


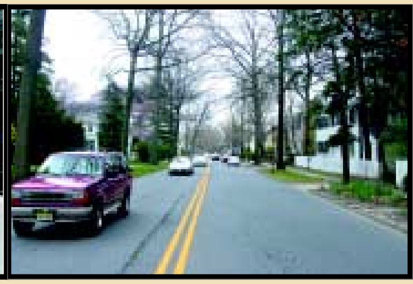

Flexible Design of New Jersey's Main Streets

prepared by the

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for the

New Jersey Department of Transportation

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DEPARTMENT OF TRANSPORTATION
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THE STATE UNIVERSITY OF NEW JERSEY
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DISCLAIMER STATEMENT

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Table of Contents

Preface

It has been said that 95% of problem solving is properly defining the problem.

If the problem is defined as the need to move traffic quickly through a community, it will lead to one set of design solutions. If the problem is defined as the need to preserve livability in the face of growing traffic, it will lead to another set of design solutions. The innovative designs proposed by engineers during the New Jersey Department of Transportation's (DOT's) Context-Sensitive Design Training Course show that different problem definitions can lead to very different design solutions.

The Voorhees Transportation Policy Institute (TPI) study team is proposing a series of policy and practice changes that would add flexibility and context sensitivity to DOT's design process for main streets. The proposals span the highway design process, from planning to final design, for it is at many points along the project pipeline that roadway design can be influenced. Modest changes in geometric standards are also proposed for main streets to add flexibility and context sensitivity.

Recommendation highlights include:

- Establishment of broad purposes and measurable objectives for main street projects,
- Selective reclassification and de-designation of main streets,
- Context-sensitive design exceptions on main streets,
- Use of Main Street Overlays to relax particular design standards on main streets, and
- Development of traffic calming guidelines to take context-sensitive main street design to the next level.

If DOT agrees with the recommendations contained herein, the TPI study team would urge that they be incorporated into the Roadway Design Manual. The TPI study team would also urge that this report be distributed throughout DOT to foster context sensitivity at all levels in the organization.

The TPI study team consisted of Michael King, Petra Staats, and Trefor Williams, as well as myself. Our counterparts at DOT, particularly William Beetle, Danielle Outlaw, and Arthur Eisdorfer, provided valuable guidance and feedback. They were a pleasure to work with. Our thanks to them. Kevin Knutson provided publishing services, including line editing, proofreading and the layout of the final document. We also want to thank the project's Technical Review Committee of national experts. The TRC's membership and contribution are outlined in the report itself.

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Chapter 1
Introduction

The New Jersey Department of Transportation (DOT) asked the Voorhees Transportation Policy Institute (TPI) to investigate possible changes in design standards for highways passing through New Jersey's communities.

Through case studies and surveys, the TPI study team discovered a burgeoning national movement away from strict reliance on highway design templates and toward flexible highway design, especially in the Northeastern and Northwestern United States. The movement seems rooted in the notion that the nation's highways are essentially complete, and working with existing roadways will require special sensitivity to context.

This report concludes the project but not the process, for structural changes can only be achieved with diligent follow-through on DOT's part.

1.1 Definitions

DOT originally gave this project the title "Flexible Design Standards for Highways through Communities." DOT's scope of work makes reference to Context-Sensitive Design (CSD). Some definitions are in order. Both flexible design and CSD call for less rigid application of design standards to highway projects. Flexible design involves utilizing the flexibility inherent in the current design process and in current national guidelines and state standards. CSD implies tailoring designs to adjacent land uses with sensitivity to community values. The raison d'etre of this report is to promote, within DOT, flexibility in the interest of context sensitivity.

The project title also refers to "highways through communities," a broad phrase which requires some narrowing. Obviously, the need for flexibility and context sensitivity is greater for some highways than others, as some impact their environments more directly. In deciding which highways through communities particularly demand context sensitivity, a label was needed. Main street was chosen as a catch-all for highways with mixed functions, not just channels for vehicular movement but places in their own right worth preserving and enhancing. To be sure, the term "main street" conjures up images of narrow shopping streets in tourist towns, and many at DOT feel their work lies elsewhere. But the TPI study team defines the term more broadly. It includes all highways and streets whose adjacent land uses require accommodation of pedestrians and bicyclists, serious consideration of street aesthetics, and a degree of traffic calming. As such, the term includes not only traditional shopping streets but

Figure 1.1: Traditional shopping street, Cranbury, New Jersey.

