AARP Public Policy Institute

PLANNING COMPLETE STREETS FOR AN AGING AMERICA

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Research Report

AARP

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AARP's Public Policy Institute (PPI) informs and stimulates public debate on the issues we face as we age. Through research, analysis, and dialogue with the nation's leading experts, PPI promotes development of sound, creative policies to address our common need for economic security, health care, and quality of life.

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PPI INNOVATION ROUNDTABLE FOR AN AGING AMERICA

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PLANNING COMPLETE STREETS FOR AN AGING AMERICA

FOREWORD

For several years, AARP has encouraged states to implement the Federal Highway Administration's roadway engineering guidelines for older drivers and pedestrians. More recently, AARP has endorsed the planning concept *Complete Streets*. Complete Streets are those that are designed for the safety and comfort of all road users, regardless of age and ability. Naturally, this definition should extend to the needs of older road users. But does it in practice? And do the engineering solutions offered for older drivers work for pedestrians and bicyclists, the major focus of the Complete Streets movement?

The AARP Public Policy Institute (PPI) embarked upon this project to discover the nexus between these two, as of yet, distinct areas of research and practice. To accomplish this PPI formed an interdisciplinary team of planners, engineers, and policy advocates to review the safety research and offer both policy and design recommendations that can be used by engineers, planners, and citizen advocates in their quest to build safe, more livable streets for everyone.

The next several years mark unprecedented opportunity to affect our built environment. The Federal Highway Administration (FHWA) is updating its *Highway Design Handbook for Older Drivers and Pedestrians*; local and state governments in ever-increasing numbers are adopting Complete Streets policies; and Congress is considering Complete Streets bills simultaneously with hearings on highway safety in anticipation of reauthorization of surface transportation legislation. This research report and accompanying design document are designed to stimulate new understanding and thinking that will lead to better streets for all Americans.

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EXECUTIVE SUMMARY

BACKGROUND

A critical component of livable communities for people of all ages is residents' ability to get where they need to go, whether by car, public transportation, bicycle, wheelchair, or foot. Yet many American streets are designed primarily for the motorist, with the goal of enabling vehicles to move as efficiently as possible. It is difficult for nondrivers of all ages and abilities to navigate many of our nation's communities, especially those located in automobile-oriented suburban areas. Furthermore, many of the nation's major thoroughfares in commercial areas are congested and confusing to navigate even for drivers because of complicated intersections and a clutter of signs, entrances, and bottlenecks. The human cost of this is significant. It exacerbates the social and physical isolation of nondrivers, not to mention the dangers imposed upon all road users.

Complete Streets initiatives present an opportunity to improve the nation's travel options. A Complete Street is safe, comfortable, and convenient for travel by automobile, foot, bicycle, and transit, regardless of age and ability. The focus of Complete Streets initiatives has been to encourage local, regional, and state planning agencies to change policies and procedures so that multimodal accommodations are a routine part of project development. The aim is to "right the balance" in a transportation system that is currently tilted toward automobiles.

Despite the goal to be inclusive, an inventory conducted for this study found that less than one-third of the 80 state and local Complete Streets policies explicitly address the needs of older road users. An online survey of more than 1,100 transportation planners and engineers revealed that nearly two-thirds do not yet consider the needs of older users in their multi-modal planning. This study encourages transportation planners and decision makers to build upon the principles of Complete Streets to address the specific needs of older drivers and pedestrians. Adoption of these principles ultimately improves the safety for all road users.

SAFETY ON AMERICA'S STREETS IS A MAJOR CONCERN FOR OLDER ADULTS

In a poll conducted for this study, 40 percent of adults age 50 and older reported inadequate sidewalks in their neighborhoods. More sobering, nearly 50 percent reported they cannot cross main roads close to their home safely. Half of those who reported such problems said they would walk, bicycle, or take the bus more if these problems were fixed.

These concerns are borne out by statistics showing older adults are more likely to be victims in both motor vehicle and pedestrian fatalities.

THE OLDER ROAD USER IS THE CUSTOMER OF THE FUTURE

Over the coming decades, the number of older Americans (ages 65 and up) is expected to increase. Estimates from the U.S. Census Bureau indicate older adults represented 12 percent of the total population in 2005. By 2025, this number will more than double to about 62 million, or 18 percent of the population (nearly one in five Americans). We also know that older Americans are more active and are driving more than ever before, and that one in four U.S. drivers will be age 65 and older. Clearly, the older road user is the customer of the future.

Aging is a highly individual process. Challenges that frequently affect people's mobility as they age include the following: declining vision, decreased physical fitness and flexibility, decreased ability to focus attention, increased reaction time. Policies and design practices that explicitly recognize these changes will better serve a growing segment of the nation's population.

TRADITIONAL TRANSPORTATION PLANNING AND ENGINEERING PRACTICE

This report examines the evolving state of the transportation planning and design practice with regard to these issues, and offers recommendations to advance mobility and accessibility for older adults within the realms of transportation policy, planning, and engineering.

In the realm of roadway engineering and design, research and guidebooks on addressing the needs of older drivers and pedestrians have been developed by the U.S. Department of Transportation as well as national professional organizations such as the Institute for Transportation Engineers and the Transportation Research Board of the National Academies. An examination of these current design guidelines reveals conflicts between strategies that address the needs of older drivers and those that meet the needs of older pedestrians, as well as other road users.

For example, some recommendations to improve older driver safety involve widening roadway lanes in order to give them more room to maneuver. However, wider roads present a challenge for older pedestrians trying to cross the broader streets. In addition, wider roadways often make it easier for drivers to go faster, which puts pressure on older drivers who have difficulty making and executing decisions quickly, as well as putting pedestrians at a higher risk for being struck and killed by drivers. An energetic debate continues among planners and engineers on how to balance the need for capacity with the needs of nonmotorized road users at intersections. As part of this study, we explore the issue of

balancing road user needs by examining some of the intersection design recommendations made in FHWA's *Highway Design Handbook for Older Drivers and Pedestrians* and offer some refinements for urban and suburban intersection treatments that provide better balance.

A NEW APPROACH

The study encourages roadway planners and engineers to employ design strategies that support older drivers and pedestrians, particularly in situations where the "status quo" design makes streets less safe for older adults. The recommendations can be summarized into the following three basic planning and design principles:

Slow Down - Reduce vehicle travel speeds in areas where drivers and pedestrians interact and where older drivers and pedestrians need more time to make decisions. Roadways can be reengineered for slower speeds through changes to curb radii, perceived or real lane widths, or replacement of typical intersections with roundabouts.

Make it Easy - Make the physical layout of the transportation network easy to navigate for older drivers and pedestrians. Some of the complexity of intersections can be removed by providing travelers a connected network of streets with lower-speed routes and intersections that are easier to maneuver.

Enjoy the View - Make it easy for drivers and pedestrians to notice, read, understand, and respond to visual cues and information. Reduction in the visual clutter of signs, better access management, and improvements to landscaping, signs, and lighting can make the roadway more intuitive.

IMPLEMENTATION STEPS

These principles can be integrated into Complete Streets policies to change the process of transportation planning so that the needs of everyone expected to use the facility are considered from the beginning. This is critical in ensuring that the needs of older travelers are considered. A broad approach that begins well before design standards are written is crucial to success. Once the basic policies are adopted, four implementation steps should be taken to ensure this comprehensive approach:

- **Develop staff skills in planning and designing for all modes.** Many planners and engineers began their careers with training that focused on the needs of automobiles, without much regard to who was driving them or to other road users. Balancing the needs of all users is a challenge, and doing so with every project requires new tools and skills.

- **Rewrite and/or refocus agency policies and procedures to serve all modes.** Many transportation agencies use transportation planning procedures focused on automobile capacity measures such as a higher level of service (a measure of congestion). They have not established a systematic way to determine all the types and modes of travelers along a corridor and to make sure their needs are met. The policy change should result in a restructuring of everyday procedures, beginning with much broader scoping processes, and new ways to decide on trade-offs.

- **Rewrite and/or adapt design guidelines to address the needs of all travelers using all modes.** This is the step most relevant to addressing the needs of older travelers, and may include new design manuals that specifically address the needs of older travelers and persons with disabilities, or they may point to current best practices manuals, such as those provided by the U.S. Access Board.

- **Collect data on all users and modes for performance improvements.** An important aspect of successful Complete Streets planning is having the tools to assess the success of new projects in meeting the needs of varied users.

Enriching Complete Streets planning processes and roadway design methods to address the principles above will advance safety and mobility for roadway users of all ages and travel modes. In addition, by adopting policies and practices that address these elements at each stage of project development—from policy to planning and design—agencies and individuals involved in the process will have a common language through which they can communicate more clearly and consistently. The results will be travel networks that better provide for the needs and safety of all users.

CHAPTER 1

INTRODUCTION AND RESEARCH APPROACH

A critical component of livable communities is residents' ability to get where they need to go, whether by car, public transit, bicycle, wheelchair, or foot. Yet, since the beginning of the post–World War II suburban housing expansion, streets have been designed primarily for the motorist. Too often, suburban areas lack sidewalks. Travel by bicycle is perilous, and missing or poorly designed curb cuts leave many wheelchair users unable to use the street network. Furthermore, many of the nation's arterial roadways in commercial areas are congested and confusing to navigate for many drivers because of a clutter of signs, entrances, and bottlenecks.

As the nation's population ages, more and more of its citizens will find it difficult to navigate the transportation network by any means. Normal aging commonly leads to changes in perceptual, cognitive, and psychomotor performance. Navigating intersections, reading the small type in road signs, following pavement markings, and making left turns are frequently cited as more challenging for older drivers than younger ones (Federal Highway Administration [FHWA], 2001; Potts, National Cooperative Highway Research Program [NCHRP], 2004). Older pedestrians may suffer decreased ability to judge the speed of cars entering an intersection and may lack the ability to run across the street. As a result, they are victims of a disproportionate number of pedestrian fatalities (FHWA, 2001).

In response to the need for safe travel for all users, a wide variety of organizations are focusing on development and implementation of policy and road design strategies that enhance safety. Complete Streets is one such approach. The name was coined by pedestrian and bicycle advocates to emphasize the importance of designing the street for all users, whether one travels by foot, bicycle, transit, or car. The focus of the Complete Streets movement has been on helping states and localities adopt new policy and procedural changes so that the entire street right-of-way is designed and operated to enable safe access for all users. Organizations as varied as America Walks, American Public Transportation Association (APTA), American Planning Association (APA), Institute of Transportation Engineers (ITE), the Natural Resources Defense Council (NRDC), and AARP have joined the National Complete Streets Coalition. These organizations helped to redefine a Complete Street as one that works for all users, regardless of age and ability.

The planning and engineering professions have developed a number of technical manuals and training programs related to Complete Streets, such as the Complete Streets webinars offered by APA; the Federal Highway Administration's Course on Bicycle and Pedestrian Transportation; ITE's *Road Diet Handbook: Setting Trends for Livable Streets* and *Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities*; and *Guide for the Planning, Design, and Operation of Pedestrian*

Facilities, by the American Association of State Highway and Transportation Officials (AASHTO). The planning and design approaches offered in these courses and manuals can undoubtedly improve the travel environment for pedestrians, bicyclists, and transit users; however, explicit attention to the unique needs of older adults has been minimal.

Publications and training that explicitly address the needs of older travelers have focused primarily on accommodating automobile drivers by designing roads and intersections to help people continue to drive safely as they age. Human factors researchers and traffic engineers have offered design guidelines for older driver safety largely within the context of this traditional engineering paradigm. In doing so, they have not questioned the long-term efficacy of this model.

RESEARCH APPROACH

AARP's Public Policy Institute (PPI) sponsored this research to stimulate the planning and engineering community to consider more comprehensively in their studies and guidelines the needs of older drivers and pedestrians and bicyclists, and transit users of all ages. PPI's goal is to increase the prominence of older travelers' needs in road planning and design, and incorporate the planning for their needs into Complete Streets policies and practices. In doing so, the road environment will be safer and more user friendly for everyone—younger drivers, parents with strollers, persons with disabilities, and so on. Furthermore, by examining the design guidelines for older drivers and pedestrians recommended by the FHWA through the lens of designing for Complete Streets, PPI recommends refinements to FHWA's *Highway Design Handbook for Older Drivers and Pedestrians* (FHWA Handbook).

The objectives of the project are the following:

- Elevate the importance of incorporating older driver and pedestrian safety into Complete Streets planning processes.
- Identify and suggest ways to reconcile potential conflicts between older driver safety recommendations and design measures that are consistent with Complete Streets principles.
- Provide professionals and community advocates alike with clear models and design resources for incorporating older driver and pedestrian safety into transportation planning.

The research process included the following milestones:

- A review and critique of key literature from the engineering and planning professions, particularly focusing on conflicts and gaps relevant to the needs of older drivers and pedestrians.
- An online survey of more than 1,100 state and local transportation planners and

engineers to ascertain the acceptance and implementation of Complete Streets policies and engineering practices for older driver and pedestrian safety and to receive feedback on recommendations presented in this report.

- An inventory and evaluation of 80 existing Complete Streets policies.
- A public opinion telephone survey to understand older adults' perception of their local travel environment and potential support for Complete Streets design measures.
- A Public Policy Institute Innovation Roundtable discussion of national leaders in the planning, engineering, and advocacy arenas who reviewed research findings and provided specific feedback on policy and design solutions.

This final product synthesizes what was learned from each of the above tasks. In this chapter we have introduced the problem statement and described the research approach and outline of the report. In Chapter 2 we lay out the demographic change facing the nation and address how the normal process of aging affects driving and walking. Chapter 3 describes the traditional, post–World War II auto-oriented road planning and design framework and its evolution toward a more balanced multimodal approach. Those new to transportation planning and engineering may find this section helpful as a primer on current practice. In this chapter we discuss the Complete Streets framework and summarize what was learned from our inventory of Complete Streets policies, as well as the feedback received from the profession through the online survey. Chapter 4 lays out our policy, planning, and design recommendations that we believe will improve the safety and usability of the road network for older road users. In this chapter we summarize our review of FHWA's *Highway Design Handbook for Older Drivers and Pedestrians* using a Complete Streets lens and offer recommendations for how the FHWA Handbook could be refined to better balance the needs of all users. In addition to some general comments, our summary includes specific recommendations for five intersection design treatments appropriate for urban and suburban contexts. It is the authors' hope that by reaching beyond the existing literature and carrying out a multifaceted research approach that takes in both user perspectives and expert feedback from the field, we have been able to put forward sound recommendations that advance our thinking on designing for an aging society.

CHAPTER 2

MOBILITY FOR AGING AMERICANS

DEMOGRAPHIC PROFILE OF AN AGING AMERICA

Over the next 20 years, the demographic profile of the United States will shift dramatically. Where once the U.S. population looked like a pyramid, with many children and young people at the bottom and only a few older people at the top, today there is a more even distribution of the population.

In 2007, 12.5 percent of the U.S. population was 65 or older. The U.S. Census Bureau estimates that by 2025, the number of seniors will increase by about 70 percent, and an estimated 18 percent of the population (64 million people) will be 65 or older. The greatest of these gains will occur in the age category 65 to 74 (Bailey, 2004; Frey, 2007). Many of those over age 65 will be very old—over ages 80–85. In 26 states, more than 20 percent—one in five residents—will be over the age of 65. One in nine of those over 65 will also be over 85 (U.S. Census Bureau, 2008). In total, people ages 65 and older will account for 25 percent of U.S. drivers (AAA Foundation for Traffic Safety, 2008). The older road user is the customer of the future.

One factor affecting mobility is the presence of a disability, which increases greatly with age. Forty-two percent of the population 65 and over reported some type of long-lasting condition or a disability in 2000. Thirty-two percent of people 65 to 74 reported at least one disability, in contrast with 72 percent of people 85 and over (Gist, 2004). In many cases, having a disability forces older adults to stop driving and reduce other forms of travel.

THE IMPACTS OF INCREASING AUTOMOBILE-DEPENDENCE ON OLDER ADULTS

Older people today are substantially more mobile than their counterparts of just ten years ago, largely because of travel in personal automobiles. For the last two decades, every automobile-related travel indicator for the elderly has increased, in terms of vehicle miles, licensing, daily trips, daily miles, time spent driving, and more (Rosenbloom, 2003). According to the most recent National Household Travel Survey (NHTS), 88 percent of all trips made by older adults are as drivers or passengers in personal vehicles. When compared with previous travel surveys, the population ages 65 and older has increased its number of daily miles traveled and number of trips taken faster than any other age group (USDOT/FHWA, NHTS, 2001).

While older adults are increasingly more mobile in the automobile, their use of alternative modes has decreased. The elderly are now less likely to take public transit, and while they are more likely to walk than younger people (Rosenbloom, 2003), urban Americans over the age of 65 still make less than seven percent of their trips on foot or bicycle. This is compared

Relative to Europeans, Americans of all ages take far fewer trips on foot or bike.

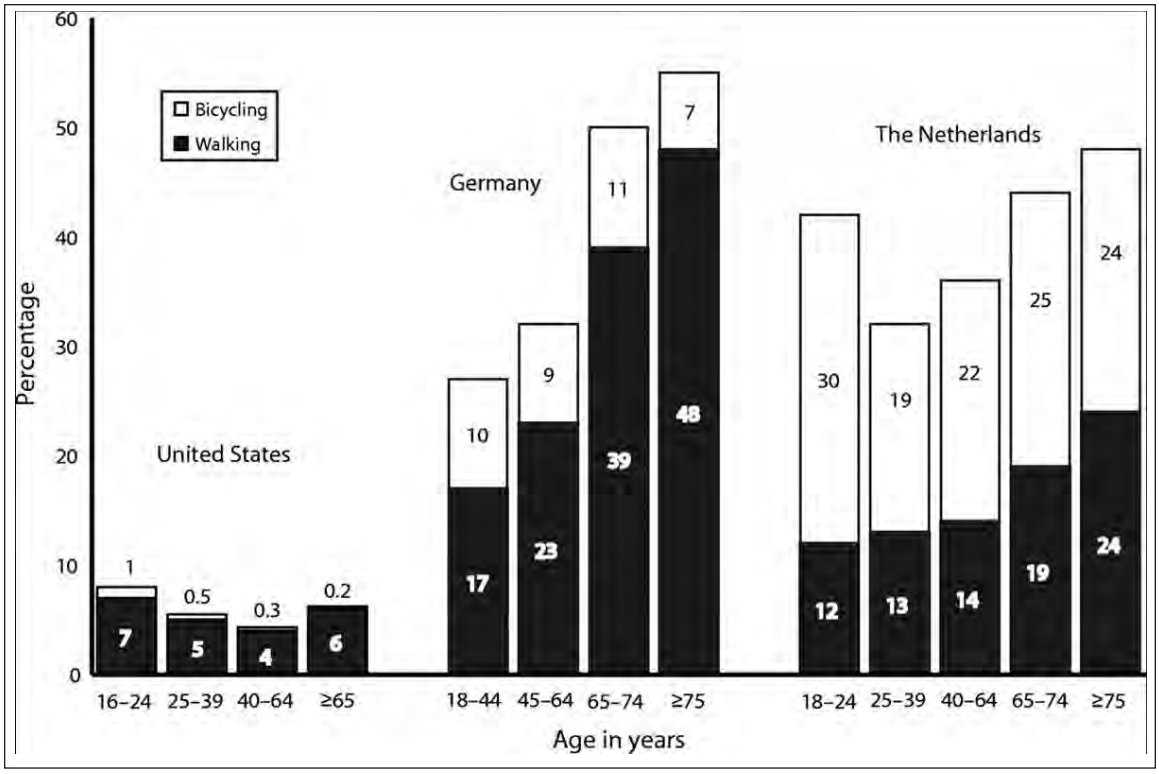


Figure 1. Percentage of trips in urban areas made by walking and bicycling in the United States, Germany, and The Netherlands, by age group, 1995

Source: J. Pucher and L. Dijkstra, "Promoting Safe Walking and Cycling to Improve Public Health: Lessons from the Netherlands and Germany," American Journal of Public Health, *September 2003, Vol. 93, No. 9, pp. 1509-16. Reprinted with permission from the American Public Health Association.*

with 50–55 percent in Germany and 44–48 percent in the Netherlands, countries with strong policy and design commitments to these forms of travel. *See Figure 1.*

In large part, this heavy reliance on automobile travel has contributed to making it difficult to get to places on foot in many parts of the United States and, in far too many cases, unsafe. Recent public health studies have found that per mile, pedestrians in the United States are three times more likely to be killed in motor vehicle crashes than in Germany, and over six times as likely to be killed as in the Netherlands (Bailey, 2004), two European countries where driving is actively discouraged in city centers and where urban land use and transportation policy support nonmotorized travel.

According to an article in *the American Journal of Public Health*, both men and women are likely to live beyond the time that they can drive safely, as much as seven years for men and about ten for women (Foley, 2002). During that period, they will lose the independence of the personal automobile and become dependent on alternative transportation. Not having safe and viable transportation alternatives can contribute to increased isolation and decline. Having few opportunities to walk on a daily basis can make it more difficult for older adults to remain active, and having to give up driving puts a great strain on their ability to live independently.

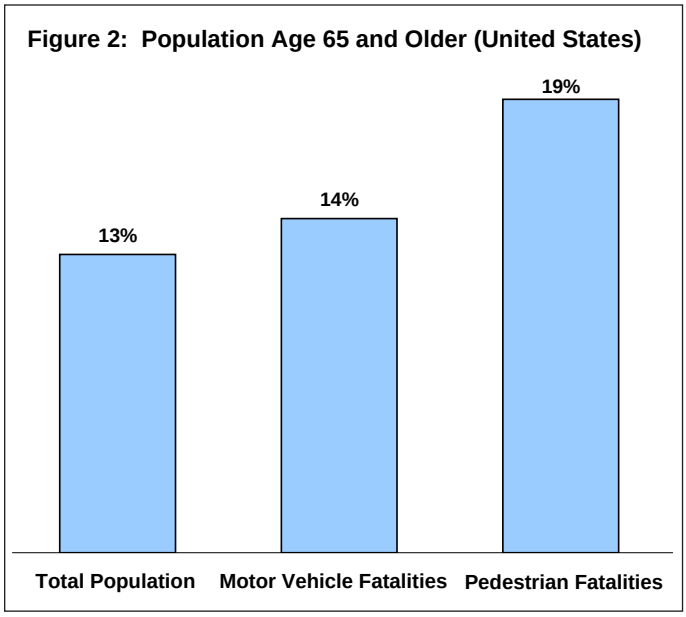
By 2025, most older adults will have spent their entire life getting around by car, and in many cases, will have chosen a home in a place where the only viable transportation mode is the automobile. Many of these older adults will be baby boomers, accustomed to the convenience and flexibility of the car, but they will be hard pressed to maintain a high level of mobility if their driving abilities deteriorate. This situation, coupled with, on average, better health and physical conditions than in the past, means that as more older adults live longer, active, and independent lives, they will require travel for work, shopping, health services, etc., for a longer period of time.

Increased mobility for the older adult population comes with greater risks. While older drivers are among the safest users of the nation's roadways, the cohort of those 75 and older do experience higher crash rates per mile driven, and are more likely to be seriously or fatally injured in their crashes due to their increased frailty (Lyman et al., 2001; Li et al., 2003). Older pedestrians also face high risks when navigating streets. In 2007, older adults accounted for 14 percent of all traffic fatalities, 14 percent of all vehicle occupant fatalities, and 19 percent of all pedestrian fatalities (Traffic Safety Facts, 2007).

THE INFLUENCE OF LOCATION ON MOBILITY

The population of older adults is exploding in suburban and exurban counties around large metropolitan areas such as Denver, Atlanta, Washington, D.C., and Dallas. Several nonmetropolitan counties, such as the picturesque parts of Colorado, Idaho, and Wyoming, are also experiencing large increases (Frey, 2007). Although some of these fast-growing regions are beginning to promote more compact suburban development that can be served by public transportation services, the predominant development pattern continues to be lower density, residential subdivisions and auto-oriented commercial corridors. Over the coming decades, increasing numbers of baby boomer retirees and active older adults who settle in these areas, attracted by amenities, such as scenic vistas and outdoor recreation, may become stranded in their homes if they can no longer drive.

Older adults are over-represented in fatal crashes



Source: NHTSA, Traffic Safety Facts, 2007

The ability to live closer to daily destinations is an important factor in maintaining mobility among

older people who cannot drive or whose driving is limited. People 65 and over living in areas where houses are built closer to shops and services are less likely to stay home on a given day, and are more likely to use public transportation and walk to get around. For example, in the Philadelphia metropolitan area, which features many high-density, walkable neighborhoods, only a third (35 percent) of nondrivers ages 65 and over stay home on a given day. In comparison, over half (53 percent) of older nondrivers in the sprawling Los Angeles metropolitan area stay home on a given day (Bailey, 2004). A study of Northern Virginia suburbs outside Washington, D.C., found that older adults ages 75 and older living in walkable, mixed-use areas took 20 percent more trips each week than their counterparts living in traditional suburbs characterized by a separation of uses, wide, fast roads, and expansive surface parking lots. And while the great majority of these older adults reported having driven in the past month (70 percent), 25 percent of them also reported having used fixed-route public transportation for a portion of their trips compared to just 14 percent of their suburban counterparts living in more sprawling areas (Lynott, 2006).

For older adults living in rural areas, and who must travel on higher-speed roads, the challenges are even greater. Research conducted by the National Highway Traffic Safety Administration (NHTSA) shows that residents of rural areas have a much greater propensity for involvement in fatal highway crashes than their urban counterparts. Although 21 percent of the U.S. population lives in rural areas, they account for 57 percent of all fatal crashes (NHTSA, 2005).

THE EFFECT OF PHYSICAL LIMITATIONS ON MOBILITY

Aging is a highly individual process, and physical and cognitive changes occur at different rates. Because of the diversity in how age affects individuals, many older adults will continue to drive safely well into their retirement years. Nonetheless, a few common functional limitations can affect the ability to drive safely: vision declines, physical fitness and flexibility diminish, the ability to focus attention decreases, and the time necessary to react to unexpected circumstances increases. Some of the same declines in physical function that affect older drivers affect them as pedestrians too. For example, common hip and leg impairments such as arthritis can limit walking comfort and distance. Loss of limb strength, flexibility, sensitivity or range of motion, and reduced ability to rotate the head and neck all can make walking more challenging or impossible.

Several organizations have researched the effects of such changes on a person's mobility. The Federal Highway Administration, in its *Travel Better, Travel Longer* handbook, summarizes the interaction between the changes in physical health and driving and walking abilities (U.S. Department of Transportation, 2003):

Declining vision - Roadway signs and pavement markings become less legible, and curbs, barriers, pedestrians, and other drivers are more difficult for older drivers to see. This is

particularly problematic at night, when low lighting and glare from headlights interfere with vision.

Decreased physical fitness and flexibility - Older drivers have difficulties turning their heads to rapidly scan to the left and right at intersections and look over their shoulders for lane changes, as well as backing up. Older people may also have trouble with activities that require quick physical movements such as abrupt turns. Additionally, many older adults walk more slowly than the current *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD) recommendation of 1.2 meters (m) (4') per second used for timing how long the clearance interval should be on the signal to allow a pedestrian to reach the far side of the street.

Decreased ability to focus attention - Older drivers may find it difficult to sort through and prioritize the large amount of ever-changing information that must be absorbed during roadway use, from signs, signals, and pavement markings to avoiding conflicts with pedestrians, bicyclists, and other drivers. This can be especially problematic in new or complicated situations, such as navigating a temporary traffic control zone or an unfamiliar area.

Increased reaction time - Older drivers are often slower to respond to traffic control devices and to changes in traffic or roadway conditions that are unexpected or contrary to expectations.

These four common limitations are particularly troublesome in specific traffic situations, such as left turns and temporary traffic control zones. Research has shown that intersections present some of the most difficult challenges for older drivers (FHWA, 2001; Morena, 2008; Government Accountability Office [GAO], 2007). In fact, a leading sentence in FHWA's *Highway Design Handbook for Older Drivers and Pedestrians* (FHWA Handbook) states that "the single greatest concern in accommodating older road users, both drivers and pedestrians, is the ability of these individuals to negotiate intersections safely."

Navigating intersections requires the ability to make rapid decisions, react quickly, and accurately judge speed and distance: skills that commonly diminish through the natural aging process. Coupled with increased frailty, these factors lead to increased older driver involvement in fatal crashes at intersections. In 2001, 50 percent of all older driver fatalities in 2001 occurred at intersections (TRIP, 2003). Since intersections also generally present the highest overall potential for pedestrian/vehicle conflicts, problems with older driver safety at these locations are also of concern when considering pedestrian safety for people of all ages.

Roads can be engineered to address the visual, fitness, and cognitive challenges commonly experienced by older adults. The next chapter discusses the planning and engineering professions and how older driver and pedestrian safety can be addressed using a Complete Streets planning framework.

CHAPTER 3

PLANNING & ENGINEERING PRACTICE FOR OLDER DRIVER & PEDESTRIAN MOBILITY

The work of transportation planners and roadway engineers has a profound effect on community character and on the availability of transportation choices. Implementation of older driver and pedestrian safety measures occurs within this larger roadway planning and engineering context.

Transportation planning precedes roadway design and engineering. It provides an opportunity for community members to come together to articulate a vision for the community, and for transportation planners to evaluate future mobility and infrastructure needs based on this vision, on existing and planned land use, and on projected demographic change and travel demand.

The development of a transportation project is not a linear process carried out by a single agency. It consists of interlinked processes carried out at multiple levels of government,

Transportation Planning Agencies

In metropolitan areas of more than 50,000 people, regional transportation planning is carried out by a federally designated Metropolitan Planning Organization (MPO). In small communities and rural areas there is no such federally designated body. Depending on the state, rural planning may be carried out by the state department of transportation (DOT), regional Rural Planning Organizations (RPOs), local governments, tribal government, or other designated entities. Many local comprehensive plans include a transportation element that may inform the regional and state planning process.

