FHWA Bicycle and Pedestrian Program Resources

https://www.fhwa.dot.gov/environment/bicycle_pedestrian/resources/
Planning and Design

- Small Town and Rural Multimodal Networks
- Achieving Multimodal Networks
- Guidebook for Developing Pedestrian and Bicycle Performance Measures
- Separated Bike Lane Planning and Design Guide
- Incorporating On-Road Bicycle Networks into Resurfacing Projects
- Pursuing Equity in Pedestrian and Bicycle Planning
- Bike Network Mapping Idea Book
Small Town and Rural Multimodal Networks

Why a Rural and Small Town Focused Guide?

• Different Types of Facilities
• Key Opportunities
Though in many rural communities, residents live long distances from services, most small towns provide a compact center well-suited for walking and bicycling trips.
Mixed Traffic Facilities

- **Advisory Shoulder**
- **Bicycle Boulevard**
- **Yield Roadway**
Visually Separated Facilities

Paved Shoulder

Bike Lane
Physically Separated Facilities

Shared Use Path

Sidewalk

Sidepath

Separated Bike Lane
Yield Roadway

A yield roadway is designed to serve pedestrians, bicyclists, and motor vehicle traffic in the same slow-speed travel area. Yield roadways serve bidirectional motor vehicle traffic without lane markings in the roadway travel area.
Yield Roadway

Yield roadways can effectively serve local travel needs, fulfill aesthetic preferences, and is a common form for low-volume local roads. When opening at very low volumes and at slow speeds, pedestrians and bicyclists are comfortable with the travel area of the roadway. Yield roadways are designed with narrower road and sidewalk dimensions to promote local access and community vitality.

For more information on related roadway types, refer to sections on Slow Streets and Shared Streets in Livable Multimodal Transportation 2036.

GEOMETRIC DESIGN

TWO-WAY TRAVEL LANE

The paved box-way travel lane should be narrowed to encourage slow travel speeds and reduce conflict yielding when vehicles traveling in opposite directions meet:

- Total travel way width may vary from 12’ (3.6 m) to 16’ (4.8 m).
- The travel way width below 16’ (4.8 m) or less should be for a yield box single-lane roadway and should follow the guidance of the AASHTO Lane Volume Roads 2001.

**Figure 2.1:** A travel way width of 14’-14’-4” (4.3 m) x 4.3 m is appropriate for low volumes of weekday traffic and may require slowing when vehicles traveling in opposite directions meet. A travel way area of 14’-14’-4” (4.3 m) or less is the standard for motor vehicle traffic, which reduces vehicle noise and pollution.

**Figure 2.2:** A travel way width of 16’-16’-4” (4.8 m) x 4.8 m is appropriate for low volumes of weekend traffic and may require slowing when vehicles traveling in opposite directions meet. A travel way area of 16’-16’-4” (4.8 m) or less is the standard for motor vehicle traffic, which reduces vehicle noise and pollution.

16-20 HS-6-60-M Designers should provide a parking area with every 200-300 ft. (61-91 m) to allow for traffic volume and meet parking requirements.

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ROADSIDE

If needed, parking may be located on the paved roadway surface or on gravel or dirt shoulders outside of the paved roadway. The parking lane may also be on the paved roadway surface or in a paved sidewalk area.

When possible, the parking lane should be constructed with a decorative material that matches the design of the lane from the travel area. Blown-in, crushed stone, gravel and burl should be used as decorative materials for the travel area (AASHTO Green Book 2018, p. 4-118).

**Figure 2.3:** A travel way width of 14’-14’-4” (4.3 m) x 4.3 m is appropriate for low volumes of weekday traffic and may require slowing when vehicles traveling in opposite directions meet. A travel way area of 14’-14’-4” (4.3 m) or less is the standard for motor vehicle traffic, which reduces vehicle noise and pollution.

**Figure 2.4:** A travel way width of 16’-16’-4” (4.8 m) x 4.8 m is appropriate for low volumes of weekend traffic and may require slowing when vehicles traveling in opposite directions meet. A travel way area of 16’-16’-4” (4.8 m) or less is the standard for motor vehicle traffic, which reduces vehicle noise and pollution.

