NHDOT Bureau of Highway Design Multimodal Design Criteria

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Purpose

This document provides a framework for Department staff to follow in order to consider typical sections that provide access and safety for pedestrian, transit, bicycle and motor vehicle modes. Borrowing from concepts introduced by MassDOT’s Cross Section and Roadside Elements, FHWA’s Achieving Multimodal Networks and FHWA’s Small Town and Multimodal Networks Guide, this document will help the planner, designer, builder and maintainer of transportation facilities to identify the appropriate allocation of pedestrian, transit, bicycle and motor vehicle accommodation for the typical section available.

MassDOT observes that highway designers traditionally consider cross section formulation “from centerline out.” This method of planning, design and maintenance has generally resulted in the provision of highway facilities that meet adequate motor vehicle levels of service and safety based on objective criteria. The “centerline out” approach, however, rarely works to provide safety and accessibility for pedestrian, transit and bicycle travel. By the time the planner, designer or operator reach the periphery of the roadway with the “centerline out” approach, there is often no available right-of-way, too much environmental impact and too much cost to consider an equitable level of pedestrian, transit and bicycle accommodation.

By considering cross section formulation from “right-of-way edge to right-of-way edge” in the planning, design, construction and operation of the roadway, MassDOT’s framework overcomes the weaknesses associated with the centerline out approach that typically work against pedestrian, transit and bicycle safety and access. With a right-of-way edge to right-of-way edge approach, the planner, designer, maintainer and operator can more equitably evaluate the available resources to balance access and safety for each mode of travel. Within a finite footprint and funding, a right-of-way edge to right-of-way edge planning, design, construction and maintenance approach can consider the safety and access needs of all modes concurrently, thereby enabling a measure of access and safety for each mode of travel and providing a real choice of modes. This approach identifies four fundamental forms for cross section design. Depending
on traffic volume, speed, available resources and context, one of the forms may best optimize access and safety in some measure for all modes of traffic. The four cross section design forms are illustrated below:

**Form 1 - Shared Accommodation for Pedestrians, Bicyclists and Motor Vehicles**

![Form 1 - Shared Accommodation for Pedestrians, Bicyclists and Motor Vehicles](source: FHWA's Small Town and Rural Multimodal Networks Guide - River Road, Concord, New Hampshire)

Consider Shared Accommodation for Pedestrians, Bicyclists and Motor Vehicles when speeds are very low, or when severe funding, right-of-way or environmental constraints limit the feasibility of providing shoulders or sidewalks. Where severe constraints prevail, the highway environment often inherently includes elements such as narrow paved lane widths, irregular horizontal and vertical geometry, parked vehicles, fixed objects in close proximity to the pavement, frequent driveways and short blocks that may effectively serve to limit average traffic speeds along the highway.

**Form 2 - Separate Accommodation for Motor Vehicles and Shared Bicycle/Pedestrian Accommodation**

![Form 2 - Separate Accommodation for Motor Vehicles and Shared Bicycle/Pedestrian Accommodation](source: FHWA's Small Town and Rural Multimodal Networks Guide - US 3, Ashland, New Hampshire)

Consider Separate Accommodation for Motor Vehicles and Shared Bicycle/Pedestrian Accommodation in sparsely developed areas (such as rural natural, rural developed and suburban low density areas). This type of accommodation may be appropriate for areas with infrequent pedestrian activity. AASHTO recommends shoulders of at least 4-feet wide for separate bicycle accommodation and at least 5 feet wide for separate bicycle accommodation when curbing or guardrail is present. The AASHTO Guide for the Development of Bicycle Facilities suggests that a total usable paved lane width (including the shoulder) of over 14 feet generally provides adequate space for separate accommodation of motor vehicles and bicycles without requiring a passing motor vehicle to cross the solid centerline.
Consider Separate Pedestrian Accommodation and Shared Bicycle/Motor Vehicle Accommodation for densely developed areas (urban areas, suburban villages, town centers and rural villages) where right-of-way is constrained and speeds are low.

In the NH 47 illustration above, the total paved width to the left of the centerline is 13 feet wide and therefore not by itself adequate to provide the AASHTO minimum width required for separate motor vehicle/bicycle operation. In conjunction with, or in addition to, any AASHTO requirements, NH RSA 143-a requires that motorists leave at least 3 feet of clear space when passing a bicycle. For passing a bicyclist operating along the way, NH RSA 265:21 does not include an explicit specific exception to the prohibition of crossing a solid marked centerline. While the titles of 265:18 and 265:20 mention “highway markings,” there’s nothing explicit in the text of either statute about unbroken paint lines.