The federal government, through the U.S. Department of Transportation, does not develop transportation plans. Instead, it reviews the planning activities of the MPOs and state DOTs for consistency with federal policy and law. Before a project can receive federal funding it must be included in the Regional Long Range Transportation Plan, the Transportation Improvement Program (TIP) and the Statewide Transportation Improvement Program (STIP).

The most recent federal surface transportation legislation (SAFETEA-LU) requires states to develop a Strategic Highway Safety Plan (SHSP). These plans define a state's key safety needs and guide investment decisions to reduce highway fatalities and serious injuries on all public roads. These plans are developed with input from public and private stakeholder groups. In addition to the local, state, and regional plans described above, the SHSP provides an excellent opportunity for states to address the specific safety needs of older drivers and pedestrians.

which intersect at key points as projects are planned, developed, and funded. Regional and local long-range transportation plans are strongly influenced by community goals, while engineering and design decisions for projects are governed more by state and local agency standards and policies.

Following World War II, the United States entered a boom period in suburban housing and highway construction. With postwar optimism and wealth, the nation embraced the newfound mobility of the automobile and directed its transportation planners and engineers to build a road network to facilitate that movement. President Eisenhower's landmark investments in an interstate highway system served to provide the nation with unprecedented levels of mobility, opening up land far from employment districts for young couples and families. Suburban development patterns, lengthened commute distances, cheap gas prices, and a general love for the automobile put pressure on road designers to focus their work on moving vehicles.

By 1991, when Congress enacted the Intermodal Surface Transportation Efficiency Act (ISTEA), America had already begun to ask how it could reintroduce balance into its transportation system. Today, federal law requires that all modes of transportation, including pedestrian and bicycle travel, be addressed in state and regional planning. "The long range metropolitan and statewide transportation plans, and the Metropolitan and Statewide Transportation Improvement Programs shall provide for the development and integrated management and operation of transportation facilities (including accessible pedestrian walkways and bicycle transportation facilities) that will function as an intermodal transportation system…" (23 U.S.C 134[c][2] and 135[a][2]).

KEY RESOURCES FOR ROADWAY DESIGNERS

Decisions on road design are made by either the state or local DOT, depending on who will own and maintain the road. Though somewhat different in every state, generally states have jurisdiction over design standards for rural roads and major urban thoroughfares, while cities or counties have jurisdiction over the design of local urban streets. Regardless of the decision-making entity, however, most road design standards are based on nationally accepted guidelines such as those published by AASHTO, and supplemented by other publications from organizations such as ITE and the U.S. Access Board.

AASHTO *Policy on Geometric Design of Highways and Streets* (AASHTO Green Book)

The single most authoritative publication used by state and local roadway engineers is *A Policy on Geometric Design of Highways and Streets*, universally known in the transportation community as the AASHTO Green Book.

The AASHTO Green Book historically has reflected the institutional needs and priorities of the organization's members, which comprise state departments of transportation

(DOT) (including the District of Columbia and Puerto Rico) having the official highway responsibility for that state or territory. The United States Department of Transportation (USDOT) is an ex officio member. Given this membership, its guidelines focus largely on interstate and intercity roads.

Over the past ten years, in response to the concerns of those planners and engineers who have sought road design guidelines that more effectively address the needs of multimodal urban areas, AASHTO has developed supplementary guidance for pedestrian and bicycle accommodations. While largely contained under separate cover, these guides are considered important components of the AASHTO Green Book.

While the AASHTO Green Book is used by state and local transportation officials as a manual of design standards, its name, "A Policy," intentionally reflects the need for engineering judgment to properly assess a particular road environment and engineer its design appropriately. As such, the AASHTO Green Book provides ranges of acceptable design parameters (e.g., 9'–12' travel lanes and 5'–50' curb radii) and describes the conditions that a professional should assess in making a determination of appropriate design.

Too often, however, in an attempt at simplification, states and localities remove the range of design flexibility from their design manuals. Another common problem is that engineers interpret the range narrowly, assuming that the standard with the most generous facilities for drivers (such as the 12' lane) is preferred unless unusual circumstances exist. These types of practices have resulted in design treatments that are applied regardless of the surrounding context, such as residential streets engineered with freeway lane widths and curb radii, or a prohibition of street trees in the median of a four-lane road through a shopping district.

It is this narrow interpretation in the application of design guidance that has, in part, led to the many vociferous debates over street design in planning forums across America. During the 1990s, Congress spearheaded a movement toward a transportation system that accommodates the multimodal movement of people and goods above and beyond motor vehicles with passage of the Intermodal Surface Transportation Efficiency Act (1991) and the Transportation Equity Act for the 21st Century (1998). The call for more walkable, livable, and accessible communities has seen public agencies and public interest groups striving to define the most appropriate way in which to accommodate the various modes within the overall transportation system so that those who walk or ride bicycles, as well as drive cars, can safely, conveniently, and comfortably access every destination within a community.

FHWA *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD)

A companion document to the AASHTO Green Book for road designers is the *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD), published by the Federal Highway Administration. In its most recent (2003) edition, the MUTCD defines

the standards used by road managers nationwide to install and maintain traffic control devices (signs, signals, and pavement markings) on all streets and highways.

Several recommendations from the last edition of the FHWA Handbook have been incorporated into the AASHTO Green Book and MUTCD. In addition, FHWA is expected to publish a final rule in 2009 on a proposal to reduce the pedestrian walk speed by which signals are timed. This would have the effect of increasing pedestrian crossing time.

The following resources resulted from initial efforts to address bicycle and pedestrian accommodations in roadway design and currently serve as the industry standard for balancing the needs of multiple users.

AASHTO *Guide for the Development of Bicycle Facilities*

The AASHTO *Guide for the Development of Bicycle Facilities* (1999) is the industry standard for bicycle facility design issues. Subjects include shared roadways, signed shared roadways, bike lanes, shared use paths (trails), bicycle planning, and other issues. Usage of the guide has grown rapidly as more bikeway projects have been funded and developed following the passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) in 1991. The guide is currently under review. A revised document is expected to be released in 2009.

AASHTO *Guide for the Planning, Design, and Operation of Pedestrian Facilities*

The AASHTO *Guide for the Planning, Design, and Operation of Pedestrian Facilities* (1st ed., 2004) provides guidance on the planning, design, and operation of pedestrian facilities along streets and highways. Specifically, the guide focuses on identifying effective measures for accommodating pedestrians on public rights-of-way. Appropriate methods for accommodating pedestrians, which vary among roadway and facility types, are described in this guide. This guide also recognizes and addresses the effect that land use planning and site design have on pedestrian mobility.

Since the guide was published in 2004, many states, such as Oregon, Vermont, Florida, Georgia, and Washington, had already created their own design manuals. Some may replace their manuals with the AASHTO guide (as Arizona did with its bikeway guide). However, others may keep their own manuals.

ITE Guidelines for Design and Safety of Pedestrian Facilities

The Institute for Transportation Engineers has long been a leader in addressing pedestrian and bicycle issues. In 1998 ITE published recommended practice guidelines for the design and safety of pedestrian facilities to provide safe and efficient opportunities for people to walk near streets and highways. Chapters include “Roadway Design Considerations”; “Pedestrians with Disabilities”; “Sidewalks and Paths”; “Pedestrian and Motorist Signing”; “Signalization”; “Crosswalks and Stop Lines”; “Pedestrian Refuge Islands”; “Pedestrian Barriers”; “Curb Parking Restrictions”; “Grade-Separated Crossings”; “School Practices”;

"Neighborhood Traffic Control Measures"; "Pedestrian-Oriented Environments"; "Transit Stops"; and "Work Zone Pedestrian Safety."

U.S. Access Board and Americans with Disabilities Act Accessibility Guidelines

The Americans with Disabilities Act (ADA) was passed in 1990 to prohibit discrimination against people with disabilities in services, programs, and activities by state and local governments. ADA standards for new construction, adopted in 1991, were principally developed for buildings and site work. They were not easily applicable to sidewalks, street crossings, and related pedestrian facilities in the public right-of-way, even though the law does apply to these facilities.

In 1999, the U.S. Access Board initiated a rulemaking process for accessible pedestrian facilities in public rights-of-way. Since that time multiple drafts have been published. The 2005 draft Public Rights-of-Way Accessibility Guidelines (PROWAG) serves as the current best practice for accessible pedestrian design (as identified by the USDOT). It provides guidance on all types of public rights-of-way, and contains a useful summary of ADA and ADA Accessibility Guidelines (ADAAG) regulations as well as industry design practices on bus stops, curb ramps, pedestrian crossings, and street furniture relevant to bus stop accessibility.

ENGINEERING RESOURCES FOR OLDER DRIVER SAFETY

FHWA *Highway Design Handbook for Older Drivers and Pedestrians*

In January 1998, FHWA released a comprehensive set of guidelines that attempted to translate the knowledge about human aging into principles of highway geometric design and operations. Collectively known as the *Older Driver Highway Design Handbook*, the guidelines recommend a wide array of practices—such as using larger letters on signs, placing advance street name signs before intersections, and improving intersection layouts, among other things—for the design and operation of roadways to make them easier for normally aging drivers to navigate. While these practices are designed to address older drivers' needs, implementation of many of the recommendations can make roads safer for all drivers. It should be noted that the *Older Driver Highway Design Handbook* did not attempt to offer design solutions for those with severe cognitive impairments such as dementia. The *Older Driver Highway Design Handbook* was revised in 2001 as the *Highway Design Handbook for Older Drivers and Pedestrians* (FHWA Handbook) to update and expand recommended practices to improve safety for older drivers and older pedestrians. An update is currently underway and is expected to be published in 2009.

With a few notable exceptions, states have done little in the way of implementing the recommendations of the FHWA Handbook. The GAO report (GAO, 2007) presents a fairly pessimistic view. When asked "To what extent has your department invested resources in older driver safety projects?" 80 percent of the states reported little or no extent. Despite

workshops conducted by FHWA to familiarize more than 1,000 state, county, and municipal engineers with this resource, the online survey of transportation planners and engineers conducted as part of this research in 2008 found that less than 40 percent of transportation planners and engineers surveyed were familiar with the FHWA Handbook. See Appendix D for the online survey results. Appendix E includes the Summary of States' Progress in Implementing the FHWA Handbook.

Other Guidebooks and Studies

Over the years, a number of federal, state, and local agencies, along with countless other organizations, have taken an interest specifically in the needs of older driver and pedestrian mobility. Among them the National Highway Traffic Safety Administration (NHTSA), Federal Highway Administration (FHWA), and Transportation Research Board (TRB) have published research and have offered programs and policies that improve the safety of older road users. Other national organizations, including the National Institute on Aging (NIA), American Association of State Highway and Transportation Officials (AASHTO), and a wide range of private, nongovernmental organizations have also contributed to the efforts.

TRB's landmark publication *Special Report 218: Transportation in an Aging Society* (1988) and subsequent update, Transportation in an *Aging Society: A Decade of Experience* (2004), helped to place the needs of older road users in the forefront of transportation safety agendas, fostering numerous research and programmatic activities.

NHTSA focuses on reducing traffic-related injuries and fatalities among older people by promoting, in conjunction with nongovernmental organizations, research, education, and programs aimed at identifying and assisting older drivers with functional limitations that impair driving performance. They have developed guides, brochures, and booklets for use by the medical community, law enforcement officials, older drivers, and their family members that provide guidance on actions and strategies to improve older drivers' capabilities or to compensate for lost capabilities.

USDOT—through FHWA and NHTSA—has a role in promoting older driver safety, although states are directly responsible for operating their roadways and establishing driver licensing requirements. Of particular interest to this study is the examination of FHWA's *Highway Design Handbook for Older Drivers and Pedestrians* and its relationship to policies promoting Complete Streets.

APPROACHES TO ROADWAY DESIGN AND ENGINEERING

Traditional Approaches

Transportation planning's decades-long emphasis on auto mobility has meant a heavy reliance on performance measurements and analytical tools related to driving. Most

transportation plans aim to reduce anticipated traffic congestion on corridors defined as having poor levels of service by travel demand models. This puts the emphasis on vehicle mobility from the start. Meanwhile, roadway design decisions are typically based upon vehicle-oriented criteria such as design speed and functional classification. The following sections discuss these issues in more detail.

Travel Demand Modeling

Travel demand models were first developed in the 1950s to aid in highway planning. Using mathematical equations to make projections of the amount of travel along a corridor or in a metropolitan region given population projections, existing and planned land use, and the facility, or network of facilities, transportation planners are able to make predictions of how well alternative plans (either project alternatives at the corridor level or long-range plans at the regional level) perform in meeting planning goals. At the corridor level, planners compare the projected traffic volumes with the existing and planned capacity for the roadway to make level of service (LOS) projections.

The passage of ISTEA and the requirement for multimodal planning has pressed modelers to project travel by public transportation, walking, and bicycling, in addition to travel taken in motor vehicles. In fact, an entire subdiscipline of transportation planning is dedicated to making travel demand models more sensitive to these other modes of travel. Nonetheless, planners and engineers recognize the limitations of current modeling practice with respect to accurately forecasting transit and, more significant, pedestrian and bicycle travel.

Level of Service (LOS)

LOS is a qualitative measure describing the flow of traffic on a roadway. It generally describes these conditions in terms of speed, travel time, freedom to maneuver, traffic interruptions, safety, and the perceived comfort and convenience of the driver.[1] LOS is represented as a spectrum from A (free-flow conditions) to F (severe congestion). The standard methodology for calculating level of service can be found in the *Highway Capacity Manual* (HCM) published by the Transportation Research Board (TRB, 2000). Average Daily Traffic (ADT) and peak hour vehicle counts are used as a basis for calculating current and anticipated future LOS.

The HCM provides roadway designers with information on "the effects of transit, pedestrians, and bicycles on the performance of these systems," but does not attempt to equally measure the comfort of the road environment for pedestrians, bicyclists, or the transit vehicle. The TRB and other entities such as the Florida Department of Transportation have developed multimodal LOS measurement techniques that include transit, bicycles, and pedestrians, but these are not yet standard practice across the nation.

1 Transportation Research Board (TRB), *Highway Capacity Manual*, Washington, DC: TRB, 2000).

Design Speed

Design speed is another factor that strongly influences engineering decisions. A common design assumption used by engineers is that drivers wish to minimize their travel time and delay. Indeed many designers consider design speed as a surrogate for design quality.

Roads are commonly engineered for speeds 5–10 miles per hour (mph) higher than the posted speed limit in order to provide a safety buffer for the 15th percentile of drivers that can be expected to drive faster than the posted speed. Given the traditional equating of design speed with design quality, the notion of designing a high-quality, lower-speed road is counter to many highway engineers' training.[2]

But when balancing the needs of all road users within a given urban, suburban, or town environment, small differences in speed can make significant differences in pedestrian comfort and safety. For instance, pedestrians face a 5 percent chance of death if hit by a motor vehicle at 20 mph, but at 30 mph the risk increases to 45 percent, and at 40 mph the risk increase to 85 percent.[3] At all levels, the risks are higher for older adults, because of their increased frailty.[4] *See Figure 3.*

While progress has been made in providing the road planning and engineering community with resources on flexible highway design and guidelines for the incorporation of pedestrian and bicycle accommodations, it is not yet standard practice. In fact, according to the latest version of the AASHTO Green Book, "the first step in the design process is to define the function that the facility is to serve." The designer then determines the level of service needed to fulfill this function for the anticipated volume and composition of traffic.[5] For a mention of the need to rely upon the public process in defining other design controls, one needs to consult another AASHTO publication entirely.[6]

To create roads that work for all users, planners, in cooperation with the public, must identify design controls beyond those of functional classification, level of service, and speed early in the planning and design process. Other control factors that measure a community's desire for increased walking, biking, and transit travel, increased safety for older drivers, economic revitalization of a corridor, or environmental protection should

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2 AASHTO, *A Guide for Achieving Flexibility in Highway Design*, Washington, D.C. AASHTO, May 2004a), pp. 17, 19.

3 National Cooperative Highway Research Program. "Report 500, Guidance for Implementation of the AASHTO Strategic Highway Safety Plan, Vol. 10: A Guide for Reducing Collisions Involving Pedestrians" TRB, Washington, D.C., 2004.

4 W.A. Leaf and D.F. Preusser, Literature Review on Vehicle Travel Speeds and Pedestrian Injuries, USDOT National Highway Traffic Safety Administration, DOT HS 809 021, October 1999, Final Report. See Table 10, p. 23.

5 AASHTO, *A Policy on Geometric Design of Highways and Streets*, 5th ed. (Washington, D.C.: AASHTO, 2004b), p. 13.

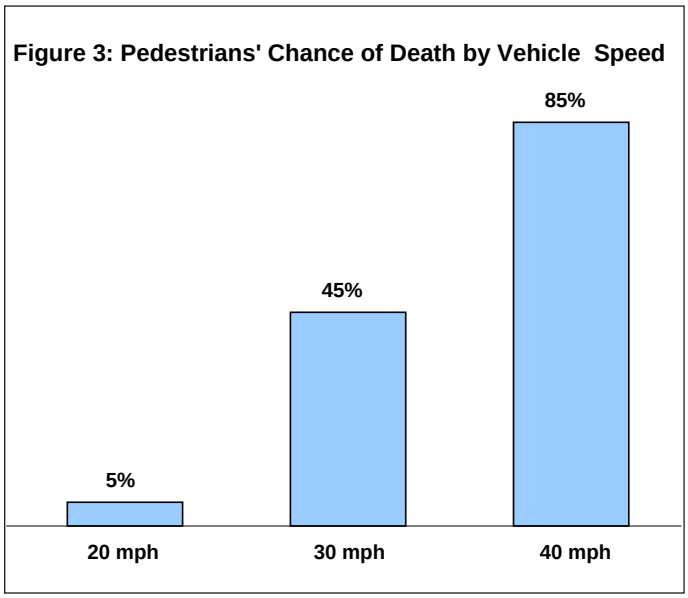
6 AASHTO, *A Guide for Achieving Flexibility in Highway Design* (Washington, D.C.: AASHTO, May 2004a).

inform the functional classification and other key design parameters, such as the number and width of lanes.

Functional Classification

The functional classification system defines public streets and highways by one of three major classes: local, collector, or arterial. The system was originally created for the purpose of defining roadway funding categories but has been widely adopted as a framework for roadway planning and design. The system is outlined in the AASHTO Green Book and universally used by state DOTs around the country as a fundamental element for highway planning, design, and engineering decisions.

Speed Matters: Pedestrians' chance of death increases dramatically with vehicle speed



Source: NCHRP, Report 500, Vol. 10, 2004.

In most highway plans and engineering projects, planners and engineers strive to balance the need for mobility (generally measured as speed or travel time between origins and destinations) and accessibility (generally measured in terms of proximity and connectivity within a given area). Arterial design favors mobility, while local street design emphasizes accessibility. Collectors serve a dual function in accommodating shorter trips and feeding the arterials; thus, they are engineered to provide some degree of mobility and also serve adjacent properties.[7]

Some transportation planners, engineers, and urban designers have challenged this "one size fits all" approach to roadway engineering, arguing that it exacerbates, rather than resolves, the conflicts between different roadway users, especially along arterials and collectors. The volumes of traffic these roads are expected to accommodate, coupled with an overarching goal of moving traffic, impose a design standard that favors speed and travel time. If this goal is not tempered by accommodating other users, travel environments that are inhospitable to pedestrians, bicyclists, and drivers with functional limitations can ensue.

7 AASHTO, *A Policy on Geometric Design of Highways and Streets*, 5th ed. (Washington, D.C.: AASHTO, 2004b).

For the foreseeable future, the functional classification system is firmly in place as a traffic engineering framework. Yet, transportation planners have realized that the simple array of definitions in the functional classification system do not fully define a roadway's purpose or its multimodal functionality. For example, a corridor classified as a principal arterial may serve a wide variety of purposes and roadway users depending upon its context. When it passes through a small town, it may serve as the local Main Street, where pedestrian safety is paramount and 25-mph design speeds are appropriate. A few miles away, it may transition into a 55-mph connector to the city, and then it may become a 45-mph urban boulevard serving an array of modes including buses, trucks, bicycles, pedestrians, and cars. It would be inappropriate to apply the same design standards to all these segments of the corridor, even though they all have the same functional classification.

New Approaches

Context Sensitive Solutions (CSS)

In response to the need for design criteria beyond the functional classification system, AASHTO, ITE, and the Federal Highway Administration have published Context Sensitive Solutions methodologies that show engineers how to introduce more flexibility into their road design processes so that a wider range of community values and user needs might be addressed.[8] The Context Sensitive Solutions (CSS) approach is defined as "a collaborative, interdisciplinary approach that involves all stakeholders to develop a transportation facility that fits its physical setting and preserves scenic, aesthetic, historic, and environmental resources, while maintaining safety and mobility."

In 2006, the Institute for Transportation Engineers and the Congress for New Urbanism (sponsored by the Federal Highway Administration and the Environmental Protection Agency) published a draft recommended practice titled *Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities*. The book provides planners and designers with guidance on adapting AASHTO policies and design guidelines in order to achieve context sensitive approaches for arterials and collectors in urban and suburban areas.

The publication introduces a design framework encompassing a spectrum of urban and suburban community "context zones" (*see Figure 4*) and thoroughfare types. Urban design and planning elements such as buildings, landscaping, land use mix, site access, and public and semipublic open spaces are the primary factors used to define context. The thoroughfare typology refines, but does not discard, the functional classification system by providing a range of design recommendations that correspond to the range of contexts served by a given corridor. *See Figure 5*.

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8 See ITE, *Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities*, Draft Recommended Practice, 2006; AASHTO, *A Guide for Achieving Flexibility in Highway Design*, May 2004; FHWA, *Flexibility in Highway Design*, 1997; and FHWA, *Community Impact Assessment*, 1996.

A Context Sensitive Solutions approach recognizes that street design will vary with changes to the surrounding land use and other environment features.

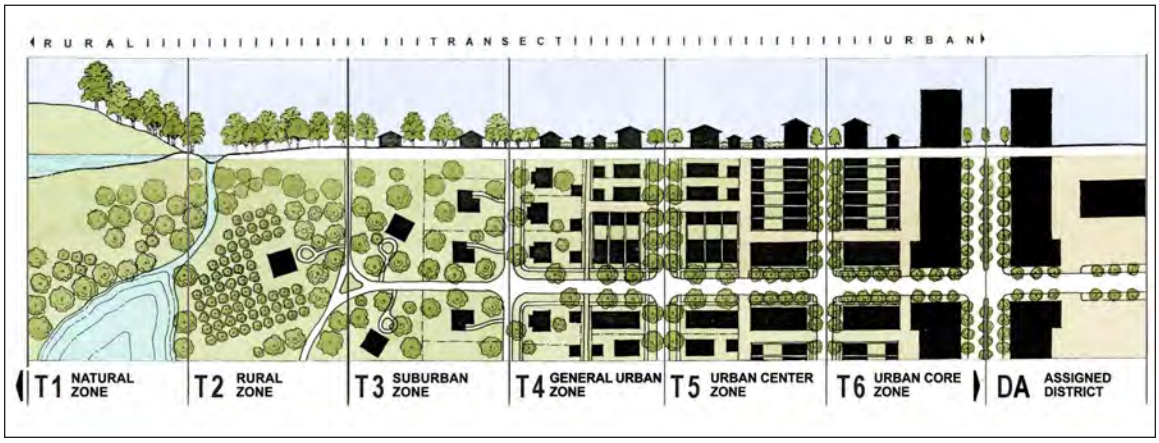


Figure 4. Illustration of a gradient of development patterns ranging from rural to urban contexts.

Source: ITE, Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities: An ITE Proposed Recommended Practice, 2006. Reprinted with permission from ITE and Duany Plater-Zyberk & Company.

For example, arterials in urban areas may be designed as boulevards, avenues, or streets, with design speeds ranging from 25 to 35 mph. They may be two to four lanes wide, with block lengths ranging from 300' to 1,320'. They may be constructed with or without medians, curb parking, bike lanes, or sidewalks. All these design factors and more are defined for different community contexts.

The ITE guidebook offers design guidance not only for the roadway (lanes, medians, on-street parking, bike lanes) but also for the roadside (e.g., sidewalks and planting strips) and intersections (e.g., curb radii, channelization, and crosswalks) for road types according to their context zone and whether they are located in predominantly residential or commercial areas. While the broader approach is complex in its presentation, its flexibility may serve to expedite projects by making road design compatible with its surroundings and community goals. While not specifically stated, this approach allows transportation agencies and land use planners the opportunity to address the needs of older road users.

Complete Streets

A Complete Street is safe, comfortable, and convenient for travel by automobile, foot, bicycle, and transit, regardless of age and ability. The focus of Complete Streets initiatives has been to encourage local, regional, and state planning agencies to change policies and procedures so that multimodal accommodations are a routine part of project development. Usually this means putting more of an emphasis on the needs of pedestrians, bicyclists, and transit riders, but the intention is not to design the car out of the picture. Rather, the aim is to "right the balance" in a transportation planning system that is currently tilted toward automobiles. People who live in communities with Complete Streets reap the benefits associated with walking and bicycling, such as increased physical activity, broader travel choices, and improved safety.

Using a CSS approach, engineers have more flexibility to tailor road design to the surrounding context.

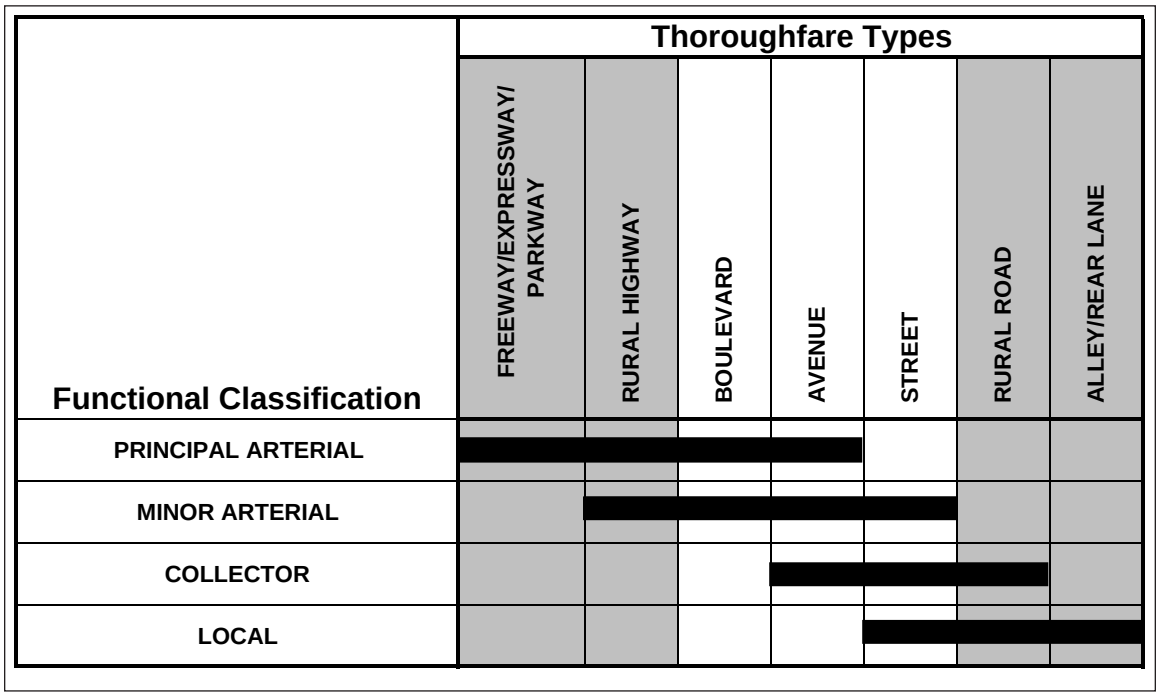


Figure 5. Relationship between functional classification and thoroughfare type.

Source: Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities: An ITE Proposed Recommended Practice, ITE. 2006. Reprinted with permission from ITE.

Complete Streets policies do not focus on design specifics. Like all policies, they are structured as vision and goal statements that provide broad direction to the agencies and individuals who will implement them. In order to ensure that their goals are carried out properly, some jurisdictions write their own design manuals or compile references to manuals such as AASHTO's *Guide for the Planning, Design, and Operation of Pedestrian Facilities*.

By adopting Complete Streets policies and developing design manuals, transportation agencies can address more effectively the needs of older road users. However, there is not currently a comprehensive reference document that offers solid guidance on how to design Complete Streets that address the specific needs of older drivers and pedestrians. The FHWA's *Highway Design Handbook for Older Drivers and Pedestrians* is an excellent resource, but it is not written from a Complete Streets perspective, in which the needs of all older roadway users are addressed simultaneously. The ADA Accessibility Guidelines are also highly informative, but do not address the needs of older drivers. A comprehensive manual on designing Complete Streets for older adults would be a valuable addition to the transportation planning and design practice. In addition, the improvements needed to make streets safer for older adults also improve conditions for other vulnerable populations, such as children. By designing Complete Streets that work for older adults, communities will reap the benefit of streets that work better for everyone.

A Good Complete Streets Policy -

- Establishes a vision for creating complete streets
- Specifies that 'all users' includes pedestrians, bicyclists, transit vehicles and users, and motorists, of all ages and abilities.
- Aims to create a comprehensive, integrated, connected network.
- Recognize the need for flexibility: that all streets are different and user needs will be balanced.
- Is adoptable by all agencies to cover all roads.
- Applies to both new and retrofit projects, including design, planning, maintenance, and operations, for the entire right of way.
- Makes any exceptions specific and sets a clear procedure that requires high-level approval of exceptions.
- Directs the use of the latest and best design standards.
- Directs that complete streets solutions fit in with context of the community.
- Establishes performance standards with measurable outcomes.
- Specifies implementation steps.