Figure 1.2: Approach to Main Street, Lambertville, New Jersey.

Figure 1.3: Commercial street, Newark, New Jersey.

Figure 1.4: Residential arterial, Princeton, New Jersey.

approaches to those streets, other commercial streets with small building setbacks, main roads with fronting residences, and other highways directly impacting people's living environments.

This broad definition of main street was validated in a survey of local governments in New Jersey (see Appendix A.3). Absent a formal definition of "main street" in the questionnaire, mayors listed among main streets all manner of roadways, from traditional urban shopping streets to suburban arterials with commercial strips along them. If mayors define their main streets so broadly, it would be counter to the purpose of this project (reconciling DOT standards with local objectives) to define main streets too narrowly.

This broad definition was also validated in the visual preference survey given to the Technical Review Committee. Results confirmed our suspicion that main streets are distinguished not so much by street geometrics as by roadside conditions and relative scale. Results suggested that main streets appear in many different contexts, not just as traditional shopping streets, and that given the right roadside conditions, main streets can be created out of conventional highways by dropping travel lanes, widening sidewalks, planting trees, and other such measures.

Based on scores assigned by the Technical Review Committee to street scenes (50 centerline photos of diverse roadways from throughout the United States), it appears that "main streetness" can be quantified (see Table 1.1). Important context variables include proportion of street frontage with trees, proportion of street frontage with active (pedestrian-generating) uses, sidewalk width, and building setback from the street. DOT could use this formula, or one like it derived through a similar process, to qualify individual highways for special treatment as main streets. The formula could be applied to roadways as they currently exist, or to roadways as redesigned to function more like main streets. It would only be necessary to establish a minimum threshold score, and quantify the variables that comprise the formula. See Appendix A.4 for a complete discussion.

Score=
2.22
+0.0149 * Trees
+0.0132 * Active Uses
+0.125 * Sidewalk
-0.0258 * Setback

Table 1.1: Main Street equation.

In New Jersey, additional guidance is available for distinguishing between main streets and state highways generally. The New Jersey State Development and Redevelopment Plan uses a "Centers" designation to plan for and direct growth within the

Center	County	Type
Hudson County	Hudson	Urban
Jersey City	Hudson	Urban
Atlantic City	Atlantic	Urban
Camden	Camden	Urban
Elizabeth	Union	Urban
New Brunswick	Middlesex	Urban
Newark	Essex	Urban
Paterson	Passaic	Urban
Trenton	Mercer	Urban
Bridgeton City	Cumberland	Regional
Bridgewater-Raritan-Somerville	Somerset	Regional
Dover	Morris	Regional
Long Branch	Monmouth	Regional
Millville-Vineland	Cumberland	Regional
Morristown	Morris	Regional
Newton	Sussex	Regional
Princeton	Mercer	Regional
Red Bank	Monmouth	Regional
Salem	Salem	Regional
Stafford	Ocean	Regional
The Wildwoods	Cape May	Regional
Andover	Sussex	Town
Atlantic Highlands	Monmouth	Town
Avalon	Cape May	Town
Bernardsville	Somerset	Town
Bloomingdale	Passaic	Town
Bound Brook	Somerset	Town
Cape May	Cape May	Town
Elmer	Salem	Town
Flemington	Hunterdon	Town
Freehold	Monmouth	Town
Gloucester City	Camden	Town
Haledon	Passaic	Town
Hightstown	Mercer	Town
Hopatcong	Sussex	Town
Manasquan	Monmouth	Town
Manville	Somerset	Town
Metuchen	Middlesex	Town