IMPLEMENTATION

In rural communities with a discontinuous street network, local streets are the only viable connection to a service of an emergency. Implementing sponsors should work closely with emergency response stakeholders.

Yield roadways allow motor vehicles, bicyclists, and pedestrians to share the space. On very low-volume and low-speed streets, pedestrians and bicyclists may accommodate using this roadway with the occasional vehicle. If this facility is intended for use by pedestrians, it must have accessibility guidelines for walkers.
CASE STUDY | YIELD ROADWAY
Manzanita, Oregon

PROJECT DESCRIPTION

COMMUNITY CONTEXT
Manzanita is a quiet, peaceful village surrounded by the natural beauty of the Pacific Ocean, Netarts Bay, and private forests. The Manzanita area is home to 7,000 full-time residents in the summer, and the population swells to 2,500 to 3,000.

KEY DESIGN ELEMENTS

The standard city residential street is 20 ft wide paved with asphalt and with a crosswalk gutter along one side.

ROLE IN THE NETWORK
Manzanita’s local streets connect residences with the ocean parks, and downtown. The ability to use these shared local streets allows people walking or on bikes to access all parts of the area.

FUNDING

The key aspect of this treatment is that it required funding beyond what is currently used to maintain the local streets. The City maintains the streets that have been brought up to city standards. So, any streets that have not been brought up to City standards are maintained by the adjacent property owners. There are some streets within the City that are County roads maintained by Tillamook County.

For more information refer to the City of Manzanita website: http://www.manzanita.or.us/

FOOTNOTES

1. Very low volume local roads are typically used by people who are familiar with the roads. These roads are used by both motorists and pedestrians that may or may not be familiar with the road. They are not considered to be a safe and consistent location that contributes to the quality of life, and which are harmonious with the coastal environment.

WORKS CITED


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Achieving Multimodal Networks

A resource for practitioners seeking to build multimodal networks.

- 24 design topics
  - 12 focus on design flexibility
  - 12 focus on measures to reduce conflicts between modes
PART 1: APPLYING DESIGN FLEXIBILITY

• Design Criteria and Lane Width
• Intersection Geometry
• Traffic Calming and Design Speed Transitions to Main Streets
• Road Diets and Traffic Analysis
• Enhanced Crossing Treatments
• Signalized Intersections
• Paved Shoulders
• Separated Bike Lanes
• Bus Stops
• Bridge Design
• Slow Streets
PART 2: REDUCING CONFLICTS

• Network Connectivity
• School Access
• Multimodal Access to Existing Transit Stations
• Multimodal Access to New Transit Stations
• Transit Conflicts
• Freight Interaction
• Accessibility
• Turning Vehicles
• Separated Bike Lanes at Intersections
• Shared Use Paths
• Midblock Path Intersections
• Shared Streets
TRANSPORTATION networks in all land use settings enable people to walk, bike, and/or take transit to and from their destinations. A single trip may consist of using multiple transportation modes, for example walking to a bus stop, riding the bus downtown, and bicycling the last half mile to the office or bike share. Each transportation mode should operate safely and efficiently without negatively impacting others.

Transit conflicts can be a brutal toll. This design topic focuses on conflicts between transit vehicles, such as buses and streetcars, and vulnerable road users, such as pedestrians, bicyclists, and pedestrians accessing bus stops. These principles and strategies can be applied to other modes such as bus rapid transit, subways, or heavy rail stations.

Conflicts between transit vehicles and vulnerable road users can consist of a bus passing a stop by crossing a standard bike lane, a bicyclist traveling across or along rail tracks, or a pedestrian or bicyclist passing a bus stop with waiting passengers. Conflicts also occur between pedestrians and motor vehicles when accessing or departing from a bus stop.

Transit conflicts may be addressed through designs that clearly delineate the path for each mode and maximize predictability between users.