Planning and Promoting Complete Streets

Complete Streets policies seek to change the process of transportation planning so that the needs of everyone expected to use the facility are considered from the beginning. This is critical in ensuring the consideration of the needs of older travelers. A broad approach that begins well before design standards are written is crucial to success. Once the basic policies are adopted, four implementation steps should be taken to ensure this comprehensive approach:

- **Develop staff skills in planning and designing for all modes.** Many planners and engineers began their careers with training that focused on the needs of automobiles, without much regard to who was driving them or to other road users. Balancing the needs of all

Traffic Calming

Traffic calming is the application of roadway engineering measures such as roundabouts, speed humps and raised crosswalks, designed to reduce vehicle speeds and improve quality of life. Traffic calming is typically applied in residential areas or central business districts where pedestrian safety and comfort is a top priority.

Traffic calming is not synonymous with complete streets, as a street may be complete at any speed. But traffic calming techniques can help make streets safer for pedestrians and bicyclists by slowing drivers down.

users is a challenge, and doing so with every project requires new tools and skills. For example, the state of South Carolina has used its Complete Streets policy to launch a comprehensive training program for staff.

- **Rewrite and/or refocus agency policies and procedures to serve all modes.** Many transportation agencies use transportation planning procedures focused on automobile capacity measures such as a higher LOS. They have not established a systematic way to determine all the types and modes of travelers along a corridor and to make sure their needs are met. The policy change should result in a restructuring of everyday procedures, beginning with much broader scoping processes, and new ways to decide on trade-offs. For example, in Charlotte, North Carolina, transportation planners are using a new six-step Complete Streets planning process that systematically evaluates the needs of all modes, focusing on fixing gaps in the network for nonmotorized and transit users. Once that evaluation is complete, an iterative process begins to decide on the best design features. In many cases, a project that fails to accommodate all expected modes must seek special approval.

- **Rewrite and/or adapt design guidelines to address the needs of all travelers using all modes.** This is the step most relevant to this report. Only a few jurisdictions have completely rewritten their primary design manuals, most notably Massachusetts and the cities of Charlotte, North Carolina, and Louisville, Kentucky. A few places have established new street classification systems and typical cross-sections as an overlay to the traditional functional classification system. Many others use existing references, simply expanding their reach to include manuals that cover design for bicycle, pedestrian, or persons with disabilities.

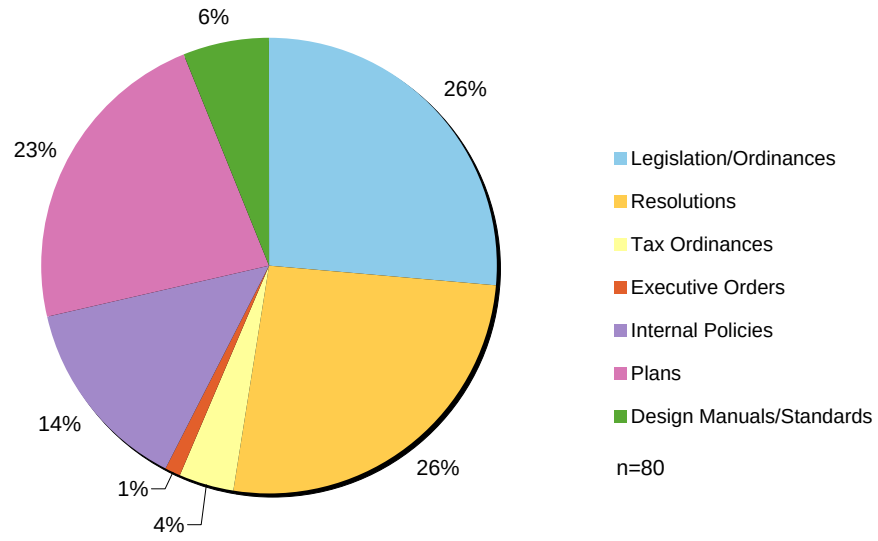
- **Collect data on all users and modes for performance improvements.** An important aspect of successful Complete Streets planning is having the tools to assess the success of new projects in meeting the needs of varied users. This is often a challenge because of a lack of data, particularly about nonmotorized users. In addition, some of the goals may be more qualitative than quantitative. Communities such as Destin, Kissimmee, and Boca Raton, Florida, and Ft. Collins, Colorado, among others, have adopted multimodal LOS standards to try to meet this challenge.

Inventory and Assessment of Complete Streets Policies

As part of this project, the study team conducted an analysis of existing Complete Streets policy documents to identify those that acknowledge the needs of older drivers and/or pedestrians. Complete Streets policies are being adopted by states and by local jurisdictions across the country. This review encompassed the 80 policies in the National Complete Streets Coalition's database as of the end of 2008. Policy types range from local ordinances to simple resolutions to lengthy comprehensive and transportation plans, as well as rewritten street design manuals, all with the intent of accommodating all users in transportation projects. Five jurisdictions have adopted more than one type of policy, so in

Complete Streets policies can take many forms

Figure: 6: Percentage of Complete Streets Policies by Type



all, at the end of 2008, 75 jurisdictions have adopted Complete Streets policies.

Twenty-one policies are in the form of state legislation or adoption of municipal ordinance. Twenty-one states, cities, or counties have passed Complete Streets resolutions, 12 have adopted policies through internal directives, and another 18 have included Complete Streets in transportation or comprehensive plans. Five jurisdictions have adopted more extensive design manuals reflecting Complete Streets principles, and three transportation funding measures have included a Complete Streets provision. *See Figure 6*. The inventory table found in Appendix C is sorted by policy type, jurisdiction, and state. It includes a listing for the USDOT guidance document that has been the basis for many state and local policies, but this document was not included in the analysis.

Not all the surveyed Complete Streets policies address the needs of all travel modes. Forty-one percent, a total of 33 policies, address only bicycle and pedestrian travel. Another 26 policies add transit users, and 21 discuss balancing the needs of these three user types with the needs of motorists, freight, or both. *See Figure 7*. One policy type, the comprehensive plan, is most likely to include all modes—44 percent of these policies address all roadway users.

The inventory also accounts for how many policies specifically include the needs of older users or persons with disabilities. Of the 80 policies analyzed, 58 make some reference to addressing these needs, with most of those references to persons with disabilities. Only 30 policies (38 percent) make specific mention of older adults, but few of these references were extensive. *See Figure 8*. The most common reference (18) was use of the phrase "users of all ages and abilities" in the opening section of the policy. Not surprisingly, 11

of the policies with a more extensive discussion are the longer and more involved policies found in comprehensive or transportation plans.

A number of policies also refer to "meeting ADA standards." In policies that include sections on specific user types (bicyclists, pedestrians, etc.), very few expand upon that intent by discussing the different travel needs of children, older people, or people with disabilities. Almost all the discussion of older travelers focuses on the needs of older pedestrians.

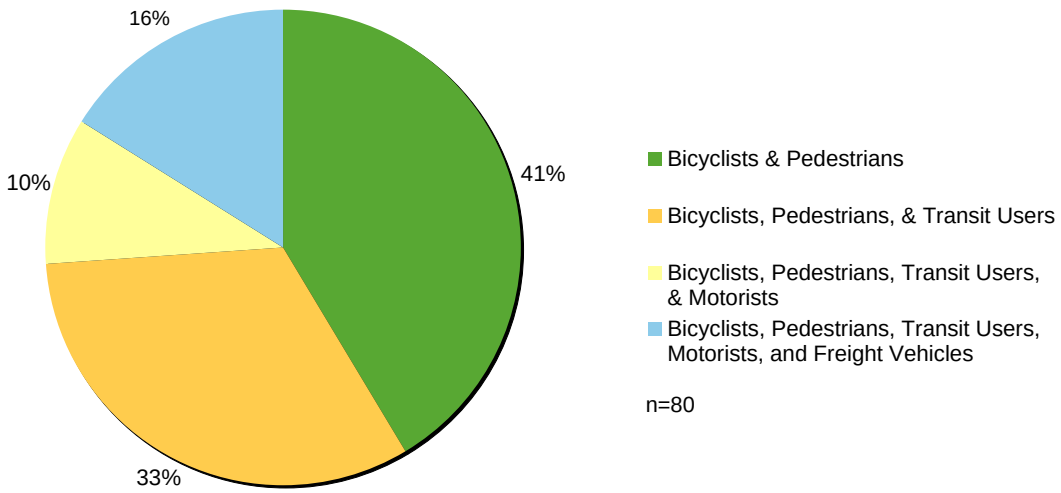
Five jurisdictions have written more extensive design manuals to accompany their Complete Streets policies. They include Charlotte, North Carolina; San Diego and Sacramento, California; Basalt, Colorado; and the Commonwealth of Massachusetts. Several others make some mention of specific design treatments. The other policies either refer readers to outside design guidance or do not mention design.

Only a few mention the Americans with Disabilities Act Accessibility Guidelines (ADAAG), and none mention the more recent Public Rights-of-Way Accessibility Guidelines (PROWAG), which are more specific to street design. Not a single policy mentions the FHWA's *Highway Design Handbook for Older Drivers and Pedestrians* as a resource.

This review was an analysis of written policies, and so does not capture the ways that policies may have opened the door to greater consideration of the needs of older adults in transportation planning. For example, Kirkland, Washington, won an EPA Achievement Award for Active Aging, in part because of its implementation of its Complete Streets policy. In Honolulu, a Complete Streets amendment to the city's charter was championed

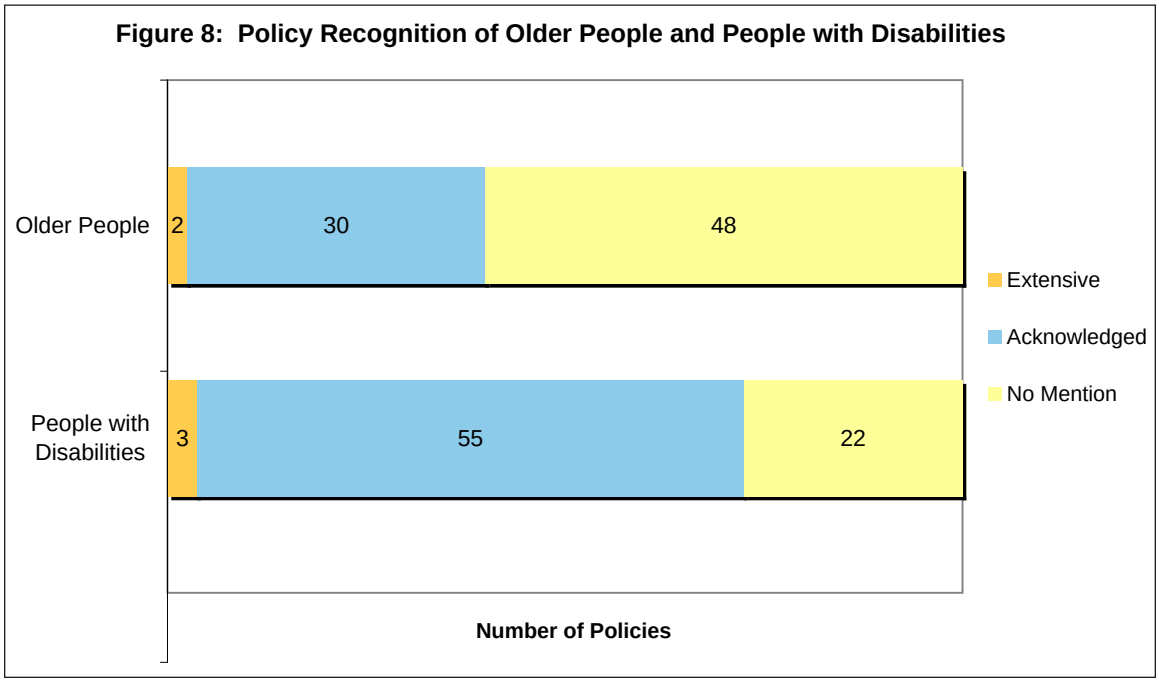
While all Complete Streets policies address pedestrians and bicyclists, few are so comprehensive as to address the needs of transit users, motorists, and freight vehicles.

Figure 7: Percentage of Complete Streets Policies by Mode



Few existing complete streets policies acknowledge the needs of older road users.

Figure 8: Policy Recognition of Older People and People with Disabilities



by the state AARP chapter, which has continued to work to promote pedestrian safety.

That said, it is clear that most Complete Streets policies can do more to recognize the needs of older adults, specifically by incorporating the three planning and design principles discussed in Chapter 4.

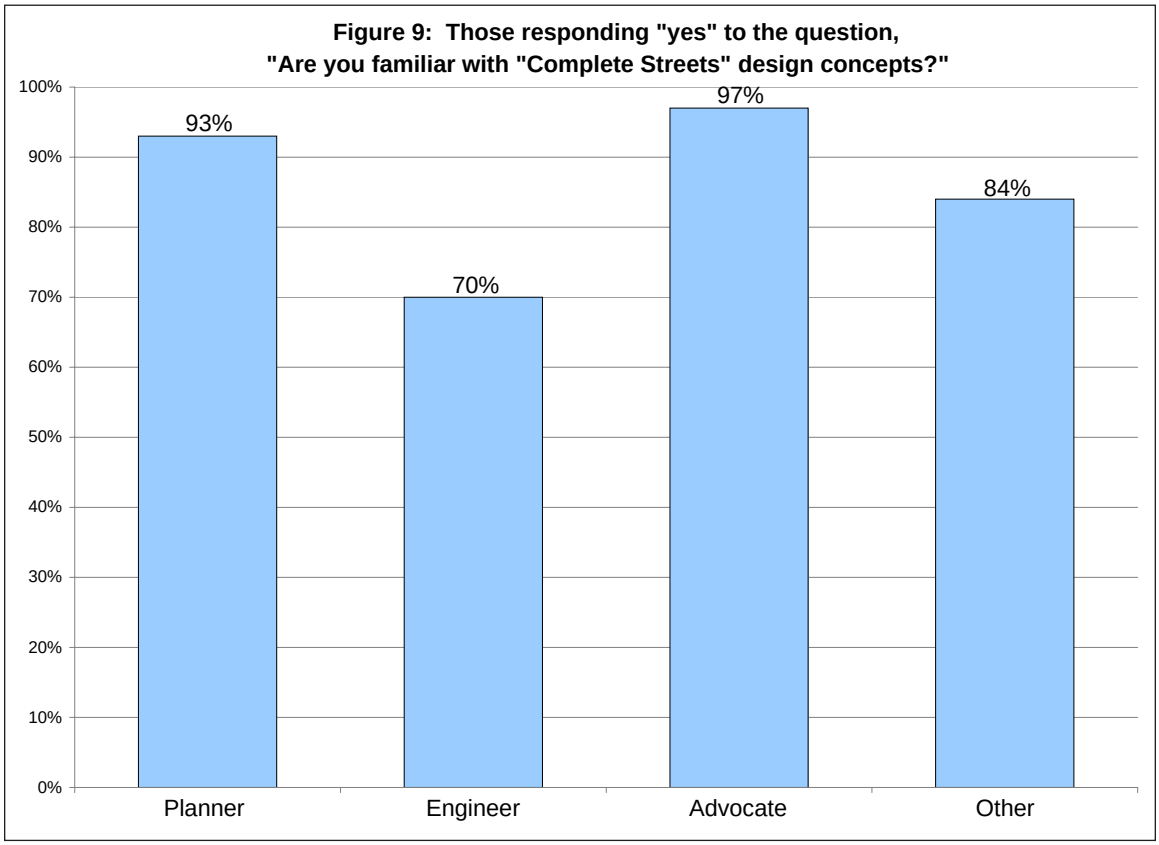
Complete Streets Survey

In July 2008, AARP's Public Policy Institute (PPI), in association with the Institute of Transportation Engineers (ITE) and the National Complete Streets Coalition, conducted an online survey of more than 1,100 state, regional, and local transportation engineers and planners. The survey was intended to identify keys to success for planning and implementing Complete Streets and older driver safety projects. Approximately 60 percent of respondents were engineers, and 20 percent were planners. The remaining 20 percent were advocates, academics, and other interested parties.

Almost 80 percent of all respondents were familiar with the concept of Complete Streets. Planners were more familiar than engineers. *See Figure 9*. One-quarter of respondents said their jurisdictions or agencies had policies that require multimodal planning on all projects; another quarter said their policies partially required multimodal planning. One quarter were unsure if they had such policies.

The survey also asked about respondents' familiarity with FHWA's *Highway Design Handbook for Older Drivers and Pedestrians*. Only six percent said the FHWA Handbook and their multimodal policies were "very helpful" in resolving potential conflicts between

Planners tend to be more familiar than engineers with Complete Streets



older drivers and pedestrians.

Survey respondents also were asked to describe difficulties in accommodating the needs of multiple roadway users. Major barriers included limited funding (72 percent), lack of political support (54 percent), lack of political authority (41 percent), and conflicts between state DOTs and local jurisdictions (52 percent), between state DOTs and MPOs (31 percent), or between MPOs and local jurisdictions (22 percent).

In response to an open-ended question on the same subject, most respondents cited lack of funding and limited rights-of-way. Others noted difficulties making multimodal improvements on roads with major traffic congestion and balancing roadway capacity with other needs. In addition, respondents cited a lack of planning and engineering personnel knowledgeable about multimodal design, the challenge of balancing Complete Streets needs with DOT standards, general resistance to change, and a lack of public and political support.

Respondents were then asked to describe how their particular challenge was addressed. Many respondents indicated that the challenge is still an ongoing struggle. Others cited strategies and approaches, such as the following:

- Include more context sensitive design guidelines for roads and development projects.

COMPLETE STREETS POLICY EXAMPLES

Charlotte, North Carolina

Charlotte, NC has adopted an innovative Complete Streets policy, and has written Urban Street Design Guidelines to aid in its implementation. The second chapter of the Guidelines is a very readable answer to the question, "What does each user want from its streets?" with sections covering motorists, transit vehicles and users, pedestrians, and bicyclists. The chapter does not address the differing needs of older users of these modes, but does discuss the challenge of balancing the needs of different users.

Decatur, Georgia

The Community Transportation Plan adopted in 2008 by the city of Decatur, Georgia, a small town surrounded by suburban Atlanta, makes it clear that this town's transportation emphasis will shift to promoting human health and safety:

"The creation and support of a healthy and active community is at the heart of the Decatur Community Transportation Plan. For this plan and the City of Decatur, that means establishment of a safe, integrated, transportation system that promotes bicycling and walking as a viable alternative to automobile travel, increased connectivity between neighborhoods and destinations, and equity for users of all ages and abilities."

The plan lays out ways to increase opportunities for nonmotorized travel, making specific mention of "the City's most vulnerable populations such as low income households, children and older adults, all of whom experience differing physical, mental and financial challenges to mobility." Drawing upon information such as a townwide Health Impact Assessment, the plan makes numerous references to accommodation of older pedestrians through application of Universal Design principles with special attention to intersection design.

California

In March 2001, the California Department of Transportation, Caltrans, first adopted a Complete Streets policy for state roads, Deputy Directive 64. While it was a progressive policy, it was focused almost exclusively on accommodation for bicycles and pedestrians. In October 2008, Caltrans adopted a revised version of that directive, much stronger in language and reach. The new policy addresses users of all ages and abilities and shows that Caltrans recognizes bicycle, pedestrian, and transit modes as integral elements of the transportation system, and will plan for all modes in all future projects. The stronger Caltrans language was developed even as a bill worked its way through the California legislature, with support from the state AARP chapter. The new state law was signed in September 2008 and brings Complete Streets concepts to local roads, by mandating that counties and cities include Complete Streets policies as part of any update to the transportation element of their general plans. This will present an ongoing opportunity to address the needs of older adults as part of the comprehensive planning process.

Adopt flexible LOS standards and "routine accommodation" mandates.

- Organize a comprehensive stakeholder process that acknowledges the trade-offs involved in developing a workable solution. Users should be prepared to compromise in order to achieve a "mobility balance."
- Refocus planning, design, and maintenance resources to ensure the needs of pedestrians and bicyclists are met.
- Pursue multiple avenues of funding such as Council of Governments funding combined with state and local funds; federal enhancement program grants; highway

Example Multi-Modal Roadway Projects

A little more than a third (37 percent) of Complete Streets online survey respondents said their agency or jurisdiction incorporated the needs of older drivers and pedestrians into multimodal planning and project design. These respondents were asked to describe one multimodal project completed by their organization within the last two years that demonstrated principles of Complete Streets as well as safety for older drivers and pedestrians, as well as pedestrians and bicyclists of all ages. Most of the projects cited (45 percent) were on arterial roadways. Projects on collector roads (16 percent) and residential or local roads (11 percent) were also described. Nearly one-quarter of the projects were on some other form of road, or an unknown type.

Respondents were asked to identify the type of community (or land use context) in which their selected project was completed. The majority (58 percent) took place within an urban or suburban land use context such as a downtown mixed-use center (22 percent), urban residential area (12 percent), suburban commercial/office center (12 percent), or suburban residential area (12 percent). Seven percent of the projects were in small town or rural settings. Another 27 percent took place in midsized cities with populations from 100,000 to 499,999. Eighteen percent took place in towns (10,000–49,999) or small cities (50,000–99,999). Five percent of projects took place in rural communities of fewer than 10,000 people, while 12 percent were in cities of more than 500,000.

Respondents were asked to name the ways in which their project incorporated design elements for older drivers/pedestrians and Complete Streets. Most of the older pedestrian accommodations were also beneficial to all pedestrians, such as ADA accessible sidewalks and ramps, pedestrian refuge medians, reduced crossing distances, pedestrian crossing signals, fewer travel lanes, additional public space, streetscaping, benches, and bus shelters. Similarly, the most popular Complete Street design elements were wide sidewalks, 4-feet shoulders, bike lanes, transit stops, shorter crossing distances, reduced speed limits, curb extensions, road diets, planted medians, street trees and buffer strips, and improved crosswalks. The most common measures that addressed older drivers and pedestrians specifically were larger street signs and longer crossing times for pedestrians.

funds; local revenues; and state funds for roads and transit.

- Reduce the need for public expenditures by changing zoning and subdivision regulations in order to promote more efficient development.
- Have patience—these processes take a long time.

Appendix B includes the online survey instrument and responses.

CHAPTER 4

BEST PRACTICES - MAKING STREETS WORK FOR OLDER TRAVELERS

PLANNING AND DESIGN PROCESS

Complete Streets planning processes usually begin with an assessment of the community context and the type of road users expected along a corridor. An analysis is conducted of the gaps in the system for different users—such as a lack of sidewalks. Planners and roadway designers then seek to make improvements that increase mobility and accessibility for all anticipated roadway users. *See Figure 10.*

By definition, a Complete Streets planning process should also address the needs of people in different stages of life and at different levels of ability. The need to expand transportation options has particular relevance for older Americans who need alternatives to driving. An AARP survey of Americans over 50 conducted in part for this study found that almost 40 percent of those polled reported inadequate sidewalks in their neighborhoods, while 55 percent do not have bike lanes or paths, and 48 percent say there is not a comfortable place to wait for the bus. Most sobering, almost half (47 percent) of poll responders say they cannot cross the main roads in their community safely. Half of those who reported such problems said they would walk, bicycle, or take the bus more if these problems were fixed (Skufca, 2008).

The Complete Streets planning and design approach provides an opportunity to address the needs of older road users.

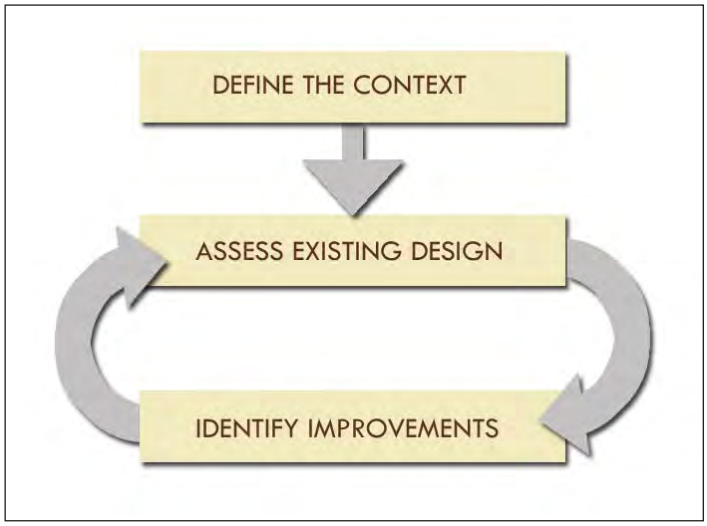


Figure 10. The Complete Streets Planning and Design Approach

A Complete Streets approach should also balance the needs of older drivers with those of older pedestrians. The wide lanes and gentle curves that may make travel easier for older drivers can make crossing the street a much bigger challenge for older pedestrians. Complete Streets planning processes should help transportation planners take the needs of both constituencies into account, consistent with the community's vision for the mobility outcomes it wishes to achieve.

PLANNING & DESIGN PRINCIPLES

As discussed in the section on the effects of physical limitations on mobility, the issues that commonly affect the safety and comfort of older drivers and pedestrians include declining vision, decreased physical fitness and flexibility, decreased ability to focus attention, and increased reaction time. Strategies to address these core issues can be organized around three basic planning and design principles explained below: Slow Down, Make it Easy, and Enjoy the View. Together these principles can aid designers in simplifying the road environment and increase its safety for all users. They can be applied to transportation project improvements at all stages, from initial planning to final design and construction, as noted below.

Slow Down

Reduce vehicle travel speeds in areas where vehicles and pedestrians interact and where older drivers and pedestrians need more time to make decisions and execute changes.

As discussed earlier, pedestrian injuries and deaths increase with increasing vehicular speed. In addition, older drivers who need more time to absorb information and make decisions may feel pressured in high-speed environments. This is especially true at intersections where 41 percent of fatal crashes involving drivers over the age of 64 take place (Eby, 2009). Older pedestrian deaths are also more likely to take place at intersections than are those involving pedestrians under the age of 65.[9]

To apply this principle in the planning realm, agencies and policy makers can establish goals and performance measures that seek to achieve optimal vehicle throughput at speeds that accommodate the needs of older drivers and pedestrians. For example, a traditional response to congestion problems along a suburban corridor is to maintain or increase vehicle capacity (measured principally by LOS and travel time or intersection delay) by widening the roadway or adding turn lanes. This can lead to increased vehicular speed.

An alternative approach would be to maintain or reduce overall corridor travel times and congestion levels while improving vehicle and pedestrian safety through strategies that aid in maintaining a desired target speed. These strategies include visual cues or physical changes that reduce real or perceived lane widths, in conjunction with improving operational efficiency through strategies such as access management and signal coordination.

Planning strategies such as these could be further strengthened by roadway design techniques aimed at keeping intersection size to a minimum and allowing sufficient signal timing for pedestrians to cross the street. Tighter curb radii at intersections require all drivers to navigate turns more slowly and serve to shorten pedestrian crossing

9 Calculated using 2006 FARS Encyclopedia.

distances. Roundabouts offer this "traffic calming" benefit plus an additional advantage to maneuverability by allowing drivers and pedestrians to monitor oncoming traffic from only one direction at a time.

Make It Easy

Make the physical layout of transportation systems easy to navigate for older drivers and pedestrians who have lost some of their dexterity.

Planning and design principles that can support better maneuverability focus on integrating transportation plans with land use policies and urban design standards in order to provide interconnected roadway networks, offering travelers a variety of multimodal routes to key destinations. Many of today's transportation networks, particularly in suburban areas, funnel virtually all travelers—drivers and pedestrians—onto a few large-scale arterials, which are typically designed for large vehicles moving at relatively high speeds. In addition to improving the design of these larger roadways in order to support the needs of older drivers and pedestrians, adding complementary grid networks of local streets provides travelers the option of lower-speed routes with smaller intersections that are easier to maneuver. These networks also shorten walking distances. *See Figure 11.*

Design treatments that improve maneuverability for pedestrians include strategies such as placing two curb ramps at each corner that lead directly into the crosswalks instead of one ramp in the middle that leads directly into the street. The latter design requires

Networks designed for proximity better accommodate older drivers and pedestrians

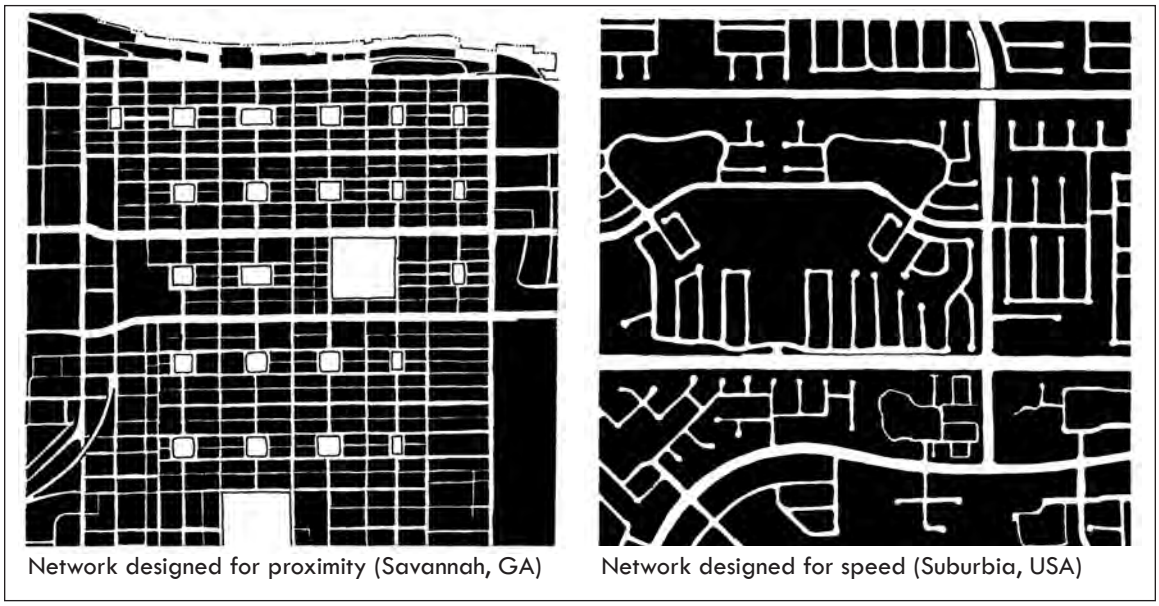


Figure 11. Speed vs. Proximity

Source: © MIT Press, 1993. Reprinted with permission from MIT Press.

people using wheelchairs, walkers, or strollers to quickly "zig-zag" over to the crosswalk after entering the street.

