCDOT) wanted to create a transit-friendly review process for proposed projects that better recognized the transportation efficiency of buses. So NYCDOT worked with the Mayor's Office of Environmental Coordination to require person-delay calculations for proposed transportation or land-use projects that affect bus lanes.

The new requirements were written into the 2010 City Environmental Quality Review (CEQR) manual[5] and carried into the 2012 CEQR manual. The manual also specified that if a bus lane decreases the person delay at an intersection, adding a bus lane can be used to mitigate a project's potential traffic impacts.[6] The new evaluation criteria gave both developers and the City a more nuanced means of judging the potential impacts and benefits of proposed projects.

The NYCDOT calculates person delay for transit riders by using intersection-based average vehicle delay and multiplying it by the number of vehicle occupants passing through that intersection. To determine the existing number of transit passengers traveling through an intersection, the NYCDOT first figures out the number of buses operating on that street. In New York City, MTA New York City Transit (NYCT) and/or MTA Bus schedules are publicly available. The information specifies how many buses on each route travel through the intersection during the analysis hours. The number of buses on each route is then multiplied by the average number of passengers on that route at that time. Occupancy should be determined for each route, as ridership levels may vary by route. NYCT and MTA Bus occupancy levels can be found from recent ride checks or point checks. The frequency and types of other buses should also be measured during analysis hours.[7]

The number of passengers should be multiplied by the average vehicle delay experienced by the lane group in which the bus is traveling. In the build case, the projected number of buses per hour by route should be multiplied by the projected average number of passengers on that bus by route. That number of passengers should then be multiplied by the average vehicle delay experienced by the lane group in which the bus will be traveling. To calculate the person delay for general vehicle traffic, multiply the average vehicle delay for each lane group by an estimate of vehicle occupancy, which can typically be obtained from a metropolitan planning organization or by observation.[8]

1. Federal Highway Administration. 6.0 Comparison of Highway Capacity Manual (HCM) and Simulation. http://ops.fhwa.dot.gov/trafficanalysistools/tat_vol1/sect6.htm
2. Sbayti, Hayssam; Roden, David. Best Practices in the Use of Micro Simulation Models. Prepared for AASHTO Standing Committee on Planning. March 2010 http://statewideplanning.org/wp-content/uploads/259_NCHRP-08-36-90.pdf
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5. The City of New York Mayor's Office of Environmental Coordination. Chapter 16: Transportation. 2010 CEQR Technical Manual. http://www.nyc.gov/html/oec/downloads/pdf/2010_ceqr_tm/2010_ceqr_tm_ch16_transportation.pdf
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7. Beaton, Eric. NYCDOT Director of Transit Development. Personal correspondence. October 4, 2011.
8. Ibid

Daylighting

Definition To "daylight" an intersection is to clear sight lines between pedestrian crossings and oncoming cars, usually by creating no-parking zones at the curbs in front of crosswalks at that intersection.

Benefits

- Improves drivers' sight lines of pedestrians waiting at intersection curbs, particularly of children and people in wheelchairs who are blocked from view by parked cars
- Improves visibility between pedestrians and drivers making turns
- Improves pedestrians' sight lines of approaching cars, allowing them to make eye contact with drivers from the sidewalk

Considerations

- Decreases the amount of available curbside parking
- Removing on-street parking could increase vehicle speeds

Appropriate Contexts

- Intersections where pedestrian crashes are common
- Intersections where no sidewalk exists or sight lines are poor
- Intersections where parked vehicles next to the crosswalk block sight lines
- Intersections near schools

Guidance

- Install no-parking signs to mark the existence and length of no-parking zones
- Daylight at least 20' (about one parking space) from the crosswalk at the near and far side of the intersection on urban streets with 20–30 mph speed limits[1]
- Daylight at least 50' (about two parking spaces) in advance of crosswalks at each intersection approach on streets with 35–45 mph speed limits[2]
- Daylight at least 30' in advance of each signal, stop sign, or yield sign[3]
- Prohibit drivers from standing or parking vehicles at the curb within 20' of a crosswalk at an intersection or within 30' of any signal, stop or yield sign, or traffic-control signal[4]
- Evaluate impacts of daylighting by collecting crash data