Center	County	Type
Mystic Island	Ocean	Town
Netcong	Morris	Town
New Egypt	Ocean	Town
Pluckemin Village	Somerset	Town
Ridgefield	Bergen	Town
Smithville	Atlantic	Town
Stone Harbor	Cape May	Town
Totowa	Passaic	Town
Tuckerton	Ocean	Town
Wanaque	Passaic	Town
Washington	Warren	Town
Washington Town Ctr	Mercer	Town
Woodstown	Salem	Town
Wrangleboro Estates	Atlantic	Town
Bedminster Village	Somerset	Village
Cape May Point	Cape May	Village
Cranbury	Middlesex	Village
Crosswicks	Burlington	Village
Delmont	Cumberland	Village
Dorchester-Leesburg	Cumberland	Village
Far Hills Borough	Somerset	Village
Heislerville	Cumberland	Village
Hope	Warren	Village
Hopewell	Mercer	Village
Mendham	Morris	Village
Mt. Arlington (portion)	Morris	Village
Oceanville	Atlantic	Village
Oxford	Warren	Village
Parkertown	Ocean	Village
Port Elizabeth-Bricksboro	Cumberland	Village
TDC Receiving Area	Burlington	Village
Vincentown	Burlington	Village
Chesterfield	Burlington	Hamlet
Mauricetown Station	Cumberland	Hamlet
Mount Hermon	Warren	Hamlet
Sykesville	Burlington	Hamlet
Route 130-Delaware River Corridor	Burlington	Strategic Plan

Table 1.2: Designated Centers 2001.

state. Centers are urban areas ranging from the smallest hamlets to the largest cities—any place with a reasonable concentration of housing and commerce, and with good accessibility to the rest of the region. As of December 2001, the State Planning Commission had designated 73 Centers—eight Urban, 12 Regional, 31 Town, 18 Villages and four Hamlets (see Table 1.2). Over 200 additional Centers have been proposed.

Centers Policy 15 in the State Plan calls for scaled-down streets, accommodation of pedestrians, traffic calming, and place making within designated Centers. Perhaps most on-point, it calls for roadway design that reflects "adjacent land use conditions as well as the volume of traffic." This is tantamount to a definition of context-sensitive design. Thus, the main street policies recommended in Chapter 2, would best be applied preferentially to main streets (as defined in Table 1.1) located within Centers (as designated in Table 1.2). By affording special status to streets within Centers, DOT can contribute directly to the overall goals of the State Plan.

1.2 Federal Initiatives

Sensitivity to community context would be difficult without recent changes in federal law. Beginning with the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, and continuing with the National Highway System Act (NHS Act) of 1995 and Transportation Equity Act for the 21st Century (TEA-21) of 1998, the US Highway code now allows, and even encourages, a certain degree of flexibility in highway design.

Before 1991, all roads built in the U.S. and paid for even in part with federal funds had to meet guidelines in the American Association of State Highway and Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets* (the "Green Book" in Figure 1.5). If officials wanted to do something different, their only options were to seek design exceptions from the Federal Highway Administration (FHWA) or to build entirely with state and local funds.

ISTEA changed all that by creating a National Highway System (NHS) of Interstate and other high-performance highways, and a larger system of non-NHS highways eligible for federal funding under the newly established Surface Transportation Program. For roads not on the NHS, ISTEA gave states latitude to adopt their own design, safety, and construction standards (see Table 1.3). The NHS Act provided that even NHS highways (other than Interstates) could be designed with due consideration for "environmental, scenic, aesthetic, historic, community, and preservation" impacts. In 1997 the FHWA published *Flexibility in Highway Design*, which forcefully argued for flexible design within AASHTO guidelines (Figure 1.6).

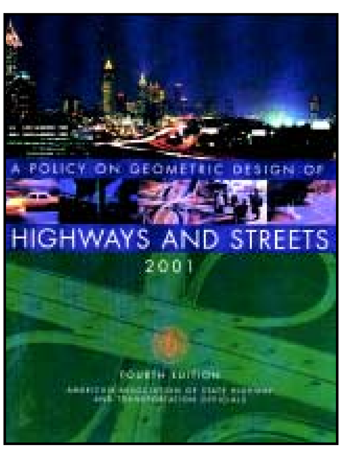

Figure 1.5: "Green Book," AASHTO 2001.