Another strategy is to avoid channelized free-flow right-turn lanes and/or use tighter angles for right turns in order to improve maneuverability for older drivers who have difficulty turning their heads. While more generous curb radii assist an older driver with limited upper body dexterity, slower intersection speed resulting from tighter curb radii benefits older drivers, while at the same time providing benefits to pedestrians as described above. The avoidance of channelized free-flow right-turn lanes allows older drivers with stiff necks from looking over their shoulders at an uncomfortable angle.

Enjoy the View

Make it easy for older drivers and pedestrians to notice, read, understand, and respond to visual cues and information.

Planners and policy makers can improve roadway visibility by adopting corridor design standards that reduce visual "clutter," such as oversized store signs and landscaping that make it hard for drivers to see important elements such as directional signs and pedestrians entering the roadway. They can also establish economic development policies and programs that support streetscape improvements such as burying overhead utility lines, further improving intersection visibility. Access management is another policy strategy that can improve corridor visibility by reducing the number of driveways and roadway signs that drivers and pedestrians must monitor.

Large-sized pedestrian countdown signals that can be seen easily from across the intersection or the median refuge improve visibility for pedestrians. For older drivers, visibility improvements can include retro-reflective signs, curb markings, and improved intersection signage and sight distance (both at and in advance of the intersection). Crosswalks painted with zebra stripes make pedestrians more noticeable to drivers.

Enriching Complete Streets policies and roadway planning and design methods to more specifically address these principles of speed, ease of navigation, and visibility will advance safety and mobility not only for older drivers and pedestrians, but for roadway users of all ages and travel modes. In addition, by adopting policies and practices that address these elements at each stage of project development—from policy to planning and design—the multitude of agencies and individuals involved in the process can communicate more clearly and consistently, so that the improvements envisioned in the plan are ultimately realized on the ground.

KEY DESIGN ELEMENTS FOR OLDER DRIVER AND PEDESTRIAN SAFETY

Older Drivers

Vertical and Horizontal Alignment

Vertical curvature can impede a driver's ability to see in the distance. Horizontal curvature can reduce a driver's peripheral vision. Roadway designers should avoid creating situations in which drivers may suddenly come upon a pedestrian or turning driver at the bottom or the crest of a steep hill (vertical alignment) or after rounding a sharp curve (horizontal alignment).

Pavement Markings

All drivers, but especially older drivers, can have trouble seeing poorly designed or maintained pavement markings, especially at night or in wet or foggy conditions. Longitudinal pavement markings that delineate the edge of the lane should be six to eight inches, rather than the four inch minimum. Retroreflective treatments, enhanced with other technologies such as oversized glass beads or raised pavement markings, improve wet-night recognition on edge and centerline markings. These treatments are is especially important for poorly lit and fast roads. The front and sides of median curb islands should be treated with retroreflective paint and/or reflectors.

Crosswalk markings can be invisible to drivers moving quickly and/or people with declining vision. Crosswalks should be designed to correspond to vehicle speeds, and made highly visible by means such as retro-reflective paint. Zebra striping draws greater driver attention to the crosswalk than two parallel lines. Alternatively, a combination style crosswalk with no paint inside the parallel lines, but with zebra striping outside the parallel lines can be used. This type of crosswalk may lessen the chance of falling from paint that gets slippery in rainy conditions. *See Figure 12.*

Combination crosswalks use zebra stripes to grab drivers' attention but keep the walking surface free of paint, which can become slippery when wet

Figure 12. Combination Crosswalk

Visual Clutter

Sign clutter is distracting and confusing to an older driver. A delayed or late reaction to an upcoming turn can be unsafe for all roadway users. Important directional signs and markings, particularly at decision points such as intersections, must be highly visible, not lost within a jumble of other signs or vegetation. Designers should create a visual clearance zone at intersections and near crosswalks, including only

those signs necessary for traffic safety.

Continuous Center-Turn Lanes

Continuous center-turn lanes (colloquially referred to as "suicide lanes") increase the chances for vehicular conflict among all drivers because turning movements become less predictable along the length of the roadway. While this issue affects drivers of all ages, older drivers are particularly challenged if they have lower visual acuity and increased reaction times. Confusion over their use can cause older drivers to stop in the through lane, leading to rear-end collisions. Roadway designers should limit vehicular turning movements to defined locations, using measures such as raised grassy medians to control these movements and increase roadway predictability. *See Figure 13.*

Watch out for "Suicide lanes!"

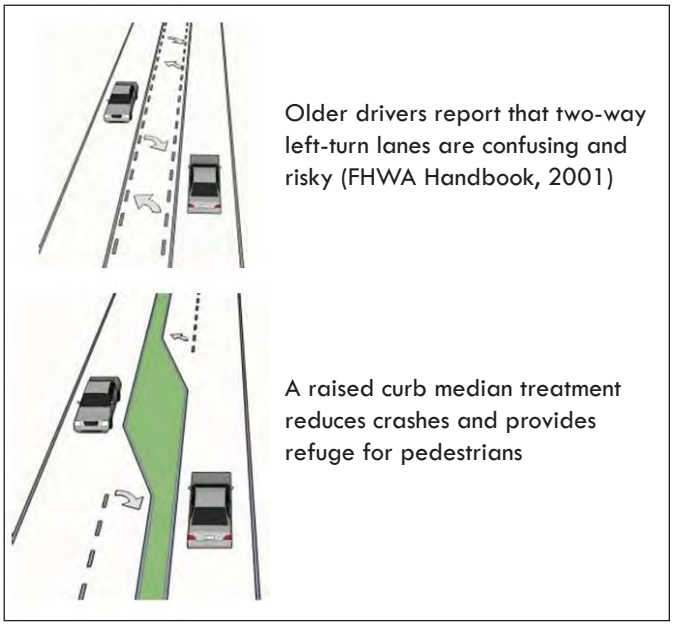


Figure 13. Comparison of a two-way left-turn lane and raised curb median treatment

Older Pedestrians

Pavement Maintenance and Materials

Road designers need to be concerned not only with the risks to pedestrians from motor vehicles, but also from falls. For those aged 65 and older, falls are the leading cause of death from injuries among older persons (Kochera, 2002). Uneven pavement can be difficult to navigate in a wheelchair, with a walker, or with a walking aid. Declining physical fitness and flexibility can make a bump feel like a mountain. Roadway designers should select smooth, strong materials for sidewalks and crosswalks such as concrete or asphalt rather than textured materials such as cobblestones or bricks. Paint can be used to highlight pedestrian areas, rather than elevating them or using knobby textures. Sidewalks should be maintained to ensure uneven pavement does not pose a hazard to pedestrians. Street trees should be chosen from species whose roots will not lift or break the pavement.

Curb Ramps

ADA standards require that curb ramps be included at all intersections; however, the design of ramps can be accomplished in a variety of ways. A single central curb ramp at an intersection can "dump" the pedestrian into the center of the intersection and to

the side of either crosswalk. People using wheelchairs or walkers in these situations may have a particularly hard time navigating to the crosswalk quickly and can become stranded in the roadway. Designers should provide a separate curb ramp directly aligned with the crosswalk and sidewalk approach at each leg of the intersection. Alternatively, designers can choose a single, continuous ramp that wraps around the corner from one crosswalk to the other.

Median Refuges

Older pedestrians need more time to cross streets, which presents a particular challenge for crosswalks on multilane and/or wide-lane highways. Small or complex crossing signal icons are hard to read from across the entire roadway for those who suffer from declining vision. Designers should break up the crossing distance on wider roadways with one or more median refuge islands that allow pedestrians to cross a single direction of traffic at a time for increased predictability and safety. Simple, highly visible crosswalk signs should be placed within the median if necessary.

Pedestrian Crossing Signals

Pedestrian crossing signals are a useful part of a complete street network. However, signals placed across a wide roadway may not be visible to older pedestrians with declining vision. In addition, complex placards can be confusing. Designers should provide pedestrian countdown signals rather than placards. For wider crosswalks, visual signals should be combined with audible signals, and crossing signals in the median may be warranted. Regardless of the width of the intersection, designers should set the walk signal time for a crossing speed of 3.5'/second plus 7 seconds to leave the curb, consistent with the proposed changes to the MUTCD.

Other Pedestrian Amenities

A lack of attention to streetscape detail discourages pedestrian activity and can even pose hazards to older travelers. Street lights scaled for automobiles can leave pedestrians in the shadows. A lack of benches and trees or awnings at transit stops can force pedestrians to stand for a long time in the hot sun. Narrow sidewalks with obstructions such as mailboxes, light posts, and fire hydrants leave no room for wheelchairs and walkers. Sidewalk amenities are important for all users; the following are especially critical for older people:

- Include pedestrian-scaled lighting to focus light onto the sidewalk, activating the sidewalk into the evening and improving visibility.
- Provide a wide sidewalk for wheelchair access and create room for outdoor cafes with awnings, benches, etc., transforming an uncomfortable, lonely pathway into a pleasant, visually interesting public plaza.
- Provide benches for sitting, resting, or gathering.

- Plant street trees for shade, enhanced aesthetics, and as a buffer between the sidewalk and roadway.

Balancing the Needs of Older Drivers and Pedestrians

Access Management

Strategies to consolidate multiple driveways into a few well-designed intersections address the needs of many different roadway users. Frequent driveways on main roads interrupt the pedestrian and bicycle network and create potential conflict points among turning vehicles, bicyclists, pedestrians, and oncoming traffic. Closing or limiting driveways along major roadways creates clearer pathways for all roadway users and less potential for conflict. Designers and planners should work together to create parallel access roads and shared driveways to improve access management.

Right Turn on Red

When a crossing signal reads "Walk," pedestrians begin crossing the street with the belief that it is safe to cross. Vehicles making right turns on red, however, may place the pedestrian in sudden, unexpected danger. Where pedestrian activity is high, designers should prohibit right turns on red and/or consider a roundabout as an alternative. Roundabouts keep traffic moving at a consistent but low speed and provide pedestrians with crosswalks that are set back from turning vehicles.

Protected Left Turns

Left-turn movements without the benefit of a turn arrow can put all road users in danger. Older drivers as a group experience difficulties when making left turns, as they do not position themselves within the intersection before initiating a left turn and they have more difficulty judging the speed of oncoming traffic to find a safe gap (Staplin, 1998). When focused on judging gaps in oncoming traffic, drivers of any age may fail to notice pedestrians in the crosswalk. To reduce the risk to drivers and pedestrians, a protected left-turn phase should be provided.

Protected left turn arrows become even more important at intersections with a pedestrian refuge island or median. The median creates a negative offset—pushing the drivers' line of site away from oncoming traffic and making it more difficult to judge gaps in traffic. See Figure 19, page 44.

Curb Radius

Curb radius describes the curvature of the curb between two legs of an intersection. Wide curb radii allow faster turning speeds and wider turning movements, lessening intersection congestion and facilitating vehicle mobility. However, higher speeds allow less time for drivers to look for other vehicles or pedestrians, and less time to make and execute decisions. These conditions are problematic for older drivers. Higher vehicle

speeds also increase the risk of serious injuries or fatalities to pedestrians, particularly among older adults. Wide curb radii also lengthen the crossing distance for pedestrians and make it more difficult to align the curb cut with the sidewalk approach. Roadway designers should use a 10'–15' maximum curb radius wherever possible, particularly in urban and suburban locations. The addition of parallel parking and bike lanes can increase the effective turning radius.

AN ASSESSMENT OF FHWA DESIGN RECOMMENDATIONS

One of the objectives of this research project was to review the FHWA's *Highway Design Handbook for Older Drivers and Pedestrians* through the lens of Complete Streets. The FHWA Handbook presents cost-effective solutions backed up by human factors and highway safety research. Given the increasing funding difficulties faced by state DOTs, the FHWA Handbook's emphasis is on providing solutions for new construction and reconstruction that have measurable safety results, rather than a systemwide retrofit. This is a positive and pragmatic approach.

The FHWA Handbook's design solutions go beyond mere policy. They offer engineers detailed recommendations that can be incorporated to "real-life" roadway design problems. The FHWA Handbook also offers a process for engineers to use in prioritizing strategies, based on safety issues specific to the community and relative cost benefit.

The great majority of the 31 recommendations in the FHWA Handbook are mode neutral. If states wholeheartedly implemented the mode-neutral recommendations, the safety of the U.S. road system would be greatly enhanced—for drivers in particular, yet without detriment to other road users. Thus, it is not the objective of this research to discard the FHWA Handbook recommendations, but to examine them through the lens of Complete Streets and offer refinements to better address the simultaneous needs of all road users.

General Issues and Opportunities for Refinement

Focusing Equally on Pedestrians and Drivers

While the FHWA Handbook is titled *Highway Design Handbook for Older Drivers and Pedestrians*, the discussions and recommendations are primarily focused on the older driver. For example, the introduction provides only one mention of the older pedestrian compared to 18 references made to the driver. The preponderance of research on drivers versus pedestrians dictates this outcome, because the FHWA Handbook presents only empirically based recommendations. Still, while it may not be possible to give equal weight to pedestrians throughout the FHWA Handbook, more discussion about the design considerations for the older pedestrian would greatly enhance the document.[10]

10 The FHWA Handbook bases its recommendations on a solid understanding of the available

The scope of the FHWA Handbook does not permit discussion of the growing debates among research, planning, and engineering communities on how to design roads for safety. Increasingly, planners and engineers challenge traditional highway design practice that tends to promote suburban roadways designed to provide mobility for the personal vehicle, often at the expense of other road users. The human cost of this traditional roadway engineering approach is significant. It exacerbates the social and physical isolation of nondrivers, not to mention the dangers imposed upon pedestrians and bicyclists.

Addressing Different Land Use Contexts

Understanding land use context is critical to balancing the needs of different users. Many suburban communities, small towns, and cities are seeking to build walkable, mixed-use places modeled upon the traditional city streetscape, and to expand public transportation options by creating a safe and comfortable walking environment around transit stops. Communities such as these would need to carefully consider whether the FHWA Handbook recommendations are appropriate for their situation. For example, the FHWA Handbook's recommendation to build acceleration lanes when applying channelization treatments (discussed below) may be appropriate for rural highways, but not for urban and suburban roadways with a mix of modes.

This emphasis on context, central to new approaches such as Context Sensitive Solutions and Complete Streets, is largely absent from the FHWA Handbook. Readers should understand that the FHWA Handbook's recommendations are appropriate primarily for rural highways and new, suburban higher-speed roads.

In a few instances the FHWA Handbook mentions the need to consider the surrounding land use when designing for improved mobility of older adults, but there is room for much more information on this topic. For example, adding several design iterations for each of the intersection recommendations could demonstrate ways in which the needs of older drivers and pedestrians can be addressed, given the functional classification of the road (residential, collector, arterial) as well as the land use context (urban, suburban, rural). The CSS framework could serve as a structure to present the FHWA Handbook recommendations.

Considering the Effects of Vehicle Speed

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research on human factors and highway safety. Unfortunately, there is much less research on older pedestrians and other road users than on older drivers, and most studies lack a multimodal analysis of safety. Furthermore, the current practice of highway safety research is largely based on the use of safety surrogates rather than actual observances of safety outcomes, such as crash frequency and severity (Hauer, 2007). When field or laboratory studies of driver behavior were not available, the research referenced in the FHWA Handbook relied upon these surrogates (driver reporting of comfort levels, observations of curb and lane encroachment, change in speed, etc.). This weakness in the current state of road safety research makes it difficult to fully consider the interrelated issues of older drivers and pedestrians.

Guidelines for many roadway design elements, from lane widths to intersection treatments, vary depending upon the assumed design speed. Traditional engineering practice is to establish a design speed of 5–10 mph above the intended posted speed. Yet, research has shown that the speed at which traffic is moving has a significant impact on pedestrian safety. The risks of fatalities and severe injuries, particularly for older pedestrians, rise exponentially with driver speeds. The literature on context sensitive solutions emphasizes the importance—and the difficulty—of establishing design speeds that balance pedestrian safety with driver mobility in different land use contexts.

The FHWA Handbook recommendations do not indicate an assumed design speed, and the supporting research in the appendix does not clearly address the question of whether treatments apply equally to roads designed for varying speeds. This lack of information indicates a need for more research on this topic. In the meantime, the FHWA Handbook could benefit from discussions and, where appropriate, design iterations to address a variety of design speeds.

Intersection Design Assessment

Intersections are complex locations that pose many safety risks, particularly for older drivers and pedestrians. Different road users must make many individual decisions rapidly at intersections, while simultaneously anticipating or reacting to the decisions of others. These decisions are harder to make with reduced visual acuity, physical dexterity, and reaction times.

The FHWA Handbook recommendations on interchanges, roadway curvature, and passing zones (presumably for rural highways); construction/work zones; and highway-rail grade crossings present comparatively few potential conflicts among bicyclists, pedestrians, and older road users. In many cases, the recommended treatments to aid older drivers, such as larger sign fonts and retro-reflectivity, can benefit all travelers.

However, a few of the intersection recommendations could have the unintended consequence of benefiting one type of roadway user at the expense of others. For example, wide lanes and sweeping curves may make it easier for older drivers to navigate an intersection. But the increased crossing widths and potentially higher vehicle speeds associated with these types of design treatments can make conditions more difficult for older pedestrians.

These design conflicts are not unique to the FHWA Handbook. An energetic debate has been going on for some time among planners and engineers on how to balance the needs for roadway capacity and vehicle mobility with the needs of nonmotorized road users at intersections, specifically when designing elements such as lane widths and curb radii.

The following analysis identifies five types of potential older driver/pedestrian conflicts presented by the FHWA Handbook's "Intersection Design Element" recommendations, and offers supplemental urban and suburban intersection refinements intended to reduce

these conflicts and achieve greater compatibility with Complete Streets goals.[11] The design assessment elements described in this section are as follows:

- Receiving lane (throat) width for turning operations
- Channelization
- Offset (single) left-turn lane geometry, signing, and delineation
- Curb radius
- Pedestrian crossing design, operations, and control

Receiving Lane (Throat) Width for Turning Operations

FHWA Recommendation

A minimum receiving lane width of 3.6 m (12') is recommended, accompanied, wherever practical, by a shoulder of 1.2 m (4') minimum width.

As explained in the FHWA Handbook, older drivers have more difficulties maneuvering their vehicles through smaller areas. Narrow (10'–11') receiving lanes with no shoulder could provide insufficient width for turning vehicles, causing conflicts as left-turning vehicles cut the corner of the turn lane on the receiving street.[12] At the same time, the FHWA Handbook acknowledges that lane widths beyond 12' may result in "unacceptable increases in older pedestrian crossing times." The recommendation (minimum receiving lane width of 12' with a 4' shoulder) is intended as a compromise to accommodate the needs of older drivers and pedestrians, as well as larger turning vehicles. *See Figure 14.*

Discussion

The AASHTO Green Book provides substantial flexibility on whether lane widths narrower than 12' are appropriate for urban and suburban arterials.[13] While narrow lanes

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11 The project team's suggested design refinements focus on intersection design appropriate for urban and suburban areas where pedestrians are present and more multimodal transportation travel is desired. The authors' goal is to show examples of how designers could approach a particular intersection treatment through the lens of Complete Streets. The intent is not to exhaust the myriad design possibilities that inevitably depend on an engineer's understanding of the particular context in which the road is situated. The design refinements that follow build upon accepted engineering design guidelines, such as those offered by AASHTO, ITE, FHWA, and the U.S. Access Board. Appendix A cross-references the project team's recommendations with those very documents to show how their guidelines can be used in the actual implementation of more universal road design.

12 Several factors that can compromise an older driver's ability to remain within the boundaries of the turning lane include a diminished ability to view and process activity at the intersection and lack of strength needed to turn the wheel sharply enough given the travel speed to properly complete the turning movement (FHWA Handbook reference of McKnight & Stewart, 1990; and Staplin, Harkey, Lococo, & Tarawheh, 1997).

13 "The use of narrower lanes in appropriate locations can provide other benefits to users and the surrounding community, including shorter pedestrian crossing distances and space for additional through

A wide receiving lane and shoulder increase pedestrian crossing distance and may encourage faster driving

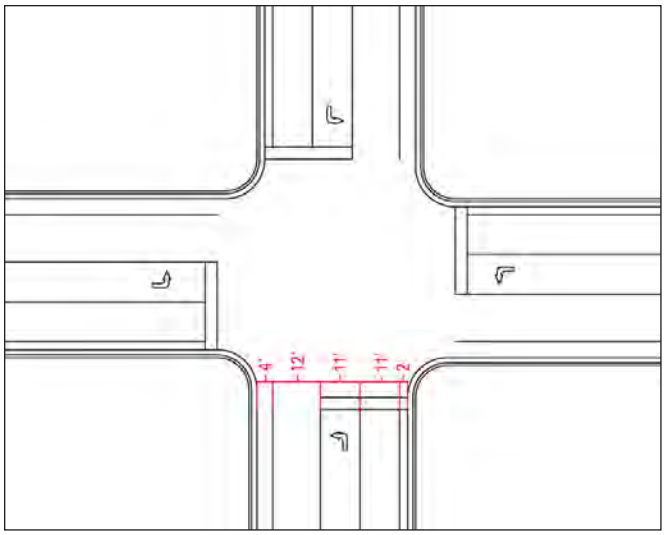

Figure 14. Authors' Illustration of Enhanced FHWA Handbook Recommendation

(less than 12') may be difficult for the older driver to maneuver in some cases, they are ideal for pedestrians, especially older pedestrians. Not only do they reduce crossing distance, they also tend to encourage drivers to drive more slowly and carefully.[14] Conversely, studies show that the safety benefit of wider lanes effectively stops once lanes reach a width of 11'; after that point, crash rates increase on lanes that approach or exceed the more common 12' standard.[15]

Narrower lanes are one element of roadway design that can contribute to lower speeds. Other factors such as roadway markings and landscaping can change the drivers' perception of their maneuvering area, causing them to feel as if they are traveling faster than they actually are and slowing down as a result (Massachusetts Highway Department Project Development and Design Guide [MassSAFE], 2004).

lanes, buffer areas between travel lanes and sidewalks, and placement of roadside hardware." I.B. Potts, D.W. Harwood, and K.R. Richard, "Relationship of Lane Width to Safety on Urban and Suburban Arterials," *Transportation Research Record: Journal of the Transportation Research Board*, no. 2023 (2007): 63–82.

14 As pointed out by Ewing (1999), narrow streets contribute to calmer traffic and less aggressive driving because drivers sense that there is a greater risk of traveling outside the lane and colliding with objects on either boundary of the lane. Several studies have found that reduced lane widths lower vehicular speeds. Yagar and Van Aerde "found a reduction in speed of 1.1 mph for every foot of reduction in lane width beyond 13 feet" (cited in Martens et al., 1997). Heimbach and colleagues found that on four-lane undivided urban roadways, during off-peak hours a foot reduction in lane width would result in traffic moving 0.6 mph slower. A 1.0 mph reduction in speed would occur during peak hours (Heimbach et al., 1983). Another study, titled "Design Factors that Affect Driver Speed on Suburban Arterials," suggested that on four-lane urban arterials for every foot the width of a travel lane increased, traffic traveled 2.9 mph faster (Fitzpatrick et al., 2000).

15 Recent studies indicate that increased lane widths and overall street widths are linked to increased crash rates and severity (Dumbaugh, 2005; King, 2003; Swift, 2006). Dumbaugh (2005) references Hauer (1999), whose examination of the literature found that there was "little evidence to support the assertion that widening lanes beyond 11 feet enhances safety. Instead, the literature has almost uniformly reported that the safety benefit of widening lanes stops once lanes reach a width of roughly 11 feet, with crash frequencies increasing as lanes approach and exceed the more common 12-foot standard." Similarly Potts and colleagues (2007) concluded that there is "no indication of an increase in crash frequencies as lane width decreased for arterial roadway segments or arterial intersection approaches."

Suggested Refinements

In most urban areas, the FHWA recommendation to widen the receiving lane can be accomplished through the provision of bike lanes. Additional travel lanes also provide the indirect benefit of additional throat width for a left-turning vehicle. In these areas, the FHWA Handbook standard should be refined to accommodate a 10'–11' receiving lane, ideally with an adjacent 5' bicycle lane. Bike lanes can increase the effective maneuvering space while still keeping speeds down, as drivers will adjust to the marked lane width. *See Figure 15*.

Bike lanes increase the effective maneuvering space without encouraging higher speeds and help to "complete the street"

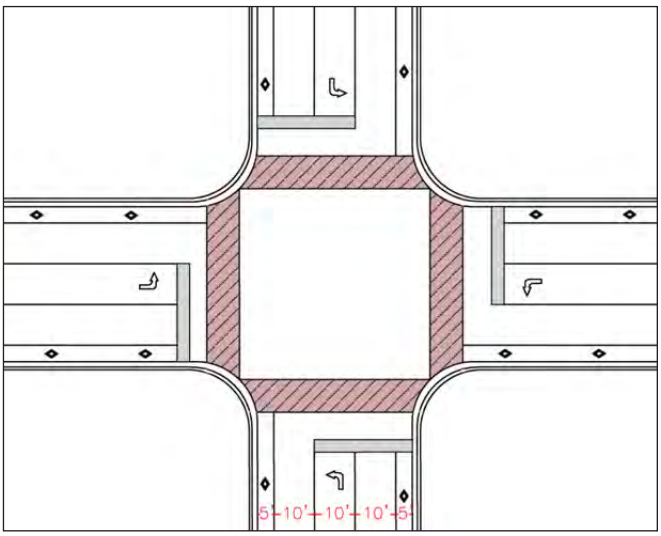

Figure 15. Authors' Refinement of Receiving Lane Treatment Appropriate for Urban Areas.

At intersections where it is necessary to accommodate heavy vehicles or other vehicles with a wider turning radius, it may be appropriate to move the stop bar on the receiving side back to accommodate a wider radius, as long as the recommended sight distance is not compromised.

It may also be useful for the FHWA Handbook to specify that the 12' receiving lane with 4' shoulder recommendation is a rural standard and may be accompanied by "share the road" signage where bicycle activity is expected. Lanes of 12' or greater should be applied, if necessary, on parkways, rural highways, and other types of throughways where traffic movement is the primary objective of the roadway.

Channelization

FHWA Recommendation

The FHWA Handbook does not endorse channelization but, rather, describes how it should be designed. For right-turn channelization where pedestrian traffic may be expected based on surrounding land use, it is recommended that an adjacent pedestrian refuge island conforming to the MUTCD and AASHTO design guidelines be provided. The crosswalk should be located as close as possible to the approach leg to maximize the visibility of pedestrians before drivers are focused on scanning for gaps in traffic on the

intersecting roadway.[16] The channel should be raised and treated with retro-reflectorized marking and maintained at a minimum luminance contrast level. The FHWA Handbook also discussed the need to provide an acceleration lane providing for the acceleration characteristics of passenger cars as delineated in AASHTO specifications.

Discussion

Channelization is used to separate and define travel paths. It directs drivers and pedestrians to the correct location when they are navigating through traffic medians or pavement markings. By providing a protected turning area with a large radius, channelized right turns allow all vehicles to turn more quickly and large vehicles to turn more easily. Some channelized right turns exit into a dedicated acceleration lane before having to merge into traffic (free right turn), while others require the merge to occur when exiting the turn itself.

The study team does not have concerns with the content of FHWA Handbook recommendation but, instead, with the issues left unstated. The FHWA Handbook does not discuss the physical fitness issues that may be at play for older drivers when they navigate channelized right turns. Furthermore, it fails to caution designers against using right-turn channelization in urban and suburban areas where pedestrians are present.

The FHWA Handbook discusses the decline of older driver's head and neck mobility and the difficulty in seeing and judging oncoming traffic at skewed intersections (Design Element A) but it does not discuss limited range of motion in the context of channelization. A channelized right turn requires a larger range of motion for a driver's head and neck, for which older drivers may be unable to compensate.[17]

In addition, since channelized turns are designed to keep traffic moving quickly around a curve, they present a short window of time for drivers to make merging or yielding decisions when exiting the channelized turn, which can be an issue for older drivers with slowed reaction times. As the angle at which the two roads intersect diverges from 90 degrees, the sight distance for turns diminishes, making it increasingly difficult for persons with reduced neck mobility to identify gaps. ITE's recent publication on context sensitive solutions (2006) justifies a low-angle turn to "slow down the speed of right-turning vehicles and improve driver visibility of pedestrians within and approaching the crosswalk." [18] While the FHWA Handbook does cite research pointing to increased

16 Found in FHWA Handbook Design Element P: Pedestrian Crossing Design, Operations, and Control.

17 The movement of neck rotation used to perform turns at skewed intersections is similar to the motion required for navigating a channelized right turn. In a study by Staplin and colleagues (1997) to determine whether older drivers used outside mirrors to help perform a right turn on red at a skewed intersection, 30 percent of drivers ages 25–45 and 65–74 used their mirrors, and none of the drivers over 75 used outside mirrors to help (FHWA, 2001). Channelization could be problematic for older drivers who are less physically capable of looking over their shoulder, and arguably less likely to use outside mirrors.

18 The AASHTO Green Book design calculations for sight distance are relevant for intersections

Channelized intersections designed for high speed place pedestrians outside the driver's cone of vision.