Professional Consensus

- Parking setbacks are included in AASHTO guidelines

Examples

- New York, NY
- Hoboken, NJ

Daylighting at the intersection of Third Avenue at Union Street, Brooklyn, NY.
Source: The Consumerist, Flickr

1. American Association of State Highway and Transportation Officials. Geometric Design of Highways and Streets. 2004. 52
2. Ibid.
3. Ibid.
4. Federal Highway Administration. 56. Remove/Restrict Parking. Other Measures. n.d. http://safety.fhwa.dot.gov/saferjourney/library/countermeasures/56.htm

Raised Crosswalks

Definition A raised crosswalk is a higher section of pavement with a marked crosswalk. It is placed across the street to encourage drivers to slow down. Raised intersections usually have sloped ramps for the driver leading and following the flat raised-crosswalk section.

Benefits

- Improves pedestrian safety
- Reduces vehicle speeds
- Increases pedestrian visibility
- Eliminates the need for a separate curb ramp
- Resolves the accessibility challenges of narrow sidewalks

Considerations

- Possible discomfort when driving over raised crosswalks or intersections
- May not be appropriate for emergency routes, bus routes, or high-speed streets
- May not be appropriate at signalized intersections where prevailing speeds are too fast for crosswalk treatment
- Difficult for snow removal

Appropriate Contexts

- Minor collector or residential streets with moderate traffic
- Alleys and shared public ways
- Intersection of low-volume and high-volume streets, such as local access lanes of multi-way boulevards
- Where a street changes its function or street type[2]

Guidance

- Construct a 10–15' plateau 2–3" shorter than sidewalk level with straight 6' ramps on either side
- Consider drainage: relocate catch basins, install trench drains or drainage pipes where necessary
- Install ADA ramps and detectable warnings (truncated domes) at the street edge for people with vision impairments
- Incorporate proposed PROWAG accessibility guidelines into design
- Highlight crosswalks with smooth, colored roadway surface materials rather than textured materials to ensure universal access[3]
- Evaluate impacts of daylighting by collecting crash data

Professional Consensus

- A recommended countermeasure within the FHWA's Pedestrian Safety Guide and Countermeasure Selection System
- A recommendation of the February 2010 International Technology Scanning Program, sponsored by the Federal Highway Administration, the American Association of State Highway and Transportation Officials, and the National Cooperative Highway Research Program

Examples

- San Francisco, CA
- Cambridge, MA
- Boulder, CO

Raised crosswalk on Water Street, in downtown Harrisonburg, VA. *Source: thanh.ha.dang, Flickr*

1. San Francisco Planning Department. The Better Streets Plan. December 2010 p. 5-8. http://www.sf-planning.org/ftp/BetterStreets/docs/FINAL_5_Street_Designs.pdf
2. David Kent Ballast Architectural Research Consulting. Initiative on Dimensional Tolerances in Construction Dimensional Tolerances for Surface Accessibility Final Report. Access Board Research. January 2011. 1.1.6. http://www.access-board.gov/research/tolerances/final-report.htm

Pedestrian **Crossing Islands**

Definition Located on the roadway between opposing lanes of traffic, pedestrian crossing islands separate pedestrians from vehicles at intersections or mid-block locations. They are typically raised medians or islands, though lower-cost versions can be made of pavement markings only. Crossing islands can also be referred to as center islands, refuge islands, or pedestrian islands.