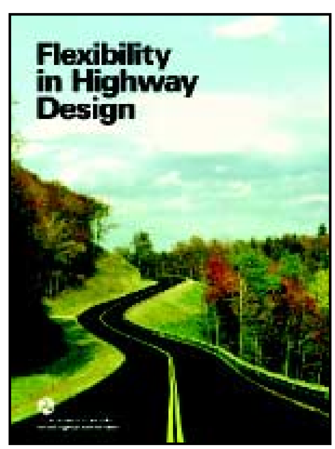

Figure 1.6: Flexibility in Highway Design, *FHWA 1997.*

Type of Road	New Construction	Rehabilitation Restoration Resurfacing
NHS, Interstate	AASHTO	state
NHS, non-Interstate	AASHTO/state	state
Non-NHS	state	state

Table 1.3: Control of standards by road type.

TEA-21 added language requiring highway projects to conform to local needs and allowing projects to be designed for desired rather than projected traffic levels. For a discussion of other relevant federal laws and initiatives, see Appendix A.5.

1.3 New Jersey Initiatives

Responding to widespread interest in context-sensitive design, the New Jersey State Legislature in re-authorizing the Transportation Trust Fund for 2000 declared that:

> *Many State highways run through fully developed cities and suburban towns. In addition, many small villages in rural areas have State highways, which pass through built-up residential areas or village centers. The traffic on many of these State highways, particularly large truck and speeding traffic, prevents these residential areas, town centers and future town centers from functioning as intended. The commissioner shall study this issue and develop a departmental program, which authorizes context-sensitive design and examines the functional classifications of State highways running through developed cities and suburban towns.*[1]

From this declaration, it is clear that DOT has a mandate to practice flexible highway design wherever the context demands it, as in town centers and built-up residential areas.

DOT has responded with several initiatives to promote CSD. It has sponsored what may be the nation's most ambitious training program for engineers. In the first round, 300 persons completed five day long courses on such unconventional topics as place making, respectful communication, conflict management, and traffic calming.

A second DOT initiative is the incorporation of planning and design guidelines for bicyclists and pedestrians, originally adopted in 1996, into the state's *Roadway Design Manual* (RDM). Before incorporation, these guidelines will be updated to reflect changes in knowledge and practice. There is much new research on pedestrian safety, traffic calming has come into its own right, and AASHTO released a new set of bicycle guidelines in 1999.

A final initiative involves DOT's design exception policies. New Jersey may be the only state in the nation to provide programmatic design exceptions for rehabilitation, restoration, and resurfacing (3R) projects. A broadening of these exceptions has been proposed by DOT, and is supported by the findings of this report.

1.4 Content and Structure of Report

This report is organized into three chapters and six appendices. The first chapter, this Introduction, places flexible highway design in a state and national context.

Chapter 2, Findings and Recommendations, is the heart of the report. The first section on proactive roadway design suggests changes in the design process to increase context sensitivity. The second section makes the case for reclassification or de-designation of certain state highway segments now functioning as local main streets. The third section recommends changes in design exception policies to

[1] Congestion Relief and Transportation Trust Fund Renewal Act (Senate Bill 16). New Jersey Public Law 2000, Chapter 73, Section 6, revised 2000.

promote context sensitivity and pedestrian safety. The fourth section proposes new design standards for main streets as part of Main Street Overlays. The fifth section recommends the incorporation of traffic calming guidance into the RDM to expand the design options available on main streets. The last section contains a conflicts-solutions matrix, offering practical solutions to conflicts between DOT standards and local objectives for main streets.

Chapter 3 contains local and regional Case Studies. There are four studies of context-sensitive design projects in New Jersey. One was written by a local practitioner and is rich in information about process and community objectives. The other three are engineering-oriented and follow a common format to permit easy comparison. There are six engineering-oriented case studies from nearby states. These represent a wider range of CSD projects than do the New Jersey studies. One additional case study was conducted in New Jersey, and four additional case studies were conducted in large metropolitan areas around the country. While not written up separately, these case studies were conducted in the same detail as the others and are given equal weight in our findings and recommendations.