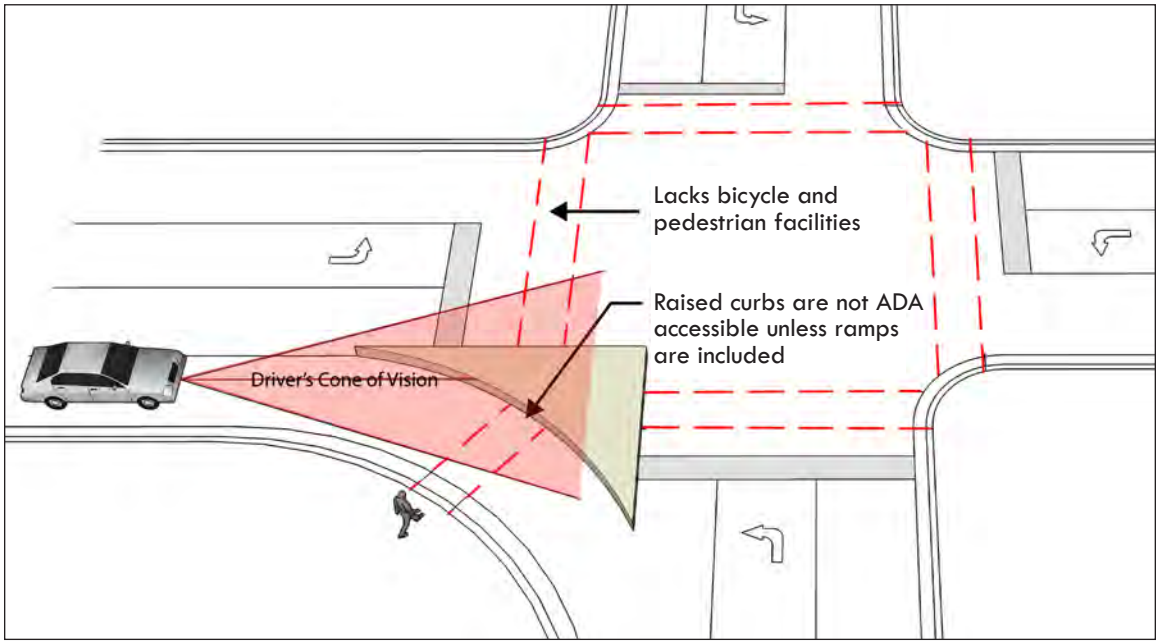

Figure 16. Illustration Showing the Challenges Faced by Pedestrians at Channelized Intersections.

older driver comfort with channelized right turns when acceleration lanes are provided, these lanes are undesirable for pedestrians as they increase pedestrian crossing distance and facilitate increased vehicle speed.

The FHWA Handbook references the benefits of the pedestrian refuge, as well as the fact that channelization can help clarify an ambiguous or complex intersection. However, it also notes that the presence of islands is unlikely to offset the pedestrian disadvantage at a large intersection (Hauer, 1988).

It also references studies that indicate vehicles move faster, are less likely to stop, and exhibit higher crash rates at channelized intersections with longer curb radii.[19] As the risk of pedestrian death in crashes with motor vehicles rises with speed, it can be assumed that higher vehicle crash rates and longer pedestrian crossing distances also contribute to a more dangerous situation for pedestrians.

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where roads intersect at an angle not less than 60 degrees. ITE's publication *Recommended Guidelines for Subdivision Streets* advises using a minimum of 75 degrees for the intersecting angle (ITE, 1984). The FHWA Handbook endorses this "75-degree minimum as a practice to accommodate age-related performance deficits" (FHWA, 2001).

19 A study by Staplin and colleagues (1997) found that higher turn speeds (3–5 mi/h) are common among younger drivers on intersection approaches with channelized right-turn lanes. The study also indicated that younger drivers were less likely to stop before making a right turn on red at channelized intersections. Additional recent research indicates that vehicle turning speed increases as the turn radius increases and, in most cases, vehicular crash rates are higher at channelized right turns than at right turns without channelization (Bauer, 2000; Fitzpatrick, 2005).

A tighter turn makes it easier for drivers with stiff necks to merge with traffic

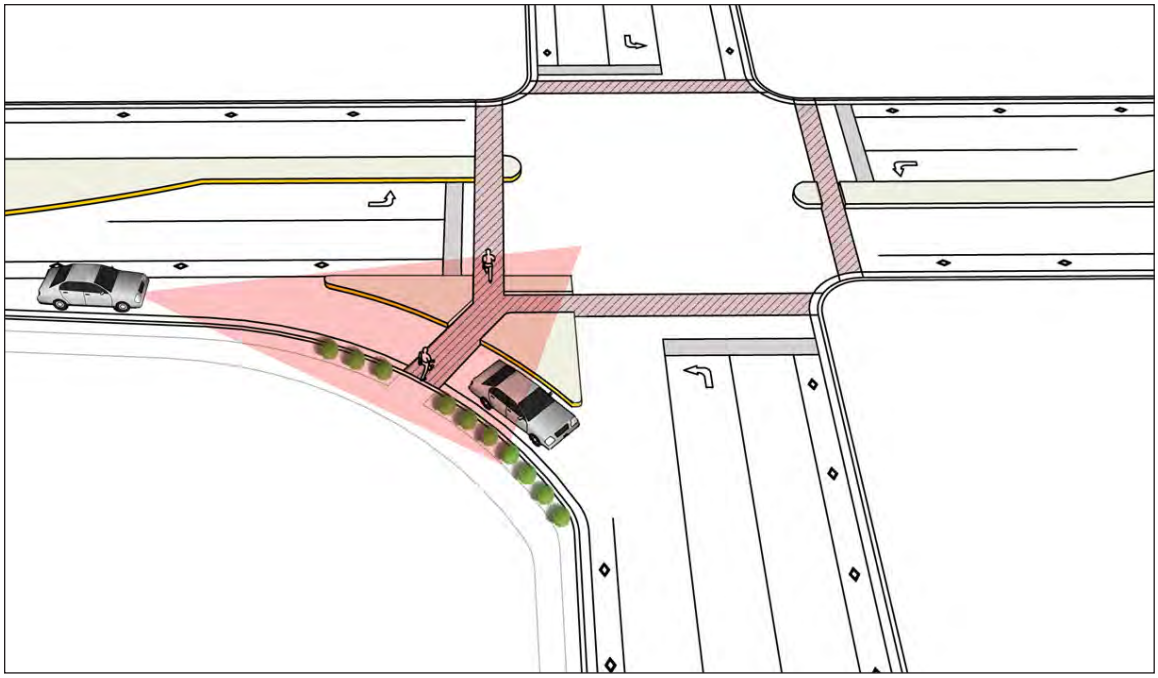

Figure 17. Illustration of Authors' Refinement Showing Pedestrian and Driver Improvements at Channelized Intersections.

Unmarked or improperly marked paths for pedestrians crossing from the curb to the channelized island refuge can cause dangerous situations. *See Figure 16.* Pedestrians at channelized intersections must cross from the curb to the island and then cross the lanes of traffic.

Research shows that poorer contrast sensitivity makes the painted channel marking less visible to older drivers. Without a visibly marked crossing path, drivers may not be aware of the presence of pedestrians at the intersection. Drivers may be unable to stop for pedestrians who cross too close to the approach, and are less likely to see pedestrians who cross too close to the receiving side. A clearly marked crossing alerts drivers to the possibility of pedestrians, and provides pedestrians with a clear safe path to follow. Advance warning signs would also remind drivers to be aware of crossing pedestrians. Installing "Yield to Pedestrian" signs reduces pedestrian crashes by 10 percent (ITE, 2004).

Suggested Refinements

As with all suggested refinements in this report, the first priority is to make sure the design treatment is appropriate for the context of the road and surrounding area. Channelization in urban and suburban settings should be discouraged, because of the potentially dangerous obstacles it can present to pedestrians. A non-channelized, 90-degree intersection accompanied by a prohibition of right turn on red (RTOR) is suggested to reduce conflicts between motorized vehicles and pedestrians and bicyclists. If RTOR

prohibitions are not used, yield to pedestrian signs should be used.

Where channelization is warranted, the older driver's cone of vision should be considered in designing the angle of a channelized turn. Pedestrian visibility to drivers should be the top priority. Tighter turn angles can reduce driver speeds and open the driver's vision to the potential presence of a crossing pedestrian. In addition, tighter angled channelized turns reduce the degree to which the driver's head must turn left in order to look for oncoming traffic. These attributes are particularly important for older drivers, who may have stiff neck issues. *See Figure 17.* Minimizing the curb radius can help increase pedestrian safety while reducing the width of the approach lane for the channelized turn can help reduce vehicle speed.

Crosswalks should be located 15'–20' behind the merge point of the channelized island to allow adequate space for a vehicle to stop and look left for oncoming traffic without blocking the path of pedestrians. This placement also enables drivers to scan the intersection for the presence of pedestrians in advance of needing to merge with traffic.

Landscaping treatments such as low prickly shrubs along the curb will confine pedestrians to crossing at the safest location. Other treatments such as rumble strips and raised crosswalks help to slow traffic and improve pedestrian safety. Signalizing the channelized right turn with an actuated pedestrian button further increases pedestrian safety, as right-turning vehicles are stopped by a red light while pedestrians are crossing.

As recommended by FHWA, if a channelized right turn is present in a pedestrian-oriented area, a raised curb is recommended with an at-grade crosswalk to provide refuge for crossing pedestrians, rather than demarcating the channel with surface paint alone. Contrast paint should be added to the curb side to make it more visible at all times of the day and under all driving conditions. The surface and sides of the median refuge should also be reflectively painted to increase visibility.

Positive offsets improve the line-of-sight for drivers making left turns.

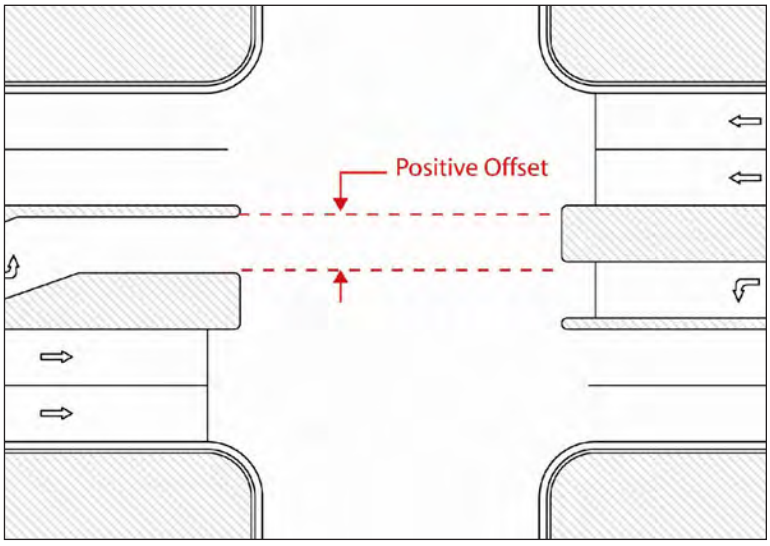

Figure 18. FHWA Handbook Illustration Refined to Show Positive Offset.

Participants in the online survey and the Innovation Roundtable assembled for this study mostly agreed with these suggested refinements. In general, survey participants discouraged channelization, encouraged raised islands especially in pedestrian-heavy areas,

supported a tighter angle for easier perception of approaching traffic, and opposed free-flow turns. To further improve the safety of pedestrians at intersections, Roundtable attendees recommended that right-turn channelization be replaced by right-angle turns in combination with a right turn on red (RTOR) prohibition. When a RTOR crash occurs, a pedestrian or bicyclist is frequently involved, and these types of crashes usually result in injury (Compton & Milton, 1994).

Offset (Single) Left-Turn Lane Geometry, Signing, and Delineation

FHWA Recommendation

Unrestricted sight distance (achieved through positive offset of opposing left-turn lanes) is recommended whenever possible, for new or reconstructed facilities. *See Figure 18*. This will provide a margin of safety for older drivers who, as a group, do not position themselves within the intersection before initiating a left turn

Discussion

Older drivers are overrepresented in left-turn crashes where failure to yield to the right-of-way is the movement violation. Typical underlying causes of these crashes include the misjudgment of oncoming vehicle speed, misjudgment of available gap, assuming the oncoming vehicle was going to stop or turn, and simply not seeing the other vehicle (Council & Zegeer, 1992, as discussed in FHWA Handbook, 2001). Older drivers as a group experience inordinate difficulties when making left turns, as they do not position themselves within the intersection before initiating a left turn. This can block the sight line to oncoming traffic for drivers waiting to make left turns from the opposite direction.

Attempting to make a left turn at an intersection where there is no protected phase can be difficult and dangerous to the older driver. Making a left turn during a permissive (unprotected) phase requires the driver to judge the speed of oncoming through traffic, identify an adequate gap, and execute the turn within the space allowed by the gap. When the oncoming traffic consists of two or more lanes, judging the speed and identifying a gap becomes considerably more difficult. In areas with pedestrian activity, left-turning drivers must also make sure that there are no pedestrians in the crosswalk that would block the vehicle from finishing the turn and proceeding safely out of the way of opposing through vehicles. Attendees at AARP's Innovation Roundtable asserted that permissive left turns with two or more lanes of oncoming traffic have very high pedestrian crash rates, and that permissive-only left turns are one of the leading causes for crashes in urban areas.

Obstructed lines of sight caused by queued vehicles in opposing left-turn lanes (i.e., negative offsets) can pose safety and capacity deficiencies for all drivers, particularly for those making unprotected left-turn movements. Older drivers may experience additional difficulties in completing left turns as a result of diminished ability to properly perceive

depth and speed of oncoming traffic.[20] Positive offsets are associated with larger sight distances (Joshua & Saka, 1992), which helps older drivers to judge gaps in opposing traffic, and they are associated with a reduction in crashes relative to permissive left turns without a positive offset.[21]

Positive offset treatments can, however, pose problems for pedestrians. Ideally, multilane roads would provide a median refuge for pedestrians unable to cross in the allotted signal time. However, this median introduces a negative offset, and an attempt to compensate for this by providing a positive offset for left-turning drivers creates an awkward location for a pedestrian to wait and is especially disorienting for visually impaired persons. *See Figures 19 and 20.*

Inclusion of a pedestrian refuge island creates a negative offset and blind spot for drivers turning left

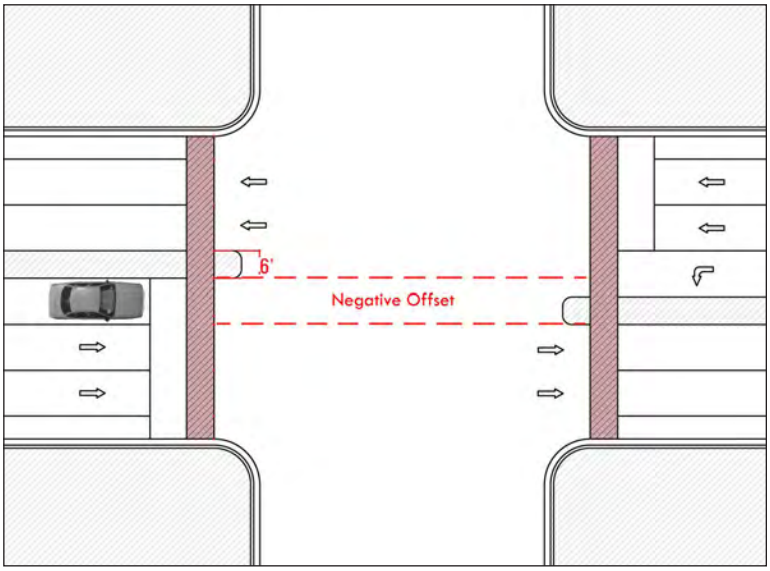

Figure 19. Illustration of Negative Offset Exacerbated by a Pedestrian Refuge Island

The additional space needed to provide the median also increases the total pedestrian crossing distance and required green time. Respondents to the online survey remarked that a pedestrian refuge must be at least 6' wide, which requires more right-of-way and increases crossing distance, while also failing to provide accommodations for bicycles.

Instead of addressing problems of restricted sight distance through geometric changes, a more affordable solution may be to make operational improvements such as traffic

20 Older drivers are found to require double the angle of stereopsis to perceive depth than is required for younger drivers (Staplin et al., 1993, as discussed in FHWA Handbook 2001). Additionally, older drivers require twice the rate of movement to perceive approaching objects as compared to younger drivers (Hills, 1975, as discussed in FHWA Handbook, 2001). These factors result in difficulty perceiving oncoming traffic and judging its speed while completing left turns.

21 Perception reaction time (PRT) also diminishes with age, which is an important factor in considering intersection sight-distance requirements for turning vehicles. Conclusions from several studies cited in the AASHTO Green Book report reaction times of 0.2 to 0.3 seconds for drivers under alerted conditions and 1.5 seconds under normal conditions (AASHTO, 2004b). To account for complexities beyond laboratory and road tests, AASHTO recommends a reaction time of 2.5 seconds, which is the minimum perception reaction time recommended by the FHWA Handbook. This amount of time is recommended in addition to the typical time needed to stop based on the road design speed.

signals with a protected left-turn phase (oncoming traffic is stopped, denoted by a green arrow). Left-turning drivers are protected from opposing drivers who are stopped at a red light, and from opposing pedestrians who have a "Don't Walk" light during the protected phase. When left turns are only allowed during a protected phase (thus prohibited during the general green phase), pedestrians are protected as they will not conflict with left-

This attempt to balance older driver and pedestrian needs by providing both a pedestrian refuge median and negative offset was rejected by engineers and planners.

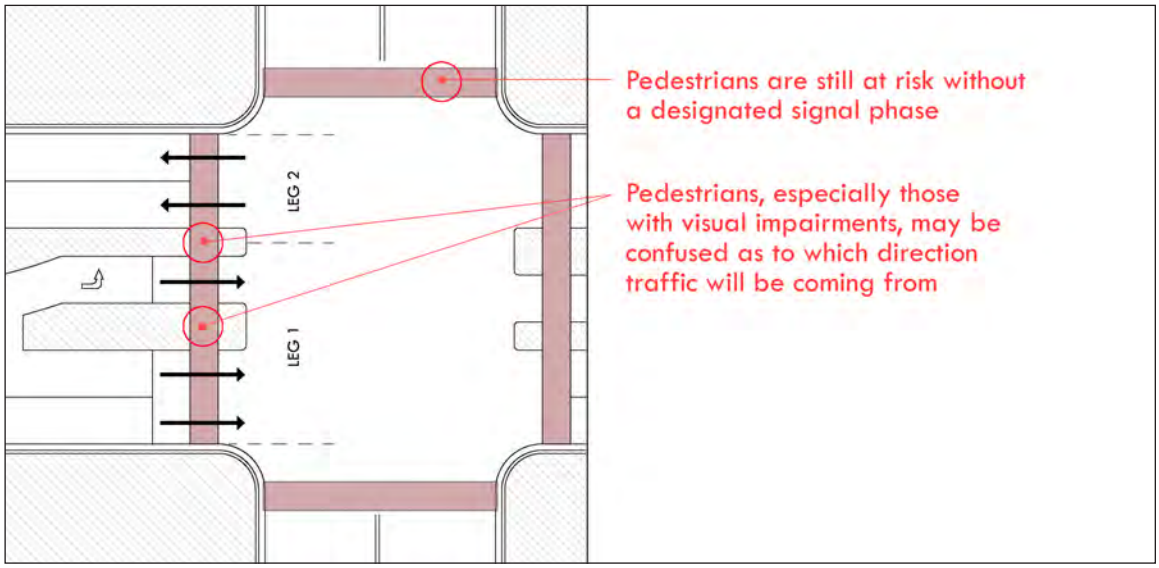

Figure 20. Intersection showing both a negative offset and pedestrian refuge median.

turning vehicles during the "Walk" phase.

A protected-only mode works best when the average daily traffic (ADT) is heavy, the use of through lanes is heavy, and the permissive left turn would result in a high frequency of crashes. The protected-only mode reduces left-turn crashes by 63–70 percent and has a particular safety benefit to the older driver (ITE, 2004).[22]

In spite of the safety benefits of protected-only left-turn phases, they present some drawbacks that can discourage an agency from universally implementing them. Providing protected phases requires green time from other phases that could decrease intersection capacity, especially on wide roads with long pedestrian crossing distances. In addition, protected-only left turns can frustrate left-turning drivers who are forced to wait even when there is no oncoming traffic.

22 Basha (2007) found collision rates at intersections with lagging left-turn arrows to be less than those at intersections with leading left-turn arrows. Left-turn head-on (LTHO) collisions make up 33 percent of all collisions at intersections in a city with leading left-turn arrows, while 21 percent of collisions are LTHO collisions in a city with lagging left-turn arrows (Basha, 2007).

Employing a phasing plan with a permissive left turn during the general phase and a lagging protected left-turn phase (solid green light, followed by a green arrow) is a comprehensive solution in most cases. Allowing left turns to process during the permitted phase reduces the queue of vehicles during the protected phase, which can give green time back to other movements. For older drivers who are less likely to position themselves within an intersection, a protected lag phase allows them time to execute the turn during the green arrow, while drivers behind them, who may normally become impatient, will have the opportunity to turn at the end of the general phase.[23]

Suggested Refinements

Depending upon the context of the intersection, a signal phasing plan with a protected left-turn lag phase will often provide more comprehensive benefits to older drivers and pedestrians than positive offset for the left-turn lane. This strategy provides an exclusive phase for drivers to make a left turn without risking conflicts with opposing traffic or pedestrians. It requires no additional pavement and does not increase pedestrian crossing distances.

Generally, if opposing through vehicular traffic is heavy, or if opposing pedestrian volumes are high, it may be best to restrict left turns to the protected-only phase. The presence of marked crosswalks between all quadrants of the intersection becomes more essential if a lagging left-term phase is permitted in order to draw the attention of turning drivers to the possible presence of pedestrians in the intersection.

In urban and suburban settings, which warrant a median refuge of 6' between directions of traffic, it becomes more important to limit the turn to a protected left-turn phase, as the refuge creates a negative offset and reduces the line of sight for drivers turning left.

As with any change in intersection design and operation, it is of utmost importance to consider the context of the road and the character of the surrounding area when deciding if a design treatment or phasing change is appropriate. The design presented here is most appropriate for urban and suburban roadways. The wider offset recommended by the FHWA Handbook may be more appropriate in limited rural settings where pedestrian traffic is not expected.

The FHWA Handbook recommends a 25' curb radius

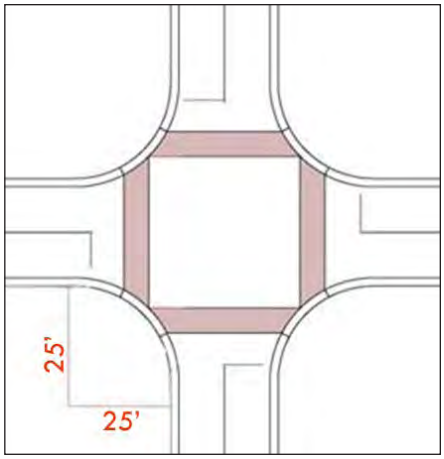

Figure 21. Authors' Illustrative of FHWA Handbook recommendation

23 It should be noted that older drivers have more difficulty understanding left turn signal relative to younger drivers. Ullman (1993) found the protected left-turn signal to be the best understood while the protected/permissive the least (Eby, 2009).

Curb Radius

FHWA Recommendation

(1) Where roadways intersect at 90 degrees and are joined with a simple radius curve, a corner curb radius in the range of 7.5 m to 9 m (25'–30') is recommended as a trade-off to (a) facilitate vehicle turning movements, (b) moderate the speed of turning vehicles, and (c) avoid unnecessary lengthening of pedestrian crossing distances, except where precluded by high volumes of heavy vehicles. *See Figure 21.*

(2) When it is necessary to accommodate turning movements by heavy vehicles, the use of offsets, tapers, and compound curves is recommended to minimize pedestrian crossing distances.

Older pedestrians may find intersections with longer curb radii more difficult to cross due to increased crossing distance and vehicle turning speeds.

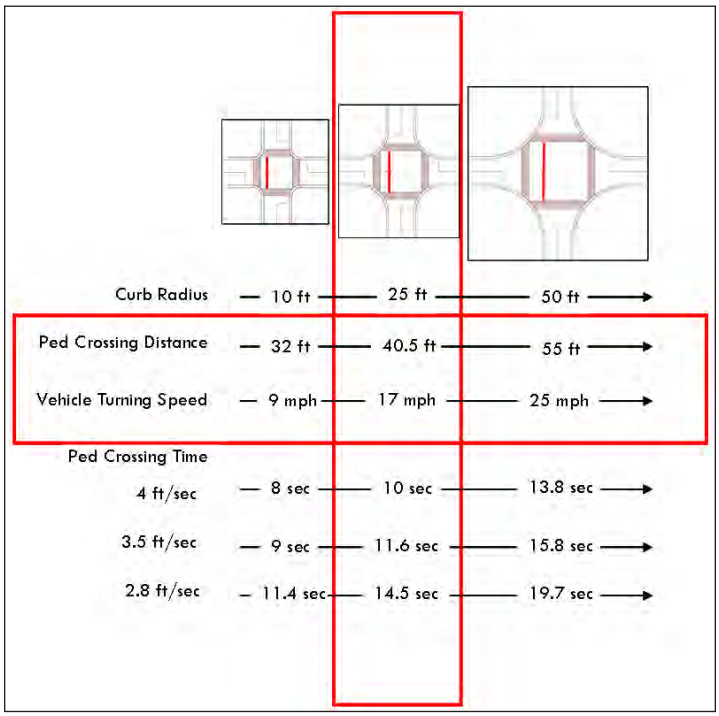

Figure 22. A comparison of the crossing distance and turning speed for 10', 25', and 50' curb radii.

Discussion

Curb radius is a measure of the sharpness of a corner: smaller radii equal sharper turns suitable for automobiles and pedestrians, while larger radii facilitate the turning of large trucks and buses. One of the common pedestrian crash types involves a pedestrian who is struck by a right-turning vehicle at an intersection. Therefore, the design of the curb radius is an important consideration at an intersection where the paths of turning cars and crossing pedestrians overlap.

When curb radii are too small, older drivers who have physical conditions that make it difficult for them to maneuver turns may attempt to increase their turning radius in order to decrease steering wheel rotation, which results in cutting the corner or encroaching into other lanes of traffic (Staplin et al., 1994, as discussed in FHWA Handbook, 2001).[24] While large curb radii are preferred by older drivers, they

24 In a design preference survey both young and old drivers preferred larger curb radii (48') over smaller curb radii (18' or 40'). Preference was given to the 48' radius curb for ease of turning and maneuverability. Tight intersections with smaller curb radii were disliked because of difficulty in maneuver-

pose significant challenges for all pedestrians. Studies have shown that wide turns at intersections extend the crossing distance and encourage higher speeds among turning vehicles, putting the pedestrian at greater risk of vehicular conflict even when a pedestrian refuge island is provided (Hauer, 1988; Fitzpatrick, 2005; Wolfe, 2000). *See Figure 22.* Participants at the AARP Innovation Roundtable also pointed out that a large radius creates difficulties with the geometry of lining up the sidewalk, crosswalk and curb ramp, a design detail of particular importance to people who use wheelchairs and those with visual impairments.

The FHWA Handbook recommends a corner curb radius between 25' and 30' at 90- degree intersections to assist with the challenge of steering wheel rotation needed for older drivers, but provides little discussion of the most appropriate context for the standard. This type of radius is appropriate on streets with high volumes of large vehicles, and it is often applied in auto-oriented suburban areas where less emphasis is placed on pedestrian activity and safety.

The AASHTO Green Book gives an acceptable range of 15'–25' as the design curb radius for passenger vehicles, appropriate for streets with fewer turning trucks or buses. The book recommends a minimum of 25' where space permits, but notes that urban areas can function with curb radii of 10'–15' given space limitations, presence of pedestrians, and generally lower operating speeds (AASHTO, 2004b). ITE's *Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities* recommends a curb radius of 10'–15' in several situations: where pedestrian activity is expected, where occasional encroachment into the opposing lane is acceptable and/or it is possible for larger vehicles to encroach on the corner of a curb, or where bike lanes or on-street parking increase the effective turning radius. Even 5' curb radii are common in older cities.

Suggested Refinements

In all cases, the context of the roadway and appropriate vehicle speed should be considered in determining the appropriate size of the curb radius for the particular condition where it is located. Smaller curb radii in the 10'–15' range, combined with lower vehicle speeds, are useful traffic calming devices and are most appropriate in urbanized areas where there is a greater mixture of users sharing the roadway. This is true for small towns, suburban mixed-use areas, and any other places where communities wish to encourage pedestrian and bicycle travel.

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ability, visibility of oncoming traffic, and likelihood of hitting a curb or median while completing a right turn (Staplin et al., 1997, as discussed in FHWA Handbook, 2001). Another study further supported these difficulties. For older persons who are more likely to suffer from rheumatoid arthritis or other arthritic conditions that make gripping and turning the steering wheel difficult and painful, these conditions result in less control over vehicle movement when completing turns (Roberts & Roberts, 1993, as discussed in FHWA Handbook, 2001).

The addition of bike lanes and parallel parking increases the effective radius making it easier for older drivers to turn.