Benefits

- Reduces pedestrian crashes by up to 46% at marked crosswalks[1]
- Reduces motor vehicle crashes by up to 39% at unmarked crosswalks[2]
- Provides pedestrians a safe place to stop midway across the road
- Increases visibility of pedestrian crossings, particularly at unsignalized crossings[3]
- Provides a cost-effective option to curb extensions because drainage problems are not as common in the center of the roadway
- Helps lower vehicle speeds approaching pedestrian crossings
- Provides space for supplemental signage on multilane roadways

Considerations

- Balancing competing needs within a limited roadway width
- Crossing islands at intersections or near driveways may affect left-turn access[4]
- Crossing islands may affect operations of wide-load vehicles[5]

Appropriate Contexts

- Marked and unmarked crosswalks adjacent to transit stops, between pedestrian origins and destinations, and in areas with significant foot traffic
- Areas with many school children, seniors, or other vulnerable pedestrians
- Multilane roadways in urban and suburban areas
- Intersections with significant numbers of pedestrian and vehicles traveling at high speeds

Guidance

- Provide pedestrian crossing islands through the crosswalk where medians are present or space exists
- Build islands at least 4' in width (preferably 8') and of adequate length and width for the anticipated number of pedestrians[6]
- Design islands with level cut-through foot paths for ADA accessibility
- Provide detectable warnings (truncated domes) at each edge of the island cut-through area for ADA accessibility
- Highlight islands with signs, striping, and reflectors

Professional Consensus

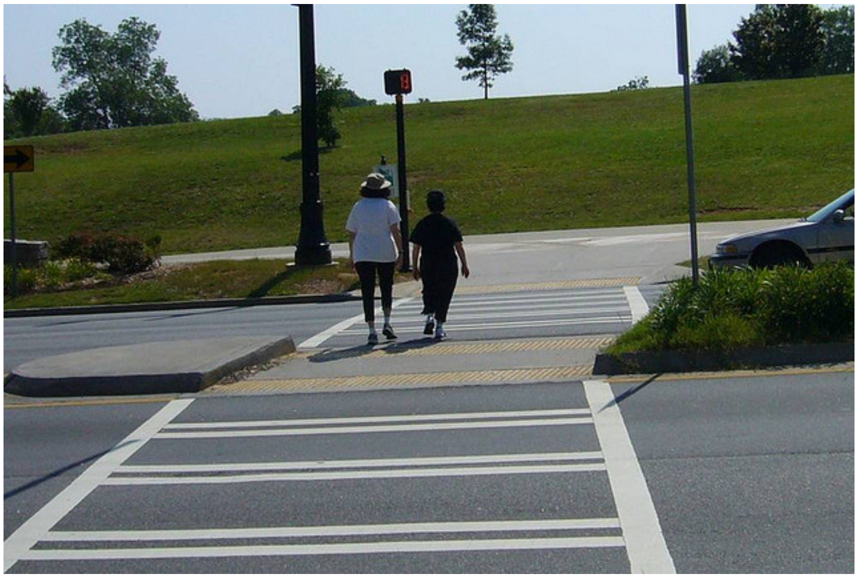
- The Federal Highway Administration (FHWA) Office of Safety includes medians and pedestrian crossing islands in their list of Proven Safety Countermeasures[7]

Examples

The FHWA is promoting wide-spread integration of median and pedestrian crossing islands into state practices. States that have adopted the countermeasure include:[8]

- Florida DOT
- New York DOT
- Oregon DOT

Examples of pedestrian crossing islands.
Source: Above, PEDS.org, Flickr; Center, Richard Drdul, Flickr; Below, PEDS.org, Flickr