**COMMON USERS IN CONFLICT AND TYPICAL CRASH TYPES**

**GUIDING PRINCIPLES TO REDUCE CONFLICTS**

**SAFETY**
Roadways should allow safe operation of transit vehicles and vulnerable road users by minimizing potential crashes.

**ACCOMMODATION AND COMFORT**
The design should provide a sense of comfort to vulnerable road users and transit passengers while accommodating transit operations.

**COHERENCE**
The path of travel for each mode should be clearly delineated through design, pavement markings, and signs.

**PREDICTABILITY**
The design should create predictable behaviors that allow transit vehicles, motorists, bicyclists, and pedestrians to have clear right-of-way assignments.

**CONTEXT SENSITIVITY**
Designs should respond to typical users and conflict types in a manner that complements community character and supports community health, economic, and liability goals.

**EXPERIMENTATION**
Designers should consider innovative solutions to reducing bicycle hazards at streetcar tracks.
**Network and Bike Use**

**Bus Stop Placement**

**Bus Stop Placement**

Bus stop placement is a key component of reducing conflicts between bus passengers, pedestrians, bicyclists, and motorists. Bus stops should be located at appropriate distances based on the context of the area. For example, bus stops in central business districts are less than 400 feet. Bus stops should complement the sidewalk and bicycle facilities to connect passengers with the surrounding pedestrian and bicycle networks. At intersections, bus stops can be provided on the near- or far-side of the intersection. Bus-side bus stops are preferred when feasible as they allow passengers to exit the bus without crossing the street.

**CONSIDERATIONS**

- Consider the use of the best track surface material for safe bicycle travel, especially when the surface may be regularly wet.
- Consider reducing the flange way or using a flange way filler product.
- Provide pavement markings such as bike lane lines, bike symbols, and green colored pavement surfaces to direct bicyclists to follow the tracks between 60 and 90 degrees to reduce the risk of getting bicycle tires caught in the tracks.
- (AASHTO Guidebook 2012, p. 4-10)
- Consider a median to force deflection of bicyclists to cross the tracks at the appropriate angle and prevent illegal parking by motorists.
- Provide advance track warning signs to alert bicyclists of the tracks ahead.
CASE STUDIES

DIRECTING BIKES ACROSS STREETCAR TRACKS
BOSTON, MA

With the number of bicyclists increasing in Boston, the City has seen an increase in bicycle crashes resulting from the presence of in-street rail lines. The City decided to address the issue of bicyclist interaction with in-street rail through pavement markings and green-colored pavement. At intersections where track angles were creating challenges for bicyclists, dashed white lane lines with green colored pavement were added to help bicyclists position themselves to cross the tracks at near 90-degree angles.

Boston also has streetcars that run along the center of streets that are too narrow for exclusive bike lanes. To encourage bicyclists to stay in the right lane, the City installed shared lane markings and left-turn queue boxes to assist bicyclists in making left turns.

FLOATING BUS STOP
SEATTLE, WA

The City of Seattle has installed bus stop floating islands at a majority of bus stops along Dexter Avenue, a major bicycle commuting corridor that has peak bicycle volumes of over 300 bicyclists per hour. This 1.5-mile corridor carries buses at 10 minute headways during peak periods. The bus stop floating islands allow buses to stop in lane, decreasing bus delay and allowing buses to easily re-enter traffic without waiting for a gap in passing motorists. The buffered bike lane is routed behind the bus stop, which prevents conflicts between bicyclists and stopped buses. The bus stop floating islands are accessible, with curb ramps and detectable warning surfaces. Some of the bus stops include sidewalks across the back of the bus island to encourage pedestrians to cross the bike lane at a designated point.

FOR MORE INFORMATION

Federal Highway Administration. Separated Bike Lane Planning and Design Guide. 2015.
Guidebook for Developing Pedestrian and Bicycle Performance Measures

Documents ways that walking and bicycling investments, activity, and impacts can be measured.