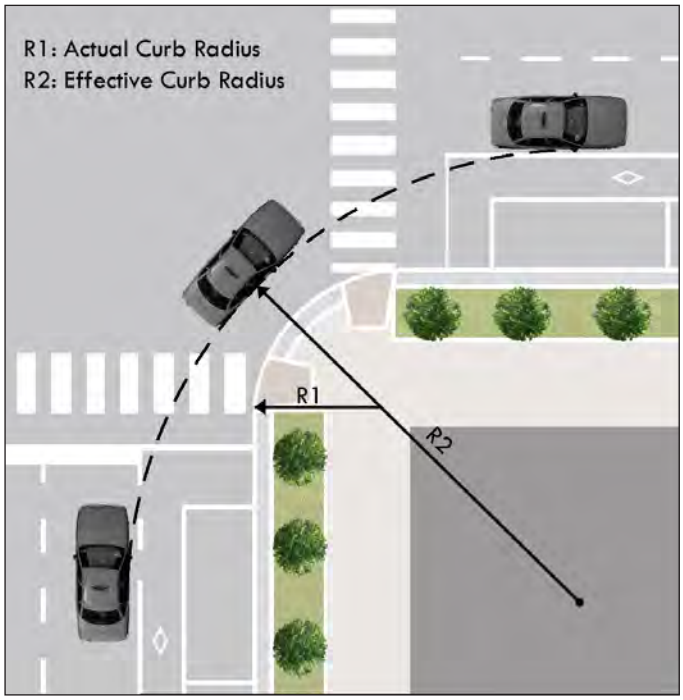

Figure 23: Comparison of Actual and Effective Curb Radii

Crosswalks do not line up with curb cuts and sidewalks

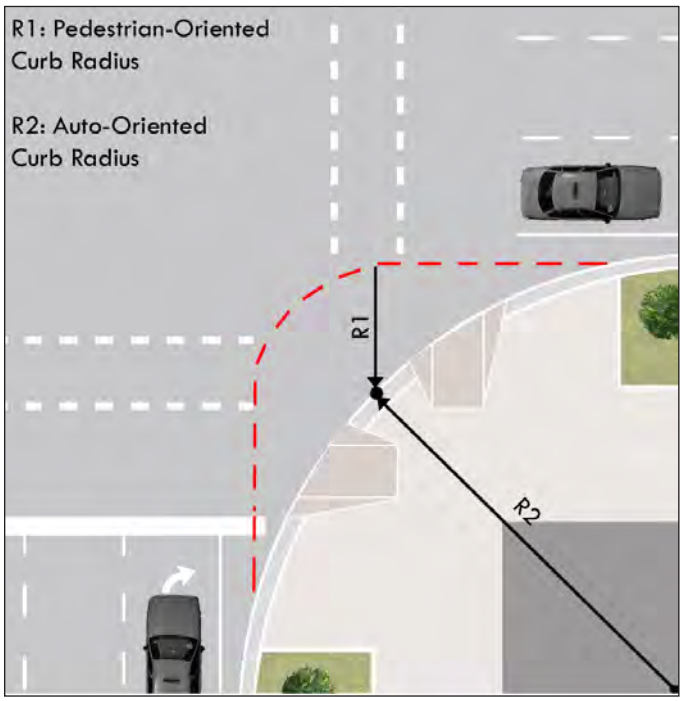

Fig. 24: Illustration of how R2 in figure 23 would appear if it were the actual radius.

A 25' curb radius may be appropriate, however, for urban boulevards, parkways, and less urbanized areas where the dominant form of mobility is the automobile, or where larger vehicles use the facility on a regular basis. In all cases, the designer should aim for the smallest curb radius possible with consideration given to the nearby land uses, design speed, and types of road users.

To ensure pedestrian safety, designers should aim for the smallest curb radius that works for the particular context, design speed, and vehicle. Smaller curb radii can both shorten the crossing distance and force drivers to slow down as they make a tighter radius turn. Participants at the Innovation Roundtable offered the following recommendations to make a tighter curb radius work in a variety of contexts:

- Choose the appropriate design vehicle. Curb radii should be designed to accommodate the largest vehicle type that will *frequently* turn the corner. For example, a bus may use a make a certain turn several times an hour, but a moving van, once or twice a year. Do not choose a larger design vehicle than necessary.

- Calculate the curb radius for each corner individually. Curb radius design is not a one-size-fits-all approach. For example, on one-way streets, a corner with

no turns can have a very tight (5') radius, while another corner may require a longer radius.

- Calculate curb radii to reflect the "effective" turning radius of the corner. The effective turning radius takes into account the wheel tracking of the design vehicle utilizing the width of parking and bicycle lanes, and location of the stop bar. This allows a smaller curb return radius while retaining the ability to accommodate larger design vehicles.
- Allow trucks and other large vehicles to encroach into second lane at large signalized intersections.
- Use a lower-speed setting on truck-turning software. Occasional turns by vehicles that are larger than the design vehicle could be accomplished by turning more slowly.

Comments from the online survey varied on this design refinement. There was general consensus that 10'–15' radii work well for pedestrians particularly in urban areas, as evidenced by the 80 percent approval that the suggested refinement resolved potential conflicts well or somewhat well as compared to the original FHWA Handbook design. Many respondents also acknowledged that small radii would be difficult for large trucks and buses, and may cause problems for pedestrians if the corner, curb, or sidewalk is damaged by heavy vehicles. These responses prove the importance of considering the context of the road, as different types of roadway users and activities will influence transportation needs and priorities.

Pedestrian Crossing Design, Operations, and Control

FHWA Recommendation

To accommodate the shorter stride and slower gait of less capable (15th percentile) older pedestrians, and their exaggerated start-up time before leaving the curb, pedestrian control-signal timing based on an assumed walking speed of 0.85 m/second (2.8'/second) is recommended.

Discussion

Assumed Walking Speeds - The walking speed set for signal operations is by far one of the most important design and operational parameters that can affect pedestrian-vehicular conflicts, pedestrian safety, and crashes at signalized intersections. Older pedestrians may have physical limitations that make it difficult to cross a street in the time allotted by a crossing signal. Additionally, older pedestrians may have physical or visual disabilities that impair their ability to safely navigate a crossing.

Current standards from the *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD) base the length of the pedestrian clearance phase (the flashing

"Don't Walk" segment) on the "normal" pedestrian walking speed of 4' (1.2 m) per second. However, the length of time it takes to cross a street varies by an individual's age, gender, physical abilities, etc. Nearly 90 percent of older pedestrians using walkers or canes would be unable to cross the street in the time allotted (Arango, 2008). Because of this, older pedestrians often find themselves caught in the right-of-way after the walking signal has already expired. To account for this discrepancy, the FHWA Handbook recommends that crossing signals be based on an assumed walking speed of 2.8'/second (Staplin et al., 2001).

In 2004, LaPlante and Kaeser summarized the research on pedestrian walking speeds, citing average crossing times for normal adults at 4.0'/second and crossing speeds for older adults ranging from 2.2'/second to 3.8'/second. Based on their research, they recommended a maximum walking speed of 3.5'/second be used to determine the pedestrian clearance interval (PCI) from curb to curb, and a maximum walking speed of 3.0'/second be used to determine the entire "Walk" plus PCI (considering signal phasing of the total crossing from the top of the ramp to the far curb).

More recent research from ITE and AAA supports these findings, recommending a 7-second walk signal, in addition to a pedestrian clearance interval based on a walking speed of 3.5'/second (Stollof, 2007). The recommendations also include options to increase or decrease the pedestrian walking speed based on specific pedestrian characteristics and available pedestrian signal hardware at intersections. In 2006, the National Committee on Uniform Traffic Control Devices (NCUTCD) Signals Technical Committee voted to recommend these changes for the next edition of MUTCD.

Signal Design - Another important crosswalk safety factor for older pedestrians is the design of the pedestrian crossing signal. Traditional pedestrian signals consist of illuminated symbols such as a walking person (symbolizing "Walk"), a flashing upraised hand during the pedestrian clearance interval (symbolizing that it is okay to continue walking if one has already begun crossing), and an upraised hand (symbolizing "Don't Walk"). Research shows that such signals can be confusing to the pedestrian if used without any explanation (Stollof, 2007). The FHWA Handbook recommends a placard that explains pedestrian control-signal operations and presents a warning to watch for turning vehicles to be posted at the near corner of all intersections with a pedestrian crosswalk.

A tested strategy to reduce confusion at crosswalks is the use of pedestrian countdown (PCD) signals, which are more easily understood than the traditional pedestrian signal (Eccles, Tao, & Mangum, 2004; Mahach, Nedzesky, Atwater, & Saunders, 2002; Allsbrook, 1999; Chester & Hammond, 1998). One study recommended the use of PCD signals at intersections frequented by an older adult population because of the value of the added information about the time available for crossing (Huang & Zegeer, 2000). The proposed amendments for the next edition of the MUTCD require all new pedestrian signal heads to include a PCD, except on the narrowest of streets.

Curb Ramp Design - The 2005 draft Public Rights-of-Way Accessibility Guidelines (PROWAG) serves as the current best practice for accessible pedestrian design (as identified by the USDOT). It provides guidance on all types of public rights-of-way, and contains a useful summary of ADA and ADA Accessibility Guidelines (ADAAG) regulations as well as industry design practices on bus stops, curb ramps, pedestrian crossings, and street furniture relevant to bus stop accessibility. A whole chapter is dedicated to providing examples of curb ramp designs for 10' and 30' radius curb returns.

Suggested Refinements

Assumed Walking Speeds - The FHWA Handbook should recommend a 7-second walk signal, in addition to a pedestrian clearance interval based on a walking speed of 3.5'/second. According to the research conducted by ITE, reducing signal timing so that the PCI accommodates a walk speed of 3.5'/second would have minimal operational impacts in most cases. Increased vehicle delays would occur most often on the major street approaches, which tend to be wider and, thus, have longer crossing distances, requiring a longer PCI. A careful balance between the needs of pedestrians and drivers is necessary; attention to the context and operational capacity of the intersection is critical in determining pedestrian crossing time.

Signal Design - Pedestrian signals should be designed simply (without complex placards) and include a pedestrian countdown (PCD). The signals should be large enough to be clearly visible from the opposite side of the street and may be best when combined with an audible signal to assist pedestrians with visual impairments. The use of backplates surrounding the signal housing would further increase signal visibility to older drivers, especially where the lights are viewed against a bright sky or confusing background.[25]

Curb Ramps - The FHWA Handbook should include a section on ADA accessibility and compliance, referring to PROWAG for the design and layout of curb ramps. While there is no standard layout for a curb ramp, there are a number of factors that need to be achieved to construct a curb ramp that will be usable by all pedestrians. These include:

1. Curb ramp slope should be aligned with the sidewalk and crosswalk to help citizens with visual disabilities or those using a wheelchair to navigate safely.

2. Where a curb ramp is present on one side of a roadway, another curb cut or at-grade sidewalk must provided on the other side of the roadway.

3. So as not impede the progress or safety of pedestrians with disabilities, sidewalks should be designed with no more than a 2 percent cross-slope, which is sufficient for proper drainage of rainwater (and snowmelt).

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25 The FHWA Handbook cites studies that show backplates can increase the intensity of the signal face by 33 percent. However, backplates increase wind loading on signal suspension systems and therefore are appropriate when used with wind-resistant suspension systems (Amparano, 2006).

ADDITIONAL RESEARCH NEEDED

Several issues were raised during the course of this study that could not be adequately addressed and are recommended for further research. These include the need for better multimodal safety research and the effects of speed on safety and urban roadway design.

Multimodal Safety Research

Current literature is deficient for fully understanding the safety implications of design on the pedestrian and bicyclist, especially the older pedestrian. More research projects need to be tailored to look at the effects of a particular treatment on more than one mode at the same time. For instance, research studies supporting the FHWA Handbook recommendations for curb radius reference focus groups of drivers, older and younger, where participants reported factors such as ease of turning, better maneuverability, and less chance of hitting the curb. Based on these studies and a desire to moderate the negative impact of a long radius on pedestrians, FHWA recommends a 25' curb radius. More recent research to test the effectiveness of the FHWA guidelines uses kinematics measures such as acceleration forces, yaw, and speed as surrogates for safe driving performance (Classen, 2007). Older drivers' ability to maintain their speed through the intersection is seen as a positive benefit of the FHWA Handbook treatment.

While the FHWA Handbook recognizes that wider radii would increase speed and compromise pedestrian safety, a 25' radius is nonetheless challenged by many engineers as still too fast and wide to "Complete the Street" in many urban and suburban settings. More rigorous research should be done to test actual safety for different road users for varying curb radii. The same is true for testing other intersection design treatments. Safety surrogates provide an inconclusive basis for design guidelines.

Effects of Speed on Safety and Urban Roadway Design

Current research related to the effects of speed on the safety of all road users, including older adults, is inadequate. A better understanding of urban roadway design and driver behavior is needed. Gattis (2005) notes that current research predominantly focuses on rural or high-speed environments, which results in urban roadway engineers' extrapolating from the principles learned in a rural highway environment to the urban environment. The current research on older driver safety fails to adequately address the effect of speed. Questions worth looking at would include:

- How could the effects of traffic calming impact the recommendations offered for older driver safety?
- What particular challenges does the older driver have in slow urban environments compared to fast rural or fast suburban environments? How would treatment recommendations vary under these different conditions?
- Treatments should be tested against the safety and traffic operations effects for each

mode. What is gained by lowering the speed? What is lost?

Road design is a both a science and an art. It requires designers to balance and prioritize the needs of diverse users. Planners, engineers, policy makers, developers, and all other stakeholders, including residents, must work together in support of a new paradigm. Approaching road planning and design through the lens of a Complete Streets framework offers designers the opportunity to assess community context and goals. The results of such an approach will never be perfect, but they will come closer to realizing solutions that work for everyone.

PLANNING COMPLETE STREETS FOR AN AGING AMERICA

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APPENDIX A

COMPLETE STREETS POLICY INVENTORY AND EVALUATION

Complete Streets Policy Analysis
Ratings Descriptions

Since Complete Streets policies are adopted in so many different forms, it is important to note that different policy types will be strong in different areas. A resolution, for example, is more likely to get a strong ranking for purpose and vision than a state law, which would be expected to do better in the Policy Reach category. Therefore, policies should be compared to their own policy type. Note that this evaluation is based entirely on the language contained in the policy document.

Users	What type of road users are covered by the policy?		
Modes	Pedestrians	Bicycles	Motorists	Transit	Freight
	A policy that covers a wider variety of modes is considered stronger than others.		
Users with Disabilities	⊘ No Mention	◐ Acknowledged	● Extensive
		If a policy makes note of users with disabilities in its text, these users' needs are "acknowledged."	If a policy makes specific references to the special considerations and design necessary to properly accommodate users with disabilities, the policy is "extensive."
Older Adults	⊘ No Mention	◐ Acknowledged	● Extensive
		If a policy makes note of older adults in its text, these users' needs are "acknowledged."	If a policy makes specific references to the special considerations and design necessary to properly accommodate older adults, the policy is "extensive."
Policy Reach	How far does the policy reach in affecting road planning and construction decisions? Is it likely to be implemented?		
	○ Limited	◐ Average	● Broad
	Limited Complete Streets policies often cover only roads controlled by the policy-making agency, which does not include privately owned or built roadways. They are often not linked to other planning documents and infrequently list specific next steps in enacting the policy.	Average policies usually affect only roads controlled by the policy-making agency, though occasionally cover private roadways as well. They are often explicitly linked to other procedures and documents and feature next steps and goals more frequently. They tend to use stronger prescriptive language.	Broad policies are most likely to affect privately built roads in addition to roadways controlled by the policy-making agency. They are almost always linked to other plans and have specific next steps in policy enactment. Language used in these policies is generally quite firm.
Purpose & Vision	Does the policy express a clear purpose and vision for the transportation system?		
	○ Limited	◐ Average	● Strong
	Limited Complete Streets policies rarely acknowledge the importance of establishing a network of Complete Streets or balancing user needs. Specific measurable outcomes are rarely established.	Average policies always acknowledge the need for Complete Streets networks and for balancing a variety of user needs, occasionally making extensive notes on one or the other. They occasionally list specific outcomes.	Strong policies almost always have extensive sections on establishing Complete Streets networks and on the necessity of balancing user needs across those networks. They frequently outline quantifiable results of the policies.
Coverage	What roads and what types of projects does the policy cover, and are exceptions clear and specific?		
	○ Limited	◐ Average	● Extensive
	Limited Complete Streets policies most often do not apply to anything other than new construction or reconstruction. They generally do not specify allowable exceptions to policy implementation.	Average policies rarely apply to anything beyond new construction or reconstruction projects. They generally do specify allowable exceptions, of which there are generally three or fewer.	Extensive policies usually cover a variety of road projects beyond new construction and reconstruction, including repaving and retrofit projects. They frequently specify allowable exceptions, of which there are generally three or fewer.
Context	⊘ No Mention	✓ Acknowledged	

Agency	Policy	Level	Description/Language
Type: Legislation/Ordinance			
San Francisco County, CA	Transit First Policy	County	"Decisions regarding the use of limited public street and sidewalk space shall encourage the use of public rights of way by pedestrians, bicyclists, and public transit, and shall strive to reduce traffic and improve public health and safety."
State of California	The Complete Streets Act (AB 1358)	State	"This bill would require...that the legislative body of a city or county...modify the circulation element to plan for a balanced, multimodal transportation network that meets the needs of all users of streets, roads, and highways, defined to include motorists, pedestrians, bicyclists, children, persons with disabilities, seniors, movers of commercial goods, and users of public transportation, in a manner that is suitable to the rural, suburban, or urban context of the general plan."
State of Florida	Bicycle & Pedestrian Ways statute (335.065)	State	"Bicycle and pedestrian ways shall be given full consideration in the planning and development of transportation facilities, including the incorporation of such ways into state, regional, and local transportation plans and programs. Bicycle and pedestrian ways shall be established in conjunction with the construction, reconstruction, or other change of any state transportation facility, and special emphasis shall be given to projects in or within 1 mile of an urban area."
Honolulu, HI	Charter Amendment 8	City	"It shall be one of the priorities of the department of transportation services to make Honolulu a pedestrian- and bicycle-friendly city."
State of Illinois	Public Act 095-0665	State	"An act...requiring incorporation of bicycle and pedestrian ways into state, regional, and local transportation plans and programs; bicycle lanes shall be established if there is sufficient right-of-way whenever there is construction, reconstruction, or other change of any state transportation facility...Provides for the inclusion of bicycle and pedestrian ways into planning and design standards for scenic highway designation."
Louisville-Jefferson Metro, KY	Cornerstone 2020 Comprehensive Plan Complete Streets Ordinance	County & City	"A thoroughfare system that creates 'Complete Streets' will require facilities that promote safe pedestrian trips for individuals of all ages and abilities."
State of Massachusetts	Bicycle-Pedestrian Access Law (Chapter 90E)	State	"The commissioner shall make all reasonable provisions for the accommodation of bicycle and pedestrian traffic in the planning, design, and construction, reconstruction or maintenance of any project undertaken by the department."
State of Maryland	Trans. Code Ann. Title 2 subtitle 602	State	"Include enhanced transportation facilities for pedestrians and bicycle riders as an essential component of the State's transportation system...in all phases of transportation planning, including highway design, construction, reconstruction, and repair as well as expansion and improvement of other transportation facilities."

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Agency	Year	Modes Covered	Users with Disabilities	Older Adults	Policy Reach	Purpose & Vision	Coverage	Context
Type: Legislation/Ordinance								
San Francisco County, CA	1995		◐	◐	●	◐	○	⊘
State of California	2008		◐	◐	●	◐	●	✓
State of Florida	1984		⊘	⊘	●	○	●	⊘
Honolulu, HI	2006		⊘	⊘	◐	○	○	⊘
State of Illinois	2007		⊘	⊘	●	○	◐	✓
Louisville-Jefferson Metro, KY	2008		◐	◐	●	◐	○	✓
State of Massachusetts	1996		⊘	⊘	●	○	●	⊘
State of Maryland	2000		⊘	⊘	◐	◐	●	✓

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Agency	Policy	Level	Description/Language
Montgomery County, MD	County Road Code (Bill 4806)	County	"Each County road and street must be designed so that the safety and convenience of all users of the roadway system - including pedestrians, bicyclists, transit users, automobile drivers, commercial vehicles and freight haulers, and emergency service vehicles - is accommodated. Each road and street must facilitate multi-modal use and assure that all users can travel safely in the public right of way."
Columbia, MO	Model Street Standards	City	"All new development will include: residential streets that are 28' wide (instead of 32'); residential sidewalks that are 5' wide (instead of 4'); major collectors and arterials with 8' or 10' multi-use 'pedways'; major collectors and arterials with 6' striped bike lanes or wide shared-use travel lanes."
DeSoto, MO	Bill No. 45-08 (Amending Municipal Code Section 410.020)	City	"...[T]o ensure that the City will design, build, and maintain its roadways in a manner that accommodates safe and contiguous routes for all users including pedestrians, individuals of all ages and abilities (including individuals with disabilities), bicyclists, transit vehicles and users and motorists."
Ferguson, MO	Bill Amending Article 1 of Chapter 40 of the Municipal Code	City	"The purpose of this Policy is to set forth guiding principles and practices to be considered in public transportation projects, where practicable, economically feasible, and otherwise in accordance with applicable law, so as to encourage walking, bicycling and transit use while promoting safe operations for all users."
Buffalo, NY	Complete Streets Ordinance Amending Chapter 413 of the Code	City	"The Commissioner of Public Works, Parks and Streets shall include pedestrian and bicycle facilities in all new street construction, street reconstruction, street maintenance, public works and park projects undertaken by the City of Buffalo…"
State of Oregon	ORS 366.514	State	"Footpaths and bicycle trails, including curb cuts or ramps as part of the project, shall be provided wherever a highway, road or street is being constructed, reconstructed or relocated."
State of Rhode Island	Chapter 31-18: Pedestrians Section 31-18-21	State	"Department of Transportation is authorized and directed to provide for the accommodation of bicycle and pedestrian traffic in the planning, design, construction and reconstruction, and to consider this in the resurfacing and striping of any project undertaken by the department..."
Roanoke, VA	Complete Streets Policy	City	"...[A]ll transportation agencies within the City shall routinely plan, fund, design, construct, operate, and maintain their streets according to the Complete Street principles of the City's 'Street Design Guidelines' with the goal of creating an attractive connected multimodal network that balances the needs of all users, except where there are demonstrated exceptional circumstances."
University Place, WA	Pedestrian Sidewalks and Bicycle Lanes	City	"Develop facilities for pedestrians and bicyclists as alternative travel modes to the automobile...Require sidewalk facilities on all public streets...Develop a system of bicycle routes, both east/west and north/south, that provides for travel within the City with connections to local parks and regional facilities."
Kirkland, WA	City Ordinance (Ordinance No. 4061)	City	"Bicycle and pedestrian ways shall be accommodated in the planning, development and construction of transportation facilities, including the incorporation of such ways into transportation plans and programs."

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Agency	Year	Modes Covered	Users with Disabilities	Older Adults	Policy Reach	Purpose & Vision	Coverage	Context
Montgomery County, MD	2007		◐	⊘	●	◐	○	✓
Columbia, MO	2004		⊘	⊘	●	○	●	✓
DeSoto, MO	2008		◐	◐	●	○	●	✓
Ferguson, MO	2008		◐	◐	●	○	○	✓
Buffalo, NY	2008		◐	⊘	◐	○	◐	✓
State of Oregon	1971		◐	⊘	◐	○	◐	⊘
State of Rhode Island	1997		⊘	⊘	◐	○	●	⊘
Roanoke, VA	2008		◐	◐	●	◐	○	✓
University Place, WA	2004		◐	⊘	●	◐	○	✓
Kirkland, WA	2006		⊘	⊘	◐	○	○	⊘

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Agency	Policy	Level	Description/Language
Seattle, WA	Ordinance No. 122386	City	"An ordinance relating to Seattle's Complete Streets policy, stating guiding principles and practices so that transportation improvements are planned, designed and constructed to encourage walking, bicycling, and transit use while promoting safe operations far all users."
Redmond, WA	Municipal Code Chapter 12.06: Complete the Streets	City	"The City of Redmond will plan for, design and construct all new transportation projects to provide appropriate accommodation for bicyclists, pedestrians, transit users and persons of all abilities in comprehensive and connected networks."
Issaquah, WA	Municipal Code Chapter 12.10: Complete Streets (Ordinance No. 2514)	City	"Bicycle and pedestrians facilities should be included in the planning, engineering, design and construction of transportation facilities, including transportation plans and programs."
Type: Resolution			
Sacramento, CA	Pedestrian Friendly Street Standards	City	"The city's street system should encourage alternate mode use, especially walking and bicycling, by working toward a balance of all street users...Staff [will] revise street standard variance procedures to include consideration of enhancing and improving the pedestrian environment and encouraging alternate mode use."
Metropolitan Transportation Commission (San Francisco Bay Area)	Regional Policy for the Accommodation of Non-Motorized Travelers	MPO	"Projects funded all or in part with regional funds...shall consider the accommodation of non-motorized travelers, as described in Caltrans Deputy Directive 64...These recommendations are intended to facilitate the accommodation of pedestrians, bicyclists, and disabled traveler needs into all projects where non-motorized travel is consistent with current, adopted regional and local plans."
Novato, CA	City Council Resolution	City	"...consider the installation of multi-modal transportation elements in each project in the City of Novato..."
Fairfax, CA	Town of Fairfax Resolution #2527	City	"Town of Fairfax recognizes that Complete Streets, which serves the needs of pedestrians, bicyclists, transit users, the disabled and automobile users generally provide for the safest travel conditions..."
San Anselmo, CA	Bicycle Master Plan Appendix B: Complete Streets Resolution	City	"...shall consider the installation of Complete Streets transportation elements in each capital project and development project."
La Plata County, CO	Resolution No. 2007-33	City	"...[T]he La Plata County Board of County Commissioners hereby requests that all transportation planning initiatives and development take into consideration a balanced, responsible, and equitable approach with regards to the recommendations set forth in the Inventory and Prioritization of Roads in La Plata County for Improved Bicycling, Pedestrian, and Motorist Safety."

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Agency	Year	Modes Covered	Users with Disabilities	Older Adults	Policy Reach	Purpose & Vision	Coverage	Context
Seattle, WA	2007		◐	⊘	●	◐	◐	✓
Redmond, WA	2007		⊘	⊘	◐	◐	◐	⊘
Issaquah, WA	2007		⊘	⊘	◐	○	◐	⊘
Type: Resolution								
Sacramento, CA	2004		⊘	⊘	◐	○	○	✓
Metropolitan Transportation Commission (San Francisco Bay Area)	2006		◐	⊘	○	○	○	⊘
Novato, CA	2007		◐	⊘	◐	○	○	⊘
Fairfax, CA	2008		◐	⊘	◐	○	○	⊘
San Anselmo, CA	2008		◐	⊘	○	○	○	⊘
La Plata County, CO	2007		◐	◐	◐	○	○	⊘

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Agency	Policy	Level	Description/Language
Cascade, IA	Policy Statement: Complete Streets	City	"The design and construction of new facilities...should anticipate likely future demand for bicycling and walking facilities and not preclude the provision of future developments... Bicycle and pedestrian ways shall be established in new construction and reconstruction projects with in the city limits of Cascade..."
Iowa City, IA	Resolution Adopting a Complete Streets Policy for the City of Iowa City, IA and Repealing Resolution No. 07-109	City	"All public street projects or public street reconstruction projects (not including maintenance) in the City of Iowa City shall be designed to accommodate travel by pedestrians, bicyclists, public transit, and motorized vehicles and their passengers."
Des Moines, IA	Complete Streets Policy	City	"The City of Des Moines recognizes this need for complete streets and will accommodate elements that create a complete street where possible...The design and development of the transportation infrastructure shall improve conditions for transit users, motorists, bicyclists and pedestrians..."
DuPage County, IL	Healthy Roads Initiative	County	"Construct a sidewalk or bicycle path where right-of-way is available; ensure that the new construction project is safe for both the user and the community; ensure that the new construction project adds a lasting value to both motorized and non-motorized users; ensure the project incorporates context sensitive and environmentally sensitive design..."
Region 2 Planning Commission (Jackson, MI)	Complete Streets Resolution	MPO	"...[T]hat bicycling and walking accommodations using the latest design standards should be a routine part of the [Region 2 Planning] Commission's planning, design, construction, maintenance, and operating activities, and will be included in the everyday operations of our transportation system."
Jackson, MI	Complete Streets Resolution	City	"...[T]hat bicycling and walking accommodations using the latest design standards should be a routine part of the City's planning, design, construction, maintenance, and operating activities, and will be included in the everyday operations of our transportation system."
Jackson County, MI	Complete Streets Resolution	County	"...[T]hat bicycling and walking accommodations using the latest design standards should be a routine part of the [Road] Commission's planning, design, construction, maintenance, and operating activities, and will be included in the everyday operations of our transportation system."
State of North Carolina Department of Transportation	Bicycling and Walking in North Carolina	State	"… bicycling and walking accommodations shall be a routine part of the North Carolina Department of Transportation's planning, design, construction, and operations activities."
Binghamton, NY	A Resolution Adopting Complete the Streets/Institute for Healthy Infrastructure Policies	City	"Whereas Complete the Streets supports construction of streets to enable safe access for all users, including motorist, pedestrians, bicyclist, and public transportation."