Appendices are placed at end of the report. The first appendix introduces the project's Technical Review Committee (TRC) of leading experts in the field of context-sensitive design. The TRC reviewed the work at the mid-point of the project, provided case study information, and participated in the Main Street Visual Preference Survey. The second appendix is an article about this project published in *Planning* magazine. It reviews our findings in summary fashion. The next three appendices present results of surveys conducted for this project: a mail-out survey to all 566 New Jersey mayors to assess their experience with DOT main street projects; a visual preference survey administered to the TRC to define salient features of main streets; and a telephone survey of leading state DOTs to learn of policies, practices, and standards that might be applicable to New Jersey. The last appendix provides a summary of design exceptions granted by DOT from 1997 to 1999. To assess New Jersey's design exception policies and procedures, it was necessary to understand how these translated into actual practice.

The survey of leading state DOTs was presented at the 2001 Annual Meeting of the Transportation Research Board. It was one of two papers selected by TRB's Technical Activities Division for distribution to each state DOT.

Chapter 2

Findings and Recommendations

In this chapter, existing DOT policies and procedures are reviewed and changes are recommended. While the focus is on main streets, the review uncovers more general issues which directly or indirectly affect the design of all streets. Accordingly, some sections speak broadly to the planning, scoping, and design processes at DOT, while others relate specifically to state highways serving as main streets.

Greater flexibility can be exercised in the design of main streets in several ways. Minimum design standards can be relaxed. This is the approach taken in Vermont, and to a lesser degree, in Connecticut and Idaho. The TPI study team finds scant justification for sub-AASHTO standards. However, selective lowering of design standards, as applied to main streets, appears warranted.

Designers can exercise flexibility with respect to non-controlling design elements, such as curb return radius, or with respect to performance standards, such as roadway level-of-service. They can add pedestrian-friendly features to standard street designs, such as median islands that provide pedestrian refuge areas and, at the same time, better manage access from abutting properties. They can downgrade main streets in terms of functional class, and thereby lower design standards, when the function of state highways has changed due to construction of bypasses or secondary routes.

And designers can make better use of the built-in flexibility of the design exception process, which all states including New Jersey make available to them when the financial, social, and/or environmental costs of meeting existing design standards are too high. The TPI study team recommends liberal but appropriate use of design exceptions.

2.1 Proactive Roadway Design

Over the course of this project, DOT has been intensely reviewing and revising its project development process to incorporate context sensitivity, improve intra- and inter-agency coordination, and increase transparency of the process to the public. In this regard DOT is at the leading edge of state departments of transportation.

An example of ongoing changes within DOT is the proposed statement on Proactive Roadway Design.

> *In conceiving, scoping and designing projects, the NJDOT will consider the needs of all road users and neighbors... Highway designs must reflect a thoughtful understanding of the context of the improvement, in addition to adherence to standards and guidelines.*[1]

Designing roads proactively implies that the designer (or agency) is in control of the outcome of the project, as opposed to simply reacting to current or expected traffic conditions. To ensure proactivity throughout the project development process, the TPI study team offers suggestions concerning scope definition and project objectives.

Project Scope Definition

If a simple culvert replacement project is classified as reconstruction, DOT may be compelled (according to its own policies) to widen the road and bring

[1] New Jersey Department of Transportation (NJDOT), "Statement of Design Philosophy for 'Proactive Roadway Design,'" October 2001 draft.

it up to geometric standards in other respects. This is known as scope creep: expansion of scope beyond what was originally intended. Perhaps the road is unsafe and does require widening. Then again, the roadway may be operating fine and there are no other plans to widen the cross section. Conversely, there may be a need for improved bicycle and pedestrian facilities and adding them to a larger project is cost-effective. Scope creep can be positive if it reflects the needs of the agency and community, and negative if it does not.

Our research uncovered three notable examples of state processes to encourage positive and discourage negative scope creep. Vermont uses a Project Definition Team to define all substantial projects. A "substantial" project is one that costs more than $1.5 million, has a design phase that lasts longer than a year, and involves right-of-way purchase. The Project Definition covers the purpose of the project, need for the project, environment concerns, aesthetics, and alternatives considered (including no-build). The Project Definition Team also reviews all changes in project scope.[2]

New Hampshire has Public Involvement Procedures for all transportation projects. Each regional planning authority submits projects every other year. DOT reviews the submissions and prepares preliminary scopes. The scopes go to the governor, whose advisory group solicits comments from stakeholders and the public.[3] If everything is satisfactory, the list is submitted to the legislature to be made law and receive appropriations. Scopes are fixed from then on rather than subject to constant change.