1. Federal Highway Administration Office of Safety. Proven Safety Countermeasures. Medians and Pedestrian Crossing Islands in Urban and Suburban Areas. http://safety.fhwa.dot.gov/provencountermeasures/fhwa_sa_12_011.htm
2. Ibid.
3. Ibid.
4. Federal Highway Administration Office of Safety. Traffic Calming. 25: Crossing Islands. http://safety.fhwa.dot.gov/saferjourney/library/countermeasures/25.htm
5. Federal Highway Administration Office of Safety. Pedestrian Countermeasure Policy Best Practice Report. http://safety.fhwa.dot.gov/ped_bike/tools_solve/fhwasa11017/
6. Federal Highway Administration Office of Safety. Proven Safety Countermeasures. Medians and Pedestrian Crossing Islands in Urban and Suburban Areas. http://safety.fhwa.dot.gov/provencountermeasures/fhwa_sa_12_011.htm
7. Federal Highway Administration Office of Safety. Memorandum: Promoting the Implementation of Proven Safety Countermeasures. January 12, 2012 http://safety.fhwa.dot.gov/provencountermeasures/pc_memo.htm
8. Federal Highway Administration Office of Safety. Pedestrian Countermeasure Policy Best Practice Report. http://safety.fhwa.dot.gov/ped_bike/tools_solve/fhwasa11017/

Offset Crosswalks

Definition An offset crosswalk is one with a center median that acts as both a pedestrian safety island and means of directing pedestrians to look toward oncoming traffic before crossing the second half of the street.

Benefits

- Orients pedestrians toward oncoming traffic so they are more likely to notice it
- Reduces unprotected pedestrians trapped in the middle of the street
- Improves driver yield-to-pedestrian compliance

Considerations

- Pedestrians might resist following the slightly longer path across the street
- Additional installation costs for longer crossing route
- Accommodating offset crosswalks within limited roadway width

Appropriate Contexts

- Signalized and unsignalized crossings on multilane roadways
- Mid-block and intersection crossings

Guidance

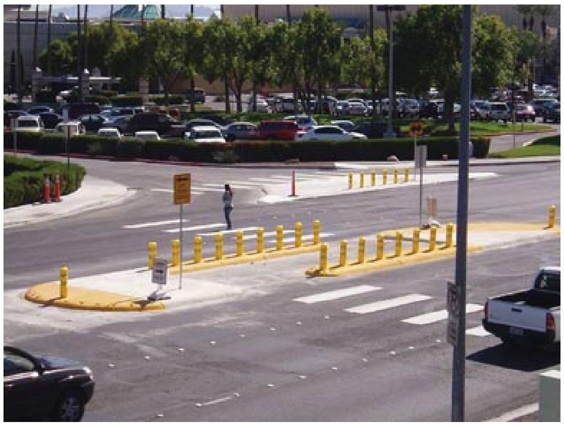
- The crosswalk offset can be a right angle or skewed depending on site conditions
- Design islands with level cut-through foot paths for better ADA accessibility
- Provide detectable warnings (truncated domes) at the each edge of the island cut-through area for better ADA accessibility
- Include a section of parallel curbing that is aligned with the direction of the crosswalk to redirect a blind or visually impaired pedestrian[4]

Professional Consensus

- Recommended within the February 2010 International Technology Scanning Program, sponsored by the Federal Highway Administration, the American Association of State Highway and Transportation Officials, and the National Cooperative Highway Research Program[1]
- Endorsed within FHWA's Pedestrian Safety Countermeasure Deployment Project when used with high-visibility crosswalks and yield to pedestrian signs[2]
- While MUTCD does not specifically recommend offset crosswalks, it does provide guidance for pedestrian barriers at offset crosswalks that act "as passive devices that force users to face approaching [trains] before entering the trackway."[3] The MUTCD also includes offset pedestrian crosswalks in its recommended roundabout configurations[4]

Examples

- Las Vegas, NV


Offset crosswalk with high visibility crosswalk markings in Las Vegas, NV. *Source: Federal Highway Administration, United States Department of Transportation*