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Cascade, IA	2006		◐	⊘	○	○	◐	⊘
Iowa City, IA	2007		⊘	⊘	○	○	◐	⊘
Des Moines, IA	2008		◐	◐	◐	○	○	⊘
DuPage County, IL	2004		⊘	⊘	○	◐	○	⊘
Region 2 Planning Commission (Jackson, MI)	2006		◐	◐	○	○	◐	✓
Jackson, MI	2006		◐	◐	○	○	◐	✓
Jackson County, MI	2006		◐	◐	○	○	◐	✓
State of North Carolina Department of Transportation	2000		⊘	⊘	○	○	○	⊘
Binghamton, NY	2007		⊘	⊘	○	○	○	⊘

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Agency	Policy	Level	Description/Language
Erie County, NY	Complete Streets Resolution	County	"...[T]he Erie County Commissioner of Public Works shall include pedestrian and bicycle facilities in all new street construction, street reconstruction and park projects undertaken by the County of Erie, where feasible."
Columbus, OH	Complete Streets Resolution	City	"That this Council supports the implementation of Complete Streets policies in Columbus, and urges the Public Service Department and the Transportation Division to include these policies in all street construction, reconstruction and repair projects."
State of South Carolina Department of Transportation	Commission Resolution	State	"…[B]icycling and walking accommodations should be a routine part of the Department's planning, design, construction and operating activities."
Spartanburg, SC	Complete Streets Resolution	City	"...[T]hat in making decisions regarding the use, maintenance, and enhancement of public street and sidewalk space, the City shall seek to facilitate and encourage the use of public rights of way by pedestrians and bicyclists and shall strive to reduce traffic and improve public health and safety."
Greenville, SC	Resolution 2008-49	City	"...[S]o that transportation systems are planned, designed, constructed, and operated to make bicycling and pedestrian movements an integral part of the City's transportation planning and programming while promoting safe operation for all users."
Pierce County, WA	Resolution 2008-86s	County	"...[T]hat the Transportation Plan Update include an assessment of the plan's support of the "Complete Streets" concept, identification of relevant policies within the plan that support the creation of 'Complete Streets,' and an identification of barriers to, and opportunities for, the development of 'Complete Streets' throughout Pierce County. The Council further requests that a specific 'Complete Streets' policy be included within the Transportation Plan Update."
Type: Tax Ordinance			
Sacramento, CA	Ordinance No. STA 04-01	County	"Revenues from the tax shall be used for transportation purposes only and may include, but are not limited to, administration, construction, maintenance, improvements, and operation of local streets, roads, and highways, state highways and freeways, public transit systems including rail, bicycle and pedestrian facilities and related purposes."
San Diego County, CA	Transnet Tax Extension (Proposition A)	County	"All new projects, or major reconstruction projects, funded by revenues provided under this Ordinance shall accommodate travel by pedestrians and bicyclists, except where pedestrians and bicyclists are prohibited by law.. or where the cost...would be excessively disproportionate to the need or probable use. Such facilities for pedestrian and bicycle use shall be designed to the best currently available standards and guidelines."

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Erie County, NY	2008		◐	⊘	○	○	◐	⊘
Columbus, OH	2008		◐	◐	◐	◐	●	✓
State of South Carolina Department of Transportation	2003		⊘	⊘	○	○	○	⊘
Spartanburg, SC	2006		⊘	⊘	○	○	○	⊘
Greenville, SC	2008		◐	◐	◐	○	○	✓
Pierce County, WA	2008		◐	◐	○	○	○	⊘
Type: Tax Ordinance								
Sacramento, CA	2004		◐	◐	●	○	○	✓
San Diego County, CA	2004		◐	◐	●	◐	◐	⊘

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Agency	Policy	Level	Description/Language
Seattle, WA	Bridging the Gap	City	"The Mayor and City Council support the principles of 'Complete Streets' and will work with SDOT so that to the maximum practicable extent, all Bridging the Gap projects will provide appropriate accommodation for pedestrians, bicyclists, transit riders, and disabled persons while promoting safe operation for cars and trucks."
Type: Executive Order			
Salt Lake City, UT	Executive Order on Accommodation of Bicyclists and Pedestrians	City	"All transportation facilities in the public right of way owned by Salt Lake City on which bicyclists and pedestrians are permitted by law...shall be designed, constructed, operated, and maintained so that users, including people with disabilities, can travel safely and independently."
Type: Internal Policy			
Marin County, CA	Best Practice Directive for Inclusion of Multimodal Elements into Improvement Projects	County	"At the outset of all projects, other than routine maintenance (e.g. cape seals, slurry seals, skin patches, crack seals, and dig outs and patches), the City Engineer of each MPWA municipality shall review each relevant capital project for consideration of inclusion of all necessary, appropriate and reasonable multi-modal facilities and improvements."
State of California Department of Transportation	Deputy Directive 64-R1	State	"The Department fully considers the needs of non-motorized travelers (including pedestrians, bicyclists and persons with disabilities) in all programming, planning, maintenance, construction, operations and project development activities and products. This includes incorporation of the best available standards in all of the Department's practices."
Wilmington Area Planning Council (Wilmington, DE Area)	Regional Transportation Plan 2030	MPO	"All projects funded through the TIP shall address bicycles and pedestrian facilities in both planning and design...sidewalks, shared use paths, street crossings, pedestrian signals, signs, street furniture, transit stops and facilities, and all connecting pathways should be designed, constructed, operated and maintained so that all modes, including pedestrians and people with disabilities, can travel safely and independently."
Johnson County Council of Governments (Iowa City, IA Area)	Complete Streets Policy	County	"All new roadway projects, or major reconstruction projects (not including maintenance), funded in whole or part by JCCOG under this policy shall accommodate travel by pedestrians and bicyclists."
Chicago, IL	Safe Streets for Chicago	City	"The safety and convenience of all users of the transportation system including pedestrians, bicyclists, transit users, freight, and motor vehicle drivers shall be accommodated and balanced in all types of transportation and development projects and through all phases of a project so that even the most vulnerable – children, elderly and persons with disabilities – can travel safely within the public right of way."

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Seattle, WA	2006		◐	⊘	●	○	◐	⊘
Type: Executive Order								
Salt Lake City, UT	2007		◐	⊘	◐	◐	◐	✓
Type: Internal Policy								
Marin County, CA	2007		◐	⊘	○	○	◐	✓
State of California Department of Transportation	2008		◐	⊘	●	◐	◐	✓
Wilmington Area Planning Council (Wilmington, DE Area)	2007		◐	⊘	○	○	◐	✓
Johnson County Council of Governments (Iowa City, IA Area)	2006		⊘	⊘	◐	○	◐	⊘
Chicago, IL	2006		◐	◐	◐	○	○	⊘

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Agency	Policy	Level	Description/Language
State of Kentucky	Pedestrian and Bicycle Travel Policy	State	"The Kentucky Transportation Cabinet (KYTC) will consider the incorporation of pedestrian facilities on all new or reconstructed state-maintained roadways in existing and planned urban and suburban areas....KYTC will consider the accommodation of bicycles on all new or reconstructed state-maintained roadways. KYTC will also consider accommodating bicycle transportation when planning the resurfacing of roadways, including shoulders."
Northeast Ohio Areawide Coordinating Agency (Cleveland, OH Area)	Regional Transportation Investment Policy	MPO	"Bicycle and pedestrian ways shall be established in new construction and reconstruction of road and bridge projects unless one or more of four conditions are met."
Mid-Ohio Regional Planning Commission (Columbus, OH Area)	Bicycle and Pedestrian Planning Policy	MPO	"Project sponsors are required to accommodate bicycles and pedestrians in the planning and design of all proposed transportation projects using MORPC-attributable federal funds. Sponsors using local, state, or other federal funds are encouraged to accommodate bicycles and pedestrians in the planning and design of all proposed transportation projects."
State of Pennsylvania Department of Transportation	Design Manual 1A Appendix J: Bicycle and Pedestrian Checklist	State	"Department policy requires the evaluation of the access and mobility needs of pedestrians and bicycle users in highway and bridge transportation corridors. This revised policy mandates that highway and bridge projects must evaluate the existing, latent, and projected needs of pedestrians and bicycle users. It requires the integration of the identified needs into project planning and design processes."
State of Tennessee Department of Transportation	Bicycle and Pedestrian Policy	State	"The policy of TDOT is to routinely integrate bicycling and pedestrian facilities into the transportation system as a means to improve mobility and safety of non-motorized traffic."
United States Department of Transportation	Design Guidance - Accommodating Bicycle and Pedestrian Travel: A Recommended Approach	Federal	"Bicycle and pedestrian ways shall be established...Sidewalks, shared use paths, street crossings, pedestrian signals, signs, street furniture, transit stops and facilities, and all connecting pathways shall be designed, constructed, operated, and maintained so that all pedestrians, including people with disabilities, can travel safely and independently...Manuals...should incorporate design information that integrates safe and convenient facilities for bicyclists and pedestrians - including people with disabilities [- and] also be amended to provide flexibility...to develop facilities that are in keeping with transportation needs, accessibility, community values, and aesthetics."
Commonwealth of Virginia Department of Transportation	Policy for Integrating Bicycle and Pedestrian Accommodations	State	"The Virginia DOT will initiate all highway construction projects with the presumption that the projects shall accommodate bicycling and walking."

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State of Kentucky	2002		◐	⊘	◐	◐	●	✓
Northeast Ohio Areawide Coordinating Agency (Cleveland, OH Area)	2003		◐	⊘	◐	◐	○	✓
Mid-Ohio Regional Planning Commission (Columbus, OH Area)	2004		◐	⊘	◐	○	◐	⊘
State of Pennsylvania Department of Transportation	2007		◐	◐	◐	◐	○	✓
State of Tennessee Department of Transportation	2003		◐	⊘	◐	◐	◐	✓
United States Department of Transportation	2000		◐	⊘	●	◐	◐	✓
Commonwealth of Virginia Department of Transportation	2004		◐	⊘	◐	◐	●	✓

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Agency	Policy	Level	Description/Language
Type: Plan			
Scottsdale, AZ	Transportation Master Plan	City	"To design, operate and maintain Scottsdale's streets to promote safe and convenient access and travel for all users: pedestrians, bicyclists, transit riders, and equestrians, as well as cars, trucks, and buses."
Santa Barbara, CA	Circulation Element to the City General Plan	City	"Emphasize alternative modes in order to provide real options and opportunities for people to choose among different forms of transportation rather than relying exclusively on the automobile."
Boulder, CO	Multimodal Corridors: Transportation Network Plans	City	"Improve access and mobility to, through, and within the BVRC area for all modes of travel by developing a multi-modal transportation grid where possible."
Fort Collins, CO	Master Street Plan	City	"It is critical that the transportation system provide mobility throughout the community and access between origins and destinations for all travel modes, accommodating all types of people...The MSP network is designed to achieve the following results: A significant shift in travel behavior, with more trips shifting away from single-occupant travel into transit, walk and bicycle, and multi-occupant vehicle travel modes; A reduction of growth in daily Vehicle Miles Traveled (VMT); Attainment of City air quality objectives."
Colorado Springs, CO	Complete Streets Amendment to the City's Intermodal Transportation Plan	City	"Construct complete streets designed to accommodate all users. In all new roadway projects or major reconstruction projects, accommodate travel by pedestrians, bicyclists, and transit users, except where pedestrians and bicyclists are prohibited by law from using a given facility or where...unsafe or impractical."
West Palm Beach, FL	Transportation Element to the Comprehensive Plan	City	"To provide transportation systems that achieve the economic, social, and environmental goals of the City of West Palm Beach which fosters sustainability, livability, and economic success."
Florida-Alabama Transportation Planning Organization (Pensacola, FL Area)	Bicycle & Transportation Plan	MPO	"The purpose of this plan is to provide transportation choices by integrating bicycle and pedestrian facilities in transportation planning activities, and to encourage and implement complete streets."
Decatur, GA	Community Transportation Plan	City	"Complete Streets are defined as streets with safe travel facilities for all users – pedestrians, bicyclists, motorists and transit riders – of all ages and ability levels...As the focus is...on increasing opportunities for non-motorized transportation alternatives, it provides safe and reliable options for everyone to become active participants, both physically and socially, in the community. It is especially beneficial to the City's most vulnerable populations such as low income households, children and older adults, all of who experience differing physical, mental and financial challenges to mobility."

This inventory of policy language is based on an assessment by the National Complete Streets Coalition as part of an AARP Public Policy Institute research project; actual policy performance was not evaluated. It is based on policies in the National Complete Streets Coalition database as of December 2008.

Agency	Year	Modes Covered	Users with Disabilities	Older Adults	Policy Reach	Purpose & Vision	Coverage	Context
Type: Plan								
Scottsdale, AZ	2008		◐	◐	◐	●	●	✓
Santa Barbara, CA	1998		⊘	⊘	◐	●	◐	⊘
Boulder, CO	1996		⊘	⊘	◐	◐	○	✓
Fort Collins, CO	2004		◐	⊘	◐	●	○	✓
Colorado Springs, CO	2005		⊘	⊘	◐	◐	◐	✓
West Palm Beach, FL	2003		◐	◐	◐	●	◐	✓
Florida-Alabama Transportation Planning Organization (Pensacola, FL Area)	2005		◐	⊘	◐	●	●	✓
Decatur, GA	2008		●	●	◐	◐	○	⊘

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Agency	Policy	Level	Description/Language
Champaign, IL	Transportation Master Plan	City	"The Plan creates a vision for a multi-modal transportation system that helps achieve the City's goals of sustainable growth. Champaign Moving Forward considers all transportation modes, including cars, public transportation, bicycling, and walking."
Washtenaw County, MI	Non-Motorized Plan	County	"Road agencies...shall provide for pedestrian and bike movements with appropriate crossings that are ADA compliant...for all urbanized area road reconstruction. Facilities shall be constructed so that there is adequate access for all types of non-motorized users and to support transit wherever possible...For areas outside the urbanized area at a minimum all road reconstruction or major improvements involving federal aid eligible roads and non federal aid eligible roads that connect existing or proposed non-motorized facilities shall include a paved shoulder or paved shoulder and accessible ADA compliant sidewalks on rural roads where traffic and speed necessitate a separate pedestrian facility."
St. Joseph Area Transportation Study Organization (St. Joseph, MO Area)	St. Joseph Bicycle and Pedestrian Master Plan	MPO	"Bicycle and pedestrian ways shall be established in new construction and reconstruction projects throughout the metropolitan area...Sidewalks, shared use paths, street crossings, pedestrian signals, signs, street furniture, transit stops and facilities, and all connecting pathways shall be designed, constructed, operated, and maintained so that all pedestrians, including people with disabilities, can travel safely and independently."
East-West Gateway Council (St. Louis, MO Area)	St. Louis Legacy 2035 Long-Range Plan	MPO	"...[E]very road project should provide routine accommodations. That is, as a matter of standard practice the transportation system should be designed, built, and maintained in a manner that accommodates not only automobiles but transit vehicles and non-motorized modes of travel as well."
Charlotte, NC Department of Transportation	Urban Street Design Guidelines and Transportation Action Plan	City & County	"The Guidelines will allow us to provide better streets throughout Charlotte – streets that reflect the best aspects of the streets built in the past, and that will provide more capacity and safe and comfortable travel for motorists, pedestrians, bicyclists, and transit riders."
New York City, NY	Sustainable Streets Strategic Plan	City	"Our streets must be safe for all New Yorkers, of all ages. We will design, build, sign, and signal roadways to safely move motorists, cyclists, transit passengers and pedestrians and ensure the safety of [ferry passengers]."
Capital Area Metropolitan Planning Organization (Austin, TX Area)	Texas Mobility Plan 2030	MPO	"...[P]rovide pedestrian facilities/bicycle accommodations with all new construction and reconstruction of roadways in this plan within urban and suburban areas unless pedestrians/bicycles are prohibited by law from using the roadway, or the jurisdiction constructing the project has demonstrated that providing the bicycle accommodation is not feasible due to excessive cost."
Arlington County, VA	Master Transportation Plan	County	"Ensure all streets are 'complete streets,' safe and comfortable for pedestrians, bicyclists, transit riders, motorists and other users."

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Agency	Year	Modes Covered	Users with Disabilities	Older Adults	Policy Reach	Purpose & Vision	Coverage	Context
Champaign, IL	2008		◐	◐	◐	●	◐	✓
Washtenaw County, MI	2006		●	⊘	◐	●	●	✓
St. Joseph Area Transportation Study Organization (St. Joseph, MO Area)	2001		◐	◐	◐	◐	◐	✓
East-West Gateway Council (St. Louis, MO Area)	2007		◐	◐	◐	◐	○	✓
Charlotte, NC Department of Transportation	2007		⊘	⊘	◐	●	◐	✓
New York City, NY	2008		◐	●	◐	◐	○	⊘
Capital Area Metropolitan Planning Organization (Austin, TX Area)	2005		◐	◐	◐	◐	◐	⊘
Arlington County, VA	2006		◐	◐	◐	●	○	✓

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Agency	Policy	Level	Description/Language
State of Vermont Agency of Transportation	Bicycle Pedestrian Plan	State	"Institutionalize bicycle and pedestrian planning and accommodation within all VAOT programs and project development...Accommodate the need for flexibility with respect to established design standards and increased awareness of aesthetic considerations with transportation project design... Develop a bicycle and pedestrian design manual for use by bicycle and pedestrian project designers and agency personnel."
Madison Area Transportation Planning Board (Madison, WI Area)	Regional Transportation Plan Update	MPO	"Develop and maintain a safe, effective, and efficient street and roadway system that meets the combined needs of all users for travel within and through the region, and enhances community and economic vitality."
Type: Manual/ Standards			
San Diego, CA	Street Design Manual	City	"To offer guidelines for the design of streets that will create harmony and promote function for all users while respecting and supporting the needs of the surrounding community."
Sacramento, CA	Best Practices Guide	City	"This document outlines an approach to designing streets that are more "complete" in the sense of accomplishing all of the goals associated with the dominant form of public space in urban societies – our streets…Complete streets are those that adequately provide for all roadway users, including bicyclists, pedestrians, transit riders, and motorists, to the extent appropriate to the function and context of the street."
Basalt, CO	Complete Street Design	City	"Creating a pedestrian environment priority within the overall transportation system and ensuring all modes are adequately considered and properly addressed is a goal of this document and of the Town of Basalt...While there needs to be functionality to the management of the vehicle, there also needs to be safety, accessibility, and pleasure for individuals walking or using alternative transportation to move and enjoy the qualities of Basalt."
Louisville-Jefferson Metro, KY	Complete Streets Manual	County & City	"Louisville Metro's transportation system shall accommodate and balance a broad range of factors within all transportation and development projects, both new and retrofit, including design, planning, maintenance, and operations, for the entire right of way. The goal of this policy is to develop a multi-modal network...."
State of Massachusetts	Project Development and Design Guide	State	"...[T]o ensure that the safety and mobility of all users of the transportation system (pedestrians, bicyclists and drivers) are considered equally through all phases of a project so that even the most vulnerable (e.g., children and the elderly) can feel and be safe within the public right of way."

This inventory of policy language is based on an assessment by the National Complete Streets Coalition as part of an AARP Public Policy Institute research project; actual policy performance was not evaluated. It is based on policies in the National Complete Streets Coalition database as of December 2008.

Agency	Year	Modes Covered	Users with Disabilities	Older Adults	Policy Reach	Purpose & Vision	Coverage	Context
State of Vermont Agency of Transportation	1998		◐	◐	◐	◐	◐	✓
Madison Area Transportation Planning Board (Madison, WI Area)	2006		◐	◐	◐	●	○	✓
Type: Manual/ Standards								
San Diego, CA	2002		◐	◐	●	◐	◐	✓
Sacramento, CA	2005		◐	⊘	◐	●	◐	✓
Basalt, CO	2005		◐	⊘	◐	◐	◐	✓
Louisville-Jefferson Metro, KY	2007		●	◐	◐	◐	◐	✓
State of Massachusetts	2006		◐	◐	◐	●	○	✓

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APPENDIX B

COMPLETE STREETS ONLINE SURVEY RESULTS

AARP Complete Streets Survey (5)

Edit & Review | Invite & Deploy | Analyze Results

Results | » Individual Responses | » Raw Data Export | » Manage Presentation

Results Overview
Filter: No filter applied

Print | Excel Export

Reports
View Report: Results Overview
New Cross Tab Report

Filters
Apply Filter: No filter applied
New Filter
Manage Saved Filters

Options
- [x] Completes
- [ ] Partials
- [ ] Screen Outs
- [ ] Over Quota

APPLY

Survey Coach
» Learn how to use filters
» View a demo of reporting

AARP Complete Streets Survey (5)

Survey Status: Closed Launched: 8/4/2008 1:53 PM Closed: 9/3/2008 9:40 AM

Email Invites:	Visits:	Partials:	Screen Outs:	Over Quota:	Completes:
7972	2743	0	0	0	1134 *(Does not include blank responses)*

Thank you for taking the time to complete this survey. AARP's Public Policy Institute (PPI), in association with the Institute of Transportation Engineers (ITE), and the National Complete Streets Coalition is examining how the design guidelines for older drivers and pedestrians recommended by the FHWA adhere to the basic design characteristics for "Complete Streets." The objective of designing for "Complete Streets" is to help states and localities adopt new policy and procedure rule changes so that the entire street right-of-way is routinely designed and operated to enable safe access for all users. The central hypothesis to be tested through this study is whether older driver safety measures recommended within the FHWA Highway Design Handbook for Older Drivers and Pedestrians may conflict with the needs of pedestrians and bicyclists. Balancing the needs of all modes and road users is the central challenge to effective complete streets implementation. The results of this survey will greatly assist in helping resolve potential conflicts and in identifying areas where gaps exist and how best to address them. We estimate that the survey will take 10-20 minutes to complete depending on the level of detail you provide. It is divided into three sections: policy oriented questions, specific questions related to intersection design, and solicitation of project specific information from your community. Please submit partially completed surveys if you are unable to get to each section. As a token of our appreciation, we will send you a copy of the final research report and name will be entered into a drawing to receive a $25 gift certificate for the ITE bookstore. We hope you find this survey both interesting and educational.

1. Respondent Information (optional)

View 1134 Responses

2. Which best describes your profession? Create Chart

Planner	216	19%
Engineer	649	58%
Advocate	59	5%
Other, please specify View Responses	192	17%
Total	1116	100%

3. Are you employed by the: Create Chart

Public sector: local	296	26%
Public sector: state	78	7%
Public sector: regional	34	3%
Public sector: federal	12	1%
Private sector	597	53%
Academia	24	2%
Retired	24	2%
Other, please specify View Responses	56	5%
Total	1121	100%

Section I

4. Are you familiar with the "Complete Streets" design concepts and principles? Click here for "Elements of Complete Streets Policies" description. Create Chart

Yes	874	78%
No	246	22%
Total	1120	100%

5. Are you familiar with the publication entitled, "FHWA Highway Design Handbook for Older Drivers and Pedestrians?" (FHWA Handbook) Create Chart

Yes	416	37%
No	706	63%
Total	1122	100%

6. Have you implemented any of the FHWA handbook recommendations? Create Chart

Yes	268	24%
No	393	35%
Don't know	457	41%
Total	1118	100%

7. Does your jurisdiction or organization have ordinances, policies, or design manuals that require multi-modal planning on all projects? Create Chart

Yes	271	24%
Partial	281	25%
None	279	25%
Don't know	287	26%
Total	1118	100%

8. [If answer is "yes" or "partial"] Please provide URLs or sources for your organization/jurisdiction's policy and design documents and resources used in designing for multi-modal travel (if available).

View 329 Responses

9. Are these resources helpful in resolving potential conflicts between user groups such as older drivers and pedestrians? Create Chart

Yes, a lot	59	6%
Yes, somewhat	325	31%
No	144	14%
Don't know	531	50%
Total	1059	100%

10. Are "Complete Streets" principles a routine part of project development in your organization? Click here for "Elements of Complete Streets Policies" description. Create Chart

Yes	453	41%
No	444	40%
Don't know	212	19%
Total	1109	100%

11. In planning and designing multimodal transportation projects, does your organization explicitly consider the needs of older drivers and older pedestrians? Create Chart

Yes	407	37%
No	493	44%
Don't know	213	19%
Total	1113	100%

Section II The following is a list of recommended design elements included in the FHWA Handbook:

12. In your opinion, how well does this design recommendation accommodate the following users? Receiving Lane (Throat Width)A minimum receiving lane of 12' is recommended, accompanied by a shoulder of 4' minimum. Click Here for Diagram

Create Chart

Top number is the count of respondents selecting the option. Bottom % is percent of the total respondents selecting the option.	Well	Somewhat	Not at all	No opinion / Don't know
Drivers	831 75%	211 19%	25 2%	43 4%
Pedestrians	182 16%	410 37%	438 40%	77 7%
Bicyclists	399 36%	502 45%	148 13%	59 5%
Buses and Trucks	612 56%	341 31%	75 7%	67 6%

View 317 Responses

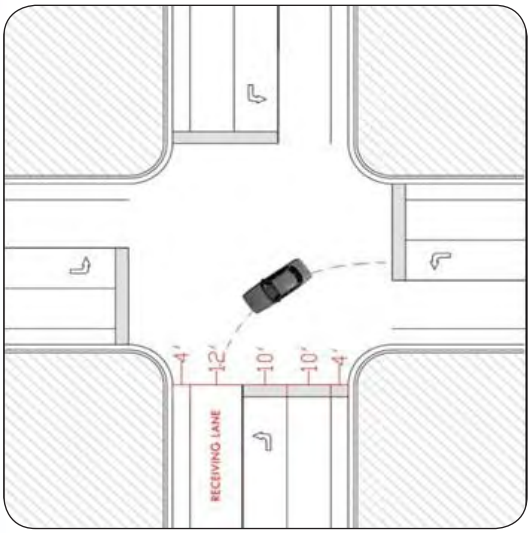


Diagram for Question 12

13. In your opinion, how well does this design recommendation accommodate the following users? ChannelizationWhere channelization is provided, raised channelization with conspicuous markings should be used for right-turn movements and an acceleration lane be provided. Click Here for Diagram

Create Chart

Top number is the count of respondents selecting the option. Bottom % is percent of the total respondents selecting the option.	Well	Somewhat	Not at all	No opinion / Don't know
Drivers	761 69%	245 22%	61 6%	41 4%
Pedestrians	180 16%	404 36%	476 43%	48 4%
Bicyclists	149 14%	463 42%	428 39%	63 6%
Buses and Trucks	513 47%	410 37%	98 9%	78 7%

View 335 Responses

Diagram for Question 13

14. In your opinion, how well does this design recommendation accommodate the following users? Offset (Single) Left-Turn Lane GeometryPositive offset of opposing left-turn lanes is recommended to provide a margin of safety for older drivers. Click Here for Diagram

Create Chart

Top number is the count of respondents selecting the option. Bottom % is percent of the total respondents selecting the option.	Well	Somewhat	Not at all	No opinion / Don't know
Drivers	798 72%	207 19%	59 5%	47 4%
Pedestrians	164 15%	403 36%	440 40%	101 9%
Bicyclists	221 20%	453 41%	298 27%	132 12%
Buses and Trucks	564 51%	359 33%	80 7%	99 9%

View 315 Responses

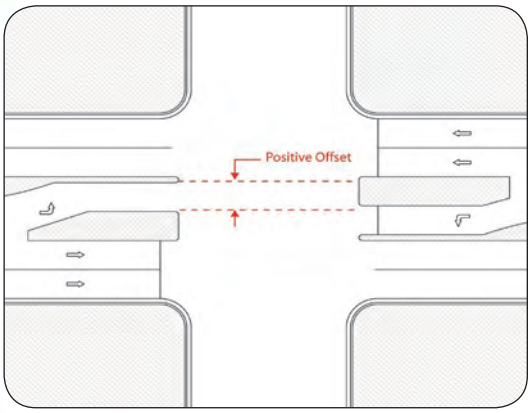


Diagram for Question 14

15. In your opinion, how well does this design recommendation accommodate the following users? Curb RadiusWhere roadways intersect at 90 degrees and are joined with a simple radius curve, provide a corner curb radius of 25 to 30 feet.Click Here for Diagram

Create Chart

Top number is the count of respondents selecting the option. Bottom % is percent of the total respondents selecting the option.	Well	Somewhat	Not at all	No opinion / Don't know
Drivers	677 61%	315 29%	42 4%	71 6%
Pedestrians	284 26%	458 42%	292 26%	68 6%
Bicyclists	344 31%	476 43%	186 17%	95 9%
Buses and Trucks	391 36%	422 38%	193 18%	91 8%

View 294 Responses

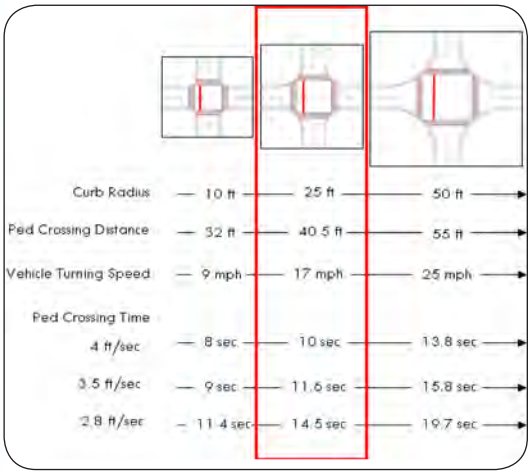


Diagram for Question 15

Section IIIFor the next series of questions, there is a potential conflict identified with the design element and a proposed alternative to resolve the potential conflict. Please rate how well the proposed alternative resolves the potential conflict.

16. Receiving Lane (Throat Width) Potential Conflict: Wider streets impact the safety and comfort of pedestrians and bicyclists as they encourage faster motor vehicle speed and increase pedestrian exposure. Click Here for Diagram. Proposed Alternative:Allow 12' for the receiving lane within the intersection, and gradually taper that lane to 10-11' beyond the intersection limits. In urban areas, use the 4' shoulder for a bike lane in order to increase the street's multi-modal capacity and to provide a visual cue for drivers to stay within the travel lane.Click Here for Diagram. In your opinion, how well does the proposed alternative resolve the potential conflict?