Under the New York State Environmental Initiative, CSD is called for in all projects. One outcome is a broadening of project purpose, as in the Saratoga Springs case study (see Subsection 3.3.4). Here the fifth project objective was added at the urging of the City of Saratoga Springs.

- ❑ Provide adequate capacity and acceptable operation for 20 years,
- ❑ Restore pavement to good condition for 50 years,
- ❑ Accommodate pedestrians and cyclists,
- ❑ Add drainage, and
- ❑ Enhance the historic, recreational and visual aspects of the state park, and establish the corridor as a gateway to the spa and city.

This example of positive scope creep led to innovative features of the Saratoga Springs redesign.

Due to acknowledged problems of scope creep in New Jersey, DOT has begun employing Scope Teams. These teams are made up of both planners and engineers, who identify possible design exceptions during the scoping phase and must agree to any changes in scope later in the process. It is a bit premature to rule on the merits of this approach (vs. the approaches used by other states), but early signs are positive.

Measurable Project Objectives

While the above-described initiatives may help broaden project purposes and combat negative scope creep, they do not provide a mechanism for ensuring that agency and community goals are met. One way to accomplish this is to establish explicit and measurable project objectives related to project purpose and need. These would be agreed upon with the community at the outset of projects and used to evaluate proposed designs. They might include:

- ❑ Target speed,
- ❑ Multimodal LOS targets, and
- ❑ Safety targets.

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[2] Vermont Agency of Transportation, "Project Definition Team Rules and Procedures," 1997.

[3] New Hampshire Department of Transportation, "Public Involvement Procedures," 1986, updated 1992.

Target speed is the desired speed of the 85th percentile vehicle. Agreement on this speed with the community allows the designer to select an acceptable design speed, and establish a new speed limit if necessary.

Multimodal LOS (level of service) targets relate to roadway service quality not only for vehicular traffic, but also for pedestrians and bicyclists. This is especially necessary in dense urban settings where the number of people on foot may approach or exceed the number in cars. Discussions with the community can clarify the relative priority to be given to different modes in right-of-way allocation, signal timing, and street design. There are many examples of multimodal LOSs around the U.S. Florida DOT's efforts in this regard are particularly noteworthy.

Safety concerns are always present in projects; indeed many projects are justified solely in these terms. Yet specifying safety targets for each project can assist in making that project more context-sensitive and perhaps more pedestrian- and bicycle-friendly. For example, if the objective were to reduce the number of vehicle-pedestrian collisions by some percentage, the onus would be on the project designer to moderate vehicle speed and reduce pedestrian exposure time.

The use of explicit and measurable objectives such as a target speed will provide a new way to evaluate projects after the fact, thereby increasing accountability. If a main street is designed for 25 mph, and "after" studies show an 85th percentile speed of 40 mph, there is a problem. Through quantification, goals agreed upon by the agency and community will more likely be met.

The TPI study team concludes:

- ❑ A well-defined project scope, established up front through an open process, can help guard against negative scope creep and ensure consideration of local objectives.
- ❑ Explicit and measurable project objectives can help ensure that agency and community goals are met.

The TPI study team recommends that:

- ❑ DOT closely monitor the use of Scope Teams to ensure that this new mechanism is discouraging negative and encouraging positive scope creep.
- ❑ DOT utilize measurable project objectives to ensure that final designs reflect agency and community goals.

2.2 Reclassification or De-Designation

Roadway classification is first and foremost among design controls (see Table 2.1). Roadways are classified according to function (arterials, collector, or local) and location (urban or rural). Classification has a bearing on design speed (and hence alignment) and cross section (lane width, shoulder width, type and median width). Because the function of roadways changes over time, there is a need to periodically update classifications.