• Highlights data requirements and examples of communities that are currently using the respective measures.
• Links transportation investments to community goals.
• A resource for communities as they develop a performance management strategy.
Performance Measures

- Access to Community Destinations
- Access to Jobs
- Adherence to accessibility laws
- Adherence to traffic laws
- Average travel time
- Average trip length
- Connectivity length
- Crashes
- Crossing Opportunities
- Delay
- Density of Destinations
- Facility Maintenance
- Job creation
- Land consumption
- Land value
- Level of service
- Miles of pedestrian/bicycle facilities
- Mode split
- Network completeness
- Pedestrian space
- Person throughput
- Physical activity and health
- Population served by walk/bike/transit
- Retail impacts
- Route directness
- Street trees
- Transportation disadvantaged population served
- User perceptions
- Vehicle miles traveled impacts
- Volume
VEHICLE MILES TRAVELED (VMT) IMPACTS

The measurement of miles traveled by vehicles in a specific location for a specific period of time. Total VMT has impacts on emissions levels and air quality, which impact public health.

CONTEXT

PERFORMANCE MEASURE APPLICATION

PROJECT PRIORITIZATION
Anticipated VMT changes can be calculated for projects and used to rank transportation investments.

ALTERNATIVES COMPARISON (POSSIBLE)
A project's impact on VMT may depend on scaling mode split and changes to the transportation network.

SCENARIO EVALUATION
Measuring VMT at a macro level under various planning scenarios helps describe impacts and benefits.

BENCHMARKING
Annual reporting of VMT will help a transportation agency understand changes in net new or net reduction of vehicle trips.

STANDARD
Using VMT impact to measure a project's impacts focuses on net new vehicle trips rather than delay or capacity.

RELATED MEASURES

Average Travel Time
Average Trip Length
Density of Destinations
Mode Split
Person Throughput
Volume

DATA NEEDS & SOURCES

ROADWAY CHARACTERISTICS (e.g., segment length)
Daily traffic volume through counts or from local jurisdiction
To estimate VMT for projects and land use scenarios; access sketch model or regional or State travel demand model
State DOT, MPO, and the FHWA Office of Highway Policy Information may have relevant data.

PEERS TRACKING THE MEASURE

Memphis MPO – The Long Range Transportation Plan goal related to congestion mitigation performance measures that track whether the number of vehicle miles traveled annually is decreasing per capita and whether the number of work commute trips made by bicycling, walking, or transit is increasing.

State of California – New draft CEQA guidelines from the Governor’s Office of Planning and Research require that environmental review of transportation impacts is measured by changes to VMT, not automobile level of service.

Denver Regional Council of Governments – DRCOG’s Metro Vision 2050 Plan identifies a 10 percent reduction in VMT per capita by 2035.

Puget Sound Regional Council (Seattle, WA) – The Council’s Transportation 2030 refers to the VMT goal and target reduction established in state legislation: RCW 47.05.440 establishes statewide annual per capita reduction benchmarks for vehicle miles traveled, the legislation establishes the forecast baseline of statewide vehicle miles traveled of 75 billion by the year 2020, exempting trucks over 10,000 pounds, with a targeted reduction of 18 percent by 2030, 30 percent by 2035, and 50 percent by 2050.

NOTES

The Environmental Protection Agency’s Mixed-Use Trip Generation Model may be used to help estimate the trip generation impacts of mixed-use developments.

HOW TO TRACK

VMT is emerging as a strong metric for evaluating transportation impacts. Unlike intersection level of service analysis, VMT impacts focus on additional vehicle trips on the network, irrespective of existing congestion. Whereas traditional methods may discourage infill development, a focus on VMT actually encourages investment in areas that can take advantage of existing walk, bike, and transit infrastructure. “Trips, another obvious and useful measure of the quantity of travel, differs from VMT in length, making VMT a more convenient measure by which to combine the travel consisting of multiple trips made by many people.” A reduction in VMT also means fewer greenhouse gases and pollutants that are harmful to the environment and public health. FHWA’s Congestion Mitigation and Air Quality Improvement (CMAQ) Program supports multimodal projects and other efforts that contribute air quality improvements and provide congestion relief.