Offset crosswalk in Bethesda, MD. *Source: Gerard Soffian*

1. Fischer, Edward L.; Rousseau; Gabe K.; Turner, Shawn M.; Blais, Ernest (Ernie) J.; Engelhart, Cindy L.; Henderson, David R.; Kaplan, Jonathan (Jon) A.; Keller, Vivian M. (Kit); Mackay, James D.; Tobias, Priscilla A.; Wigle, Diane E.; Zegeer, Charlie V. Pedestrian and Bicyclist Safety and Mobility in Europe. 2010. http://www.international.fhwa.dot.gov/pubs/pl10010/pl10010.pdf
2. Federal Highway Administration. Pedestrian Safety Countermeasure Deployment Project. 2002–2012. http://safety.fhwa.dot.gov/ped_bike/tools_solve/ped_scdproj/index.cfm
3. Federal Highway Administration. Manual on Uniform Traffic Control Devices on Streets and Highways. December 2009. 780. http://mutcd.fhwa.dot.gov/pdfs/2009/mutcd2009edition.pdf
4. Federal Highway Administration. Manual on Uniform Traffic Control Devices on Streets and Highways. December 2009. 399–413. http://mutcd.fhwa.dot.gov/pdfs/2009/mutcd2009edition.pdf

High-Visibility Crosswalks

Definition Crosswalk markings provide guidance for pedestrians crossing roadways by defining the appropriate paths for them. While basic crosswalk markings consist of two transverse lines, an FHWA study found that continental markings were detected at about twice the distance upstream as the transverse markings during daytime conditions. In the study, this increased distance meant that drivers traveling at 30 mph had eight additional seconds of awareness of crossing pedestrians.[1]

Benefits

- Increases visibility of pedestrian crossing paths
- Discourages drivers from encroaching into crosswalks

Considerations

- Funding for markings
- Funding for ongoing maintenance

Appropriate Contexts

- Intersections with conflicts between vehicular and pedestrian movements
- Areas with lots of foot traffic, such as loading islands, midblock pedestrian islands
- Commercial business districts

Guidance

- For continental, or ladder markings, stripe the longitudinal lines within between 12" to 24" in width and separated by gaps of 12" to 60"[2]
- For bar pair markings, stripe two 8" stripes separated by 8" to form a 24" wide bar pair. Separate pairs by gaps of 24" to 60"[3]
- Some pedestrians with low vision prefer ladder markings, which help them follow the crosswalk better, particularly where bar pairs are widely separated
- Place markings to avoid the wheel paths of cars
- Extend crosswalks to the edges of the roadway or intersecting crosswalk
- Stripe crosswalks to encompass curb ramps
- Use inlay tape and thermoplastic tape rather than paint: Inlay tape works for new and resurfaced pavement; thermoplastic works for rougher surfaces[4]
- Avoid using contrasting materials like brick to create higher visibility. These materials cost much more to maintain, but are not highly visible—particularly at night, in the rain, and over time as they lose contrast with the surrounding street

Professional Consensus

- An FHWA-sponsored Crosswalk Marking Field Visibility Study recommended including bar pairs in the MUTCD and making bar pairs or continental the default crosswalk markings for all crosswalks across roadways not controlled by signals or stop signs. The MUTCD adopted these recommendations in January 2011[5]

Examples

Many cities are expanding the use and variety of high-visibility crosswalk markings, including:

- Boston, MA
- Charlottesville, VA
- Salt Lake City, UT

Bar-pair high-visibility crosswalk markings across International Boulevard in SeaTac, WA. *Source: Oran Viriyincy, Flickr*

1. Federal Highway Administration. Crosswalk Marking Field Visibility Study (FHWA-HRT-10-068). October 2010. http://www.fhwa.dot.gov/publications/research/safety/pedbike/10067/index.cfm
2. National Committee on Uniform Traffic Control Devices on Streets and Highways. Markings No. 1. January 2011. https://ceprofs.civil.tamu.edu/ghawkins/MTC-Files/2011-06_Meeting/Marking_No.1.pdf
3. Ibid.
4. Pedestrian and Bicycle Information Center. Crosswalks. n.d. http://www.walkinginfo.org/engineering/crossings-crosswalks.cfm
5. National Committee on Uniform Traffic Control Devices on Streets and Highways. Markings No. 1. January 2011. https://ceprofs.civil.tamu.edu/ghawkins/MTC-Files/2011-06_Meeting/Marking_No.1.pdf