	Functional Class	Traffic Volume	Design Speed
Rural lane width	X	X	X
Urban lane width	X		
Rural shoulder	X	X	
Width and type			
Urban shoulder			
Width and type	X		
Degree of curve radius	X		
Grades	X		X
Bridge clearances	X	X	
Stopping Sight Distance			X
Superelevation			X
Widening on curves			X
Rural design speeds	X	X	NA
Urban design speeds	X		NA

Table 2.1: Determinants of geometric standards.

State highway systems have many roads that once functioned as principal routes from town to town but have since been supplanted by bypasses or freeways. These can be reclassified to a lower functional level and retained on the state system. Or they can be de-designated and placed under local control. Both are viable options for relieving states of maintenance responsibility and liability for roads no longer integral to their systems, and at the same time, giving localities more control over roadway design.

Among the 15 case studies, no facility was actually reclassified to a lower functional class within a state system. However, a surprising number (eight) were subject to de-designation or similar action by the controlling DOT. Plainfield and York have assumed responsibility for main streets through maintenance agreements. Albuquerque, Maplewood, Red Bank, South Miami, and Westminster have had ownership transferred to them outright. Circumstances vary from case to case, but in all cases, the highway in question was no longer integral to the state or county system. In Westminster, East Main Street (MD 32) could be reconstructed and transferred to the city because the MD 140 bypass carried most of the through traffic. In York, Market Street (PA 462) could be reconstructed and transferred because the US 30 bypass was available and a parallel local street was redesignated as a truck route. In South Miami, Sunset Drive (SR 986) could be reconstructed and transferred because it lay at the end of the state route (see Figure 2.1). In Washington Township, NJ 33 will be reconstructed and transferred when a secondary route to US 130 is opened.

The most obvious hindrance to de-designation is money, or the lack thereof. Towns typically lack the resources to pay for reconstruction and maintenance. This burden may be partially alleviated through state or federal grants, through cost sharing arrangements, or through road swaps. In Westminster, the state paid for the reconstruction before transferring jurisdiction to local government. York utilized federal disaster relief money following a hurricane to pay for the reconstructed roadway. In Albuquerque and Red Bank, road swaps have allowed local governments to shed some costs at the same time they assumed others (see Figure 2.2).

The TPI study team concludes:

- ❑ Removing segments that no longer function as state or county routes may permit more context-sensitive main street design. Maintenance agreements between state and local governments may also permit more design flexibility.

The TPI study team recommends that:

- ❑ As part of any main street reconstruction project, DOT consider whether the segment should be de-designated and transferred to local government or retained by the state but reclassified to reflect changing function. The existing DOT de-designation process provides a mechanism for

Figure 2.1: Portion of SR 986 transferred to the City, South Miami, Florida.

Figure 2.2: Broad Street acquired through a road swap, Red Bank, New Jersey.

transfer of highways and should be utilized whenever local governments wish to assume responsibility and the segment in question is no longer critical to the state system.

2.3 Context-Sensitive Design Exceptions

From the survey of New Jersey local governments (Appendix A.3) and the New Jersey case studies (Section 3.2), it is clear that roadway design standards sometimes conflict with local desires for human-scale, walkable, aesthetically pleasing main streets. Design standards may not be the main source of conflict, nor a source of conflict in most communities. But the exceptions, such as Red Bank and Washington Township, prove the need for more flexibility in highway design.

Designers can make better use of the built-in flexibility of the design exception process, which all states including New Jersey make available to them when the financial, social, and/or environmental costs of meeting existing design standards are too high. Issues surrounding design exceptions include:

- ❑ Is "context" being given sufficient weight relative to safety, cost, and other considerations?
- ❑ Are safety impacts being analyzed in a way that ensures cost-effective decisions?
- ❑ Would main streets actually benefit from the addition of certain design features to the list of controlling design elements?
- ❑ Are 4R projects (3R and reconstruction projects) that do not alter basic roadway geometrics subject to appropriate design exception policies?
- ❑ Are DOT design exception policies in line with those of other progressive states, and might policies of other states be beneficial if adopted here?

To inform our answers, the TPI study team reviewed DOT's existing policies and conducted two supplemental studies: a review of all DOT design exceptions approved for the years 1997-1999 (Appendix A.6) and a survey of design exception policies of other states (described below).