VMT can be calculated per capita, an average daily basis, in total, and/or on an annual basis. There are two approaches for calculating VMT:

1. Geographic boundary: use traffic counts to estimate the amount of vehicle travel that occurs within a given geographic boundary. This is the method used to develop the FHWA VMT data.

2. Trip generation: use a travel demand model to estimate the vehicle travel of residents living within a given geographic area. An alternative data source is household surveys. Travel model data can include trips produced by and/or attracted to an area, for all trip purposes (e.g., work, school, shopping, etc.).

A rural community may need to rely on a statewide travel model to estimate VMT.
Separated Bike Lane Planning and Design Guide

The what and why of separated bike lanes.

• Planning Separated Bike Lanes
  ✓ Location
  ✓ Funding, maintenance, outreach
  ✓ Evaluation
Separated bike lanes fill needs in creating low stress bicycle networks.
Planning: Choosing Locations

• Are cyclists already using corridor?
• Connect Origins and Destinations
• Improve connections for disadvantaged populations
• In context with on-street parking? Transit? Loading/unloading?
• Pilot projects with flex posts allow for adjustments after implementation.

*With newer, complex facility types, design tweaks can be expected and are not indicative of a failed design.*
Planning: Funding, Maintenance and Outreach

Figure 6

Separated Bike Lane OUTREACH

- Public Health and other related organizations
- Local Residents living on SBL corridor
- Local Businesses located on SBL corridor and local Business Improvement Districts
- Local Transit Agencies
- State or County Departments of Transportation
- Advocates for Persons with Disabilities
- SBL Advocacy Groups
- Local Maintenance Agencies and maintenance partners
- General Public including public education in SBLs
- Enforcement such as Police and Traffic Control Agencies

CASE STUDY

Sweeper Selection for Separated Bike Lane Maintenance

NARROW SWEEPERS LIKE THIS ONE CAN FIT INTO MOST SEPARATED BIKE LINES (Source: PeopleForBikes)
Project Evaluation

• Holistic Evaluation of Separated Bike Lanes

• Best Practices on Data Collection
Design Recommendations

1. Establish directional and width criteria
   • 1 or 2-way, bicycle volume, parking placement

2. Select forms of separation (parked cars, bollards, medians, etc.)
   • Based on street widths, cost, maintenance, motorized traffic volume + speed

3. Identify midblock design challenges and solutions
   • Loading zones, driveways, transit stops

4. Develop intersection design
   • Safe, within sight, guide and prompt
Incorporating On-Road Bicycle Networks into Resurfacing Projects

Recommendations for how roadway agencies can integrate bicycle facilities into their resurfacing program.
• Why Include Bicycle Facilities When Resurfacing?

• Resurfacing Process and Timelines

• Methods for Including Bikeways
  • Lane narrowing, roadway reconfiguration, parking removal

• Cost and Material Considerations

<table>
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<th>Initial Relative Cost</th>
<th>Lifespan (months)</th>
<th>Retroreflectivity</th>
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<td>Thermoplastic (sprayed)</td>
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<td>48 – 72*</td>
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<tr>
<td>Preformed Tape</td>
<td>4</td>
<td>36 – 96*</td>
<td>High</td>
</tr>
</tbody>
</table>

*Thermoplastic and tape have shortened lifespans in snowy areas where they are often damaged by snowplows.*
Pursuing Equity in Pedestrian and Bicycle Planning

1. Transportation equity-related terms in the context of pedestrian and bicycle planning.

2. Recent research findings related to the travel needs of traditionally underserved populations and the role of pedestrian and bicycle planning in addressing equity concerns.

3. Strategies, practices and resources to address bicycle & pedestrian planning inequities.
Bike Network Mapping Idea Book

Highlights ways that different communities have mapped their existing and proposed bicycle networks.
FHWA Bicycle and Pedestrian Program Resources

https://www.fhwa.dot.gov/environment/bicycle_pedestrian/resources/