Create Chart

Well	317	29%
Somewhat	594	54%
Not at all	144	13%
No opinion / Don't know	51	5%
Total	1106	100%

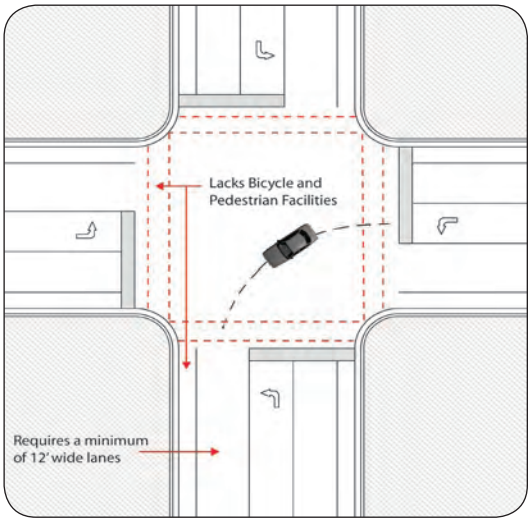
17. Receiving Lane (Throat Width) Additional Comments

View 373 Responses

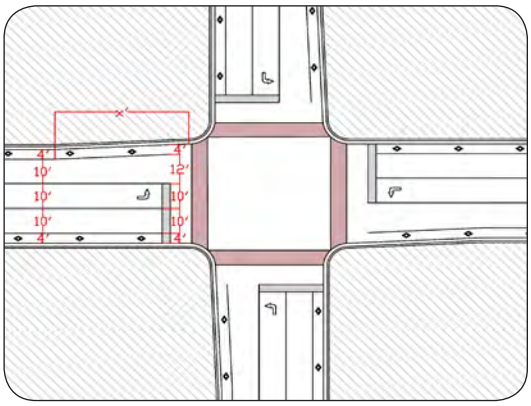
18. Channelization Potential Conflict: In accordance with the FHWA Handbook, this design could include a wide turning radius with a wide angle which is difficult for older drivers with stiff neck issues to manage as they cannot turn their heads far enough to the left to look for oncoming traffic. In addition, higher vehicular turning speeds and longer pedestrian crossing distances reduce pedestrian safety and comfort even if a raised median is provided. Furthermore, the FHWA Handbook is silent on the cone of vision created by the turn angle, which can limit all drivers' ability to see pedestrians waiting to cross the channelized lane. Click Here for Diagram. Proposed Alternative:To provide safe pedestrian crossing, avoid the use of right-turn channelization in urban and suburban areas whenever possible. When channelization is necessary, raise it and provide barrier curbs (as recommended in the FHWA Handbook), and use a tight angle turn (no less than 75 degrees). Click Here for Diagram. In your opinion, how well does the proposed alternative resolve the potential conflict?

Create Chart

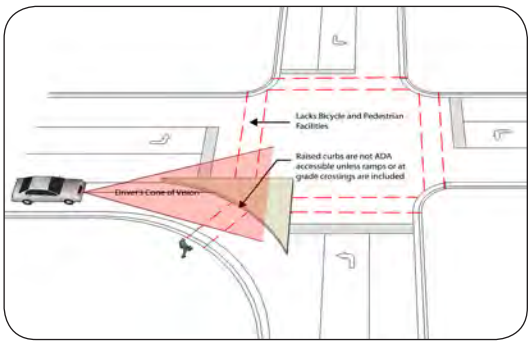
Well	441	40%
Somewhat	511	47%
Not at all	105	10%
No opinion / Don't know	38	3%
Total	1095	100%



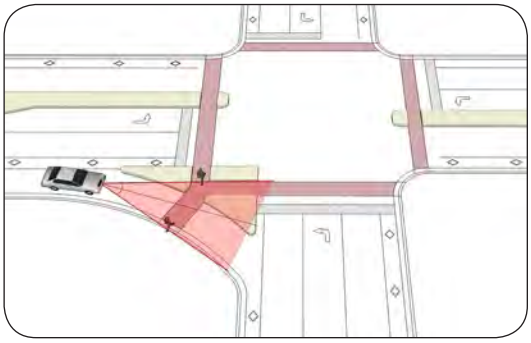
Potential Conflict Diagram for Question 16



Proposed Alternative Diagram for Question 16



Potential Conflict Diagram for Question 18



Proposed Alternative Diagram for Question 18

19. Channelization Additional Comments

View 311 Responses

20. Offset (Single) Left-Turn Lane Geometry Potential Conflict: Positive offsets are effective at clearing sight-distance problems at an intersection; however, the location of the median refuge creates a safety problem for pedestrians. The pedestrian refuge is located between two lanes of traffic traveling in the same direction, requiring the pedestrian to cross traffic traveling in two directions across the second leg of the intersection. This is an awkward location for a pedestrian to wait and negates much of the benefit of a pedestrian refuge. Click Here for Diagram. Proposed Alternative:Provide additional median width (minimum 4') between turn lane and lane of opposing traffic as a pedestrian refuge. Click Here for Diagram. In your opinion, how well does the proposed alternative resolve the potential conflict?

Create Chart

Well	313	29%
Somewhat	515	47%
Not at all	224	21%
No opinion / Don't know	36	3%
Total	1088	100%

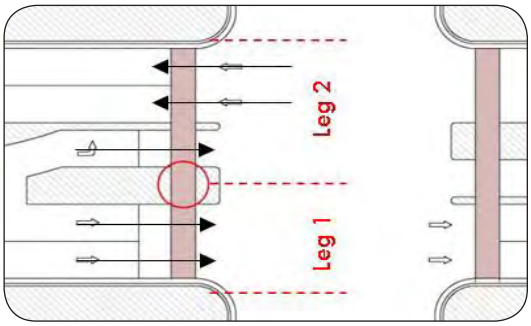
21. Offset (Single) Left-Turn Lane Geometry Additional Comments

View 402 Responses

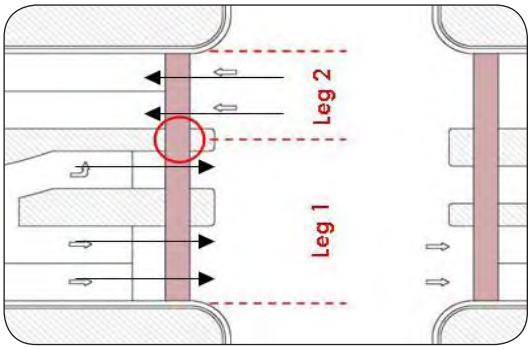
22. Curb Radius Potential Conflict: A 25-30' curb radius is typical of rural and suburban design where less emphasis is placed on pedestrian activity and safety. It presents two potential conflicts with pedestrian safety: Vehicle turning speeds may exceed 17 MPH, increasing the potential for more severe driver/pedestrian conflicts; and the scale of radius increases the crossing distance for pedestrians. Click Here for Diagram. Proposed Alternative:To facilitate safer pedestrian activity, use a 10-15' curb radius wherever possible and no greater than a 25' curb radius, particularly in urban and suburban locations. This tighter radius is more compatible with the goals of "Complete Streets" and helps to balance the needs of all roadway users. Click Here for Diagram. In your opinion, how well does the proposed alternative resolve the potential conflict?

Create Chart

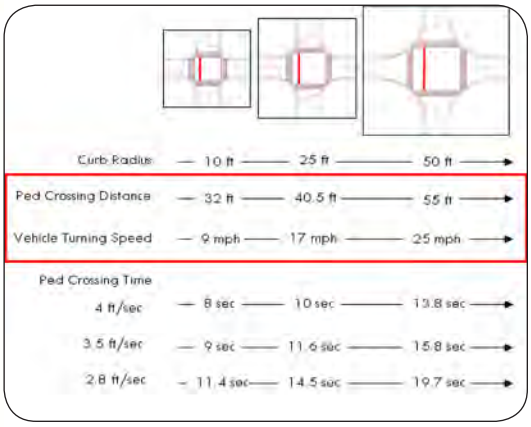
Well	448	41%
Somewhat	429	39%
Not at all	163	15%
No opinion / Don't know	54	5%
Total	1094	100%



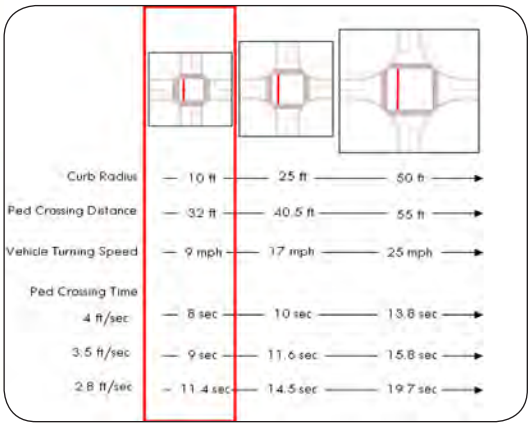
Potential Conflict Diagram for Question 20



Proposed Alternative Diagram for Question 20



Potential Conflict Diagram for Question 22



Proposed Alternative Diagram for Question 22

23. Curb Radius Additional Comment

View 406 Responses

24. Barriers to Success: Please indicate the extent to which, in your experience, the following issues pose barriers to planning, designing, or implementing complete street improvements.

 Create Chart

Top number is the count of respondents selecting the option. Bottom % is percent of the total respondents selecting the option.	Major barrier	Minor barrier	Not a barrier	Don't know / No opinion
Lack of public input	247 22%	494 45%	301 27%	58 5%
Lack of political support	599 54%	341 31%	120 11%	41 4%
Lack of political authority	447 41%	392 36%	193 18%	66 6%
Limited public funding	786 72%	235 21%	50 5%	27 2%
Lack of private investment	285 26%	454 42%	247 23%	106 10%
Lack of staff, e.g. planning, engineering, etc.	285 26%	513 47%	251 23%	43 4%
Lack of information and/or technical expertise	384 35%	441 40%	242 22%	30 3%
Community leaders are resistant to change	453 42%	440 40%	152 14%	45 4%
Conflicts between state DOT & local jurisdictions	564 52%	380 35%	85 8%	56 5%
Conflicts between state DOT & MPO / regional planning agencies	339 31%	435 40%	192 18%	125 11%
Conflicts between MPO / regional planning agencies and local jurisdictions	246 22%	473 43%	257 23%	124 11%
Conflicts between jurisdictions	296 27%	496 45%	220 20%	84 8%

Section IV Please select one multimodal project completed by your organization within the last two years that best demonstrates the characteristics of "Complete Streets" principles and the provision of safety for older drivers/pedestrians, and all pedestrians and bicyclists. Click here for "Elements of Complete Streets Policies" description.

25. Project Characteristics

View 338 Responses

26. Roadway Classification: Create Chart

Expressway	4	1%
Arterial	154	45%
Collector	57	16%
Residential or Local	37	11%
Don't know	54	16%
Other, please specify View Responses	40	12%
Total	346	100%

27. Predominant Land Uses Within Corridor Create Chart

Downtown mixed-use center	77	22%
Urban Residential area	43	12%
Suburban Commercial/Office center	42	12%
Suburban Residential area	41	12%
Small town or village	20	6%
Rural	3	1%
Warehouse/Industrial	3	1%
Don't know	43	12%
Other, please specify View Responses	75	22%
Total	347	100%

28. Community Population (choose one) — Create Chart

< 10,000	22	5%
10,000 – 49,999	78	18%
50,000 – 99,999	77	18%
100,000 – 499,999	115	27%
500,000 – 999,999	53	12%
1,000,000 +	33	8%
Don't know	48	11%
Total	426	100%

29. Name as many older driver/pedestrian design elements that were incorporated as part of this project?

View 251 Responses

30. Indicate as many "Complete Streets" pedestrian-bicycle-transit or other design elements that were incorporated as part of this project?

View 257 Responses

31. Briefly describe areas of particular challenge in accommodating the varying needs of users.

View 351 Responses

32. Briefly describe how this challenge was addressed?

View 286 Responses

33. PROJECT CONTACT:

View 231 Responses

34. Thank you for your assistance with this project. If you have any additional comments, please provide them below.

View 137 Responses

APPENDIX C

COMPLETE STREETS OMNIBUS SURVEY RESULTS

ANNOTATED QUESTIONNAIRE

The study was conducted for AARP's Public Policy Institute via telephone by ICR, an independent research company. Interviews were conducted from July 9 – 15, 2008 among a nationally representative sample of 1006 respondents 50 years of age or older. The margin of error for total respondents is +/-3.09% at the 95% confidence level. More information about ICR can be obtained by visiting www.icrsurvey.com

LC-1 How concerned are you about the recent rise in gas prices? Would you say you are…?

	CONCERNED				NOT CONCERNED			Don't know	Refused
	NET	Extremely	Very	Somewhat	NET	Not very	Not at all		
7/20/08	94	48	37	9	6	2	3	*	--

LC-2 Have you modified your lifestyle in any of the following ways to accommodate for the high gas costs? Have you (INSERT ITEM)?

	Yes	No	Don't know	Refused
a. Walked more frequently to get wherever you need to go	29	71	*	*
b. Limited your daily driving	67	32	*	*
c. Used public transportation (e.g. taking the bus or subway)	16	84	--	*
d. Rode a bicycle	15	85	--	*
e. Participated in carpools	13	86	1	1
f. Worked from home/teleworked	14	85	*	1
g. Cut back on other expenses	61	39	*	*
h. Postponed travel/vacations	46	54	*	*

LC-3 Cities and towns may have many features in their community that help make streets comfortable for all users including drivers, pedestrians, and bicyclists. For the most part, does your neighborhood have (INSERT ITEM)?				
	Yes	No	Don't know	Refused
a. Adequate sidewalks	61	39	*	*
b. Adequate bike accommodations (e.g., bike lanes or paths)	41	55	4	*
c. A comfortable place to wait for the bus	46	48	6	1
d. Accessible public transportation (e.g., bus, subway, train)	55	44	1	*
e. Intersections with safe crosswalks for pedestrians	59	39	2	*
f. A safe place for pedestrians to wait midway when crossing a wide street	48	47	4	*
g. Adequate street lighting	76	23	*	*
h. Adequate enforcement of posted speed limits	77	21	3	*

LC-4 Some cities and states across the country are implementing policies to ensure roads will be designed for all users, not only drivers, but also pedestrians, bicycle riders, and those using public transportation. How likely would you be to support such a policy in your community? Would you be…?									
	LIKELY				NOT LIKELY			Don't know	Refused
	NET	Extremely	Very	Somewhat	NET	Not very	Not at all		
7/20/08	78	22	34	22	18	8	9	3	1

LC-5 If the streets in your neighborhood were accommodating, how likely would you be to walk, ride a bike, or catch a bus to your destination? Would you be…?									
	LIKELY				NOT LIKELY			Don't know	Refused
	NET	Extremely	Very	Somewhat	NET	Not very	Not at all		
7/20/08	56	13	21	23	40	16	24	2	2

AM-1 Are you or your spouse or partner currently a member of AARP (IF NECESSARY: formerly known as the American Association of Retired Persons)?				
	Yes	No	Don't know	Refused
7/20/08	45	54	*	1

For a full analysis of the survey results please see:

Skufca, Laura. *Is the Cost of Gas Leading Americans to Use Alternative Transportation?* AARP Knowledge Management, August 2008

http://www.aarp.org/research/housing-mobility/transportation/gas_costs.html

APPENDIX D

SUMMARY OF STATES' PROGRESS IN IMPLEMENTING THE FHWA HANDBOOK

To determine the extent to which states, counties, and cities have implemented a variety of older driver safety projects based on certain design elements included in *FHWA's Highway Design Handbook for Older Drivers and Pedestrians*, the following reports were reviewed.

- GAO Report to the Special Committee on Aging, U.S. Senate Older Driver Safety, GAO-07-413, April 2007
- NCHRP Synthesis 348: *Improving the Safety of Road Users*, 2005
- NCHRP Report 500, Volume 9: *A Guide for Reducing Collisions Involving Older Drivers*, 2004
- *Designing Safer Roads for Older Drivers: A Compilation of How U.S. States Address Older Driver Safety in Their Strategic Highway Safety Plans*, Anna Gilbert, Intern, Government Relations and Advocacy, AARP, Spring 2008

The GAO report presents a fairly pessimistic view. When asked, "To what extent has your department invested resources in older driver safety projects?" 80 percent of the states reported little or no extent. However, a number of states have taken steps to accommodate the older driver through a number of categories, including signs and pavement markings, automated enforcement and traditional enforcement, signal operational changes, geometric and design changes, policy and education, and pedestrian and bicycle improvements. Within each category, several strategies specifically speak to the needs of accommodating all road users, including older drivers and older pedestrians. They are as follows:

Design

- Consider realigning intersections to 90 degrees to improve safety.
- Construct roundabouts.
- Construct offset left- and right-turn lanes.
- Construct exclusive left-turn lanes (with exclusive signal phases).

Signal Operations

- Improve signal timing by adding phases, lengthening clearance intervals, eliminating or restricting higher-risk movements, and coordinating signals.
- Prohibit right turns after a complete stop at a red traffic light.

- Install 12” LED signal heads.

Signs and Markings

- Call attention to intersections by installing rumble strips on intersection approaches.
- Improve intersection lighting.
- Install highly reflective sheeting on signs to improve legibility.

Pedestrian and Bicycle

- Increase length of signal timing at crosswalks.
- Construct median refuge islands.
- Use pedestrian countdown signals.
- Install sidewalks.
- Use audible pedestrian countdown signals.

Policy and Education

- Control and manage roadway access points, particularly in the vicinity of intersections, to reduce driver-pedestrian conflicts and improve traffic flow.
- Increase enforcement of intersection violations, such as red light running, with such as regulatory signs and cameras.
- Improve sight distances at both signalized and unsignalized intersections. For example, remove parking that restricts sight distance, and clear sight distance triangles of shrubs and trees.

States worthy of mention include California, Florida, Iowa, and Michigan.

California

The Transportation Safety Task Force was charged with incorporating components of the Federal Highway Administration’s “Guidelines and Recommendations to Accommodate Older Drivers and Pedestrians” into state and local traffic engineering design manuals. The task force prioritized more than 125 recommendations that specifically assist older drivers (and all roadway users) for eventual introduction into California’s *Manual on Uniform Traffic Control Devices and Caltrans HDM* (Highway Development Manual). During 2006 the work group made presentations to the California Traffic Control Devices Committee (CTCDC), which approved almost all the recommendations for incorporation into the manuals. An example of such adoption includes the CTCDC-approved use of the 2.8’/second signal timing where older pedestrians are present.

Florida

Florida is recognized as a leader in making its roadways safe for older road users. The state identified short-term and long-term improvements as part of its 1991 Florida Elder Road User Program. Short-term improvements include:

- Reflective pavement markers
- Overhead street name signs
- Wider pavement markings
- Advance street name signs
- Improved pedestrian crossings
- Improved work zone safety

Long-term improvements include:

- Increasing sign visibility
- Providing advance notice
- Improving intersection design and operation

Iowa

The Iowa Department of Transportation has undertaken several initiatives to enhance the road environment for older drivers. They include:

- Using more durable pavement markings on selected roads and servicing all pavement markings on a performance-based schedule to maintain their brightness
- Adding paved shoulders with the edge line painted in a shoulder rumble strip to increase visibility and alert drivers when their vehicles stray from the travel lane
- Converting four-lane undivided roads to three-lane roads with a dedicated left-turn lane to simplify turning movements
- Encouraging the use of more dedicated left-turn arrows on traffic signals on high-speed roads
- Installing larger street name signs
- Replacing warning signs with ones that have fluorescent yellow background to increase visibility
- Converting to Clearview fonts on interstate signs to increase sign readability
- Demonstrating older driver and pedestrian-friendly enhancements on a roadway corridor in Des Moines
- Using the older driver as the "design driver" when designing Iowa roadways

Michigan

More than $27 million was spent upgrading intersections in the cities of Detroit and Grand Rapids. Changes have included:

- Brighter stop lights
- Bigger street name signs
- Brighter reflective markings
- Upgraded walk lights
- New left-turn lanes
- Brighter sign legends, high-visibility reflective sheeting for signs
- Enlarged fonts on guide signs
- Brighter warning signs
- Increased edge line and gore pavement markings
- Phase-in of 12” LED signal heads

APPENDIX E

APPLICATION TO ACCEPTED STANDARDS

FHWA DESIGN ELEMENT B. RECEIVING LANE (THROAT) WIDTH FOR TURNING OPERATIONS

Recommendation

One of the greatest challenges with implementing this recommendation is the fact that the land use context is not addressed. In most urban areas, the FHWA recommendation does not apply because additional travel lanes, bike lanes, or on-street parking provide the indirect benefit of additional throat width for a left-turning vehicle. In these areas, the standard should be refined to accommodate a 10'–11' receiving lane with a 5' bicycle lane adjacent to the receiving lane, wherever practical.

AASHTO Green Book, p. 312: In urban areas where pedestrian crossings, right-of-way, or existing development become stringent controls, the use of 11' lanes is acceptable. Lanes 10' wide are acceptable on low-speed facilities.

Recommendation

It may also be useful to specify that the 12' receiving lane with 4' shoulder recommendation is a rural standard and may be accompanied by "share the road" signage where bicycle activity is expected.

AASHTO Green Book, p. 100: Improvements such as the following, which generally are of low to moderate cost, can considerably enhance the safety of a street or highway and provide for bicycle traffic: paved shoulders.

AASHTO Green Book, p. 314: Where bicyclists and pedestrians are to be accommodated on the shoulders, a minimum usable shoulder width (i.e., clear of rumble strips) of 4' should be used.

MUTCD, Section 2C.51: In situations where there is a need to warn drivers to watch for other slower forms of transportation traveling along the highway, such as bicycles, golf carts, horse-drawn vehicles, or farm machinery, a "Share the Road" W16-1) plaque may be used.

FHWA DESIGN ELEMENT C. CHANNELIZATION

Recommendation

If a channelized right turn is present in a pedestrian-oriented area, a raised curb is

recommended with an at-grade crosswalk to provide refuge for crossing pedestrians, rather than demarcating the channelization with surface paint alone.

AASHTO Green Book, p. 622: Under certain conditions, painted, flush medians and islands or traversable type medians may be preferable to the raise curb islands. These conditions include the following: lightly developed areas that will not be considered for access management; intersections where approach speeds are relatively high; areas where there is little pedestrian traffic

Recommendation

Contrast paint may be added to the curb side to make it more visible at all times of the day and under all driving conditions. The surface and sides of the median refuge should also be reflectively painted to increase visibility.

CSS, p. 141: Islands should be sufficiently large to command attention. … Medians expected to be used as pedestrian refuges should be surrounded by vertical curbs to delineate the pedestrian refuge from the surrounding roadway.

Recommendation

The driver's cone of vision should be considered in designing the angle of a channelized turn. Pedestrian visibility to drivers should be the priority to keeping roadways safe and navigable.

CSS, p. 165: Place crosswalks so that a motorist has a clear view of pedestrians. A well-illuminated crossing point should be placed where drivers and pedestrians have good sight distance and can see each other in advance of the crossing point.

CSS, p. 166: If vehicle-pedestrian conflicts are a significant problem in the channelized right-turn lane, it might be appropriate to provide signing to remind drivers of their legal obligation to yield to pedestrians crossing the lane in the marked crosswalk. Regulatory signs such as "Turning Traffic Must Yield to Pedestrians" (R10-15) or warning signs such as "Pedestrian Crossing" (W11-2) could be placed in advance of or at the crossing location.

Recommendation

Tighter turn angles can reduce driver speeds and open the driver's vision to the potential presence of a crossing pedestrian. In addition to reducing the likelihood of vehicle-pedestrian conflicts, tighter-angled channelized turns reduce the vehicle speed and the degree to which the driver's head must turn left in order to look for oncoming traffic. These attributes are particularly important for older drivers.

CSS, p. 165: Provide a low-angle right turn (about 112 degrees). This angle slows down the speed of right-turning vehicles and improves driver visibility of pedestrians within and approaching the crosswalk.

Recommendation

Reducing the lane width of the approach lane for the channelized turn can also help to reduce vehicle speed.

CSS, pp. 165–66: Unless he turning radii of large vehicles, such as tractor-trailers or buses, must be accommodated, the pavement in the channelized right-turn lane should be no wider than 16'. For any width right-turn lane, mark edge lines and cross-hatching to restrict the painted width of the travel way of the channelized right-turn lane to 12' to slow smaller vehicles.

Recommendation

Crosswalks should be located 15'–20' behind the edge of the median on the receiving side to allow adequate space for a vehicle to stop and look left for oncoming traffic without blocking the path of pedestrians.

CSS, p. 165: Unless no other choices are available, the crossing point should not be placed at the point where right-turning drivers must yield to other vehicles and therefore might not be watching for pedestrians.

Recommendation

Landscaping low prickly shrubs along the curb will confine pedestrians to crossing at the safest location.

AASHTO Green Book, p. 96: Pedestrian actions are less predictable than those of motorists. Many pedestrians consider themselves outside the law in traffic matters, and in many cases, pedestrian regulations are not fully enforced. This makes it difficult to design a facility for safe and orderly pedestrian movements.

Recommendation

If at all possible, consideration should be given to removing channelization in urban and suburban settings, because of the potentially dangerous obstacles it can present to the older pedestrian.

CSS, p. 164: Avoid using channelized right-turn lanes where pedestrian activity is significant. If a channelized right-turn lane is unavoidable, use design techniques described to lessen the impact on pedestrians.

CSS, p. 165: Removing channelized right-turn lanes also makes it possible to use signing, such as "No Turn on Red" or turn prohibition signs.

CSS, p. 164: If an urban channelized right-turn lane is justified, design it for low speeds (5–10 mph) and high-pedestrian visibility.

FHWA DESIGN ELEMENT E. OFFSET (SINGLE) LEFT-TURN LANE GEOMETRY, SIGNING, AND DELINEATION

Recommendation

A solution that provides a benefit to both drivers and pedestrians would be to implement a phasing plan with a protected left-turn lag phase instead of providing positive offset for the left-turn lane. This would reduce the crossing distance for pedestrians, while providing an exclusive phase for drivers to make a left turn with no conflicts.

MUTCD, Section 4D.09: No movement that creates an unexpected crossing of pathways of moving vehicles or pedestrians should be allowed during any green or yellow interval, except when all three of the following conditions are met:

- The movement involves only slight conflict.
- Serious traffic delays are substantially reduced by permitting the conflicting movement.
- Drivers and pedestrians subjected to the unexpected conflict are effectively warned thereof by a sign.

Recommendation

Determining if left turns should be allowed during the general phase is dependent upon the context of the intersection. Generally, if opposing through vehicular traffic is heavy, or if opposing pedestrian volumes are high, it may be best to restrict left turns to the protected-only phase.

MUTCD, Section 4D.06: In areas having a high percentage of elderly drivers, special consideration may be given to the use of protected-only mode left-turn phasing, when appropriate.

FHWA DESIGN ELEMENT G. CURB RADIUS

Recommendation

In all cases, the context of the roadway and appropriate vehicle speed should be considered in determining the appropriate size of the curb radius for the particular condition where it is located. Smaller curb radii in the 10'–15' range, combined with lower vehicle speeds, are useful traffic calming devices and are most appropriate in urbanized areas where there is a greater mixture of users sharing the roadway. This is true for small town and suburban mixed-use areas and any other areas where communities wish to encourage pedestrian and bicycle travel.

AASHTO Green Book, p. 621: Guidelines for right-turning radii into minor side streets

in urban areas usually range from 5’ to 30’ and most are between 10’ and 15’. Where a substantial number of pedestrians are present, the lower end of the ranges described below may be appropriate. Most passenger cars operating at very low speed on lanes 10’ or more in width are able to make a right turn with a curb radius of about 15’ with little encroachment on other lanes. However, operation of these vehicles at increased speeds or of larger vehicles even at a very low speed generally results in substantial encroachment on adjacent lanes at either the beginning or the end of the turn, or both.

Recommendation

A 25’ curb radius may be appropriate, however, for urban boulevards, parkways, and less urbanized areas where the dominant form of mobility is the automobile.

AASHTO Green Book, p. 614: The “Bus” and WB-50 design vehicles will encroach onto the opposing lanes in making a turn unless the turning radius is at least 25’ and parking is restricted at the far end of the turn for at least 40’ beyond the radius.

AASHTO Green Book, p. 621: To ensure efficient traffic operation on arterial streets carry heavy traffic volumes, it is desirable to provide corner radii of 15’–25’ for passenger vehicles and 30’–50’ for most trucks and buses, provided there are no significant pedestrian conflicts.

Recommendation

At this radius, a refuge island should be constructed whenever pedestrians are expected so that they may cross the street in two segments. In all cases, the designer should aim for the smallest curb radius possible with consideration given to the nearby land uses, design speed, and types of road users.

AASHTO Green Book, p. 619: Where larger radii are used, an intermediate refuge or median island is desirable, or crosswalks may need to be offset so that the crosswalk distances are not objectionable.

FHWA DESIGN ELEMENT P. PEDESTRIAN CROSSING DESIGN, OPERATIONS, AND CONTROL

Recommendation

According to the research conducted by ITE, reducing signal timing to accommodate a longer pedestrian clearance interval (PCI) using a walk speed of 3.5’/second would have minimal operational impacts in most cases. Increased vehicle delays would occur most often on the major street approaches, which tend to be wider and, thus, have longer crossing distances, requiring a longer PCI. A careful balance between the needs of pedestrians and drivers is necessary; attention to the context and operational capacity of the intersection is critical in determining pedestrian crossing time.

AASHTO Green Book, p. 97: Because pedestrians have a broad range of walking speeds, the speeds at which they may cross a street is significant in design. Average pedestrian walking speeds range from approximately 2.5' to 6.0'/second. The *Manual on Uniform Traffic Control Devices for Streets and Highways* uses a normal walking speed of 4.0'/second. Older people will generally walk at speeds in the lower end of this range.

Recommendation

The signals should be large enough to be clearly visible from the opposite side of the street and may be best when combined with an audible signal to assist persons with visual impairment with crossing the street.

MUTCD, Section 4E.04: Pedestrian signal head indications should be conspicuous and recognizable to pedestrians at all distances from the beginning of the controlled crosswalk to a point 3 m (10') from the end of the controlled crosswalk during both day and night.

MUTCD, Section 4E.06: The primary technique that pedestrians who have visual disabilities use to cross streets at signalized locations is to initiate their crossing when they hear the traffic in front of them stop and the traffic alongside them begin to move, corresponding to the onset of the green interval. This technique is effective at many signalized locations. The existing environment is often sufficient to provide the information that pedestrians who have visual disabilities need to operate reasonably safely at a signalized location. Therefore, many signalized locations will not require any accessible pedestrian signals.