Form 4 - Separate Accommodation for Pedestrians, Bicyclists and Motor Vehicles

Separate Accommodation for Pedestrians, Bicyclists and Motor Vehicles to provide pedestrians with a sidewalk separated from the roadway by a raised curb and to provide bicyclists with designated space in the paved cross section. Consider Separate Accommodation for Pedestrians, Bicyclists and Motor Vehicles when traffic volumes and speeds are too high for pedestrian and bicycle access to the highway. Shared use of the cross section will still be required, for example, where pedestrians cross the roadway, where bicyclists prepare to make left turns or where the right portion of the roadway is otherwise inaccessible or unsafe for pedestrian or bicycle travel.
Other Innovative Models and Key Network Opportunities Toward Providing a Real Choice of Modes

Beyond the 4 fundamental forms to cross section design from MassDOT’s framework discussed above, FHWA’s Small Town and Rural Multimodal Networks Guide offers for various traffic conditions and contexts, specific models and key network opportunities that may provide safety and access for each mode of travel within the existing right-of-way and funding constraints. Many conventionally-trained highway engineers may have previously simply dismissed the access and safety needs of non-motorized users, citing “irresolvable” funding, environmental and space constraints. FHWA, however, provides real solutions and three unconventional sample models and opportunities selected from FHWA’s Guide follow:

Yield Roadway


The Yield Roadway uses no marked centerline within the travel area. Rather, an alternating two-way traffic lane designates priority space providing pedestrians and bicycles with access and safety. Shared pedestrian and bicycle space must in turn be shared by motor vehicles passing in opposite directions. Whether a Yield Roadway is actually marked as such or not, any roadway without adequate shoulders is essentially a Yield Roadway. When motor vehicles pass by pedestrians, the vehicle must temporarily operate toward the center of the road in order to allow safe and comfortable passage for a pedestrian, many of whom require the travel stability that only the paved surface offers. The behavior of a motorist using due care for the pedestrian would be the same even if the highway included a solid centerline not otherwise violable by RSA 265:22.

A total absence of striping in some contexts may contribute to a slow-speed operating environment where all modes of traffic may more safely and comfortably mix. Specifically with regard to the presence of a solid centerline marking, FHWA’s Small Town and Rural Multimodal Networks guide notes (page 2-24), that “trials conducted by Transport for London (TfL) show a statistically significant speed reduction effect of 5.4 mi/h–8.6 mi/h as a result of removing centerline markings on the roadway (TfL 2014). A four-year study from Wiltshire County (England) showed a 35 percent drop in motor vehicle crashes along 30 mi/h roadways where the centerline was removed (Wiltshire County Council 2014).”
Pedestrian Lane Solution

FHWA’s Guide further offers a “pedestrian lane,” which can provide an interim solution for pedestrian safety and access for a highway that is otherwise appropriate for a raised sidewalk. A pedestrian lane is a designated space on the roadway for the exclusive use of pedestrians. As with any sidewalk, bicycles must use the portion of the roadway designated for vehicles. The lane may be on one or both sides of the roadway and may fill critical gaps between destinations in a community. A marked pedestrian lane would have a maximum cross slope of 2%.

Hounsell Avenue, Gilford, New Hampshire provides interim Separate Pedestrian Accommodation and Shared Bicycle/Motor Vehicle Accommodation with virtually no construction and maintenance costs, which can be especially attractive to small New Hampshire towns that do not possess sidewalk clearing equipment.
Constrained Bridges Solutions

FHWA’s Small Town and Rural Multimodal Networks guide does not offer traffic speed and count threshold criteria for its Constrained Bridge models. The FHWA models, however, recognize the access and safety problems involved for all modes of traffic using narrow bridges regardless of traffic volumes and prevailing operating speeds and the models in many cases can potentially provide relief especially for pedestrians and a key network connection.

FHWA offers several solutions for accommodating pedestrian and bicycle traffic across constrained bridges, two of which are shown above left.

As shown from the FHWA model above, consider either Yield Roadway striping or marking the travel lanes with shared use lane markings. This may clarify to all road users that, when pedestrian or bicycle activity is present, the cross section is too narrow for two-way motor vehicle traffic to safely operate in separate space on the bridge.

The one-lane bridge illustrated at left may be considered adequate for non-motorized access and safety. The bridge is wide enough for a pedestrian to share the bridge space with a single vehicle traveling in only one direction, yet the bridge is only wide enough to support two-way motor vehicle traffic in an alternating one-way pattern and motor traffic speeds approaching the bridge will be calmed.

Old Shaker Road, Loudon, New Hampshire

Interstate Highway Ramps Solution

Highway ramps can be designed to meet local streets at right angles.