Room for Design Exceptions

The bases for most geometric standards and guidelines are approximate at best, and generally conservative.[4] The Transportation Research Board's *Proceedings of the 2nd International Symposium on Highway Geometric Design* contains many examples of standards without adequate bases in fact.

Consider stopping sight distance (SSD). In a fascinating article, Ezra Hauser reviews the history of the AASHTO guideline and declares it "based not on empirical fact but on plausible conjecture."[5]

Until recently, the AASHTO guideline for stopping sight distance at a design speed of 60 kph (37 mph), typical of main streets, varied from 74.3 to 84.6 meters (244 to 278 feet), depending on the operating speed assumed at this design speed (see Table 2.2). New Jersey has adopted the lower end of the range as its minimum value, and the upper end as its desirable value. This alone suggests the approximate nature of standards.

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[4] A special study committee of the Transportation Research Board (TRB) put it this way: "In general, relationships between safety and highway safety features are not well understood quantitatively, and the linkage between these relationships and highway design standards has been neither straightforward nor explicit. The American Association of State Highway and Transportation Officials (AASHTO), which has historically assumed primary responsibility for setting design standards, relies on committees of experienced highway designers to do this work. The committees use a participatory process that relies heavily on professional judgment." Transportation Research Board (TRB), *Designing Safer Roads—Practices for Resurfacing, Restoration, and Rehabilitation*, Washington, D.C., 1987, p. 77.

[5] E. Hauer, "Safety in Geometric Design Standards I: Three Anecdotes," in R. Krammes and W. Brilon (eds.), *Proceedings of the 2nd International Symposium on Highway Geometric Design*, Transportation Research Board, 2000, p. 12.

Design Speed (km/h)	NJ Desirable (m)	NJ Minimum (m)	NJ Programmatic Design Exceptions (m)	Former AASHTO Minimums (m)	New AASHTO Minimums (m)	Other Countries[6] (m)
40	44.4	44.4	44.4	44.4	46.2	35
50	62.8	57.4	57.4	57.4-62.8	63.5	50
60	84.6	74.3	74.3	74.3-84.6	83.0	70
70	110.8	94.1	91.4	94.1-110.8	104.9	90
80	139.4	112.8	106.7	112.8-139.4	129.0	115

Table 2.2: Minimum Stopping Sight Distance from different sources.[7]

AASHTO minimum stopping sight distances have recently been raised based on a study by the Texas Transportation Institute (TTI). Critical to these revisions are three conservative assumptions, *cumulatively* producing very conservative minimum stopping sight distances. The three assumptions are: driver eye height of 1,080 mm (43 inches, 90th percentile), driver reaction time until brakes are applied of 2.5 seconds (95th percentile), and a deceleration rate once brakes are applied of 3.4 m/sec^2 (1 ft/sec^2, 90th percentile). Other countries have typically adopted shorter minimum stopping sight distances based on less conservative assumptions as shown in Table 2.2.

More Emphasis on Context

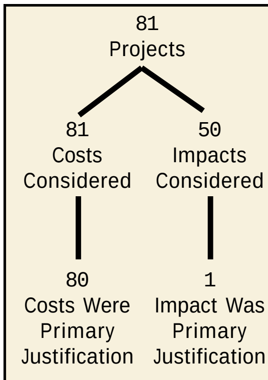
A report is required for every project involving design exceptions. The typical report reads something like this: A road is being reconstructed. To achieve a design speed (maximum safe speed under favorable conditions) of X mph, 10 mph over the posted speed limit, requires a minimum horizontal curve radius of Y feet at a superelevation rate of Z. This particular road has a sharper curve, which would have to be straightened, to meet the standard for horizontal curvature. This would mean someone's house or business would be taken, some park or cemetery would be encroached on, a lot of extra asphalt would have to be poured, etc. Or perhaps this particular road has a substandard superelevation rate, which if brought up to the DOT standard, would require the abutting property to be raised, utilities to be moved, and bulkhead improvements to be made.

The design engineer checks crash statistics for the roadway in question, focusing on the types of crashes associated with substandard horizontal curvature or substandard superelevation, and finds that these crashes are not over-represented relative to state norms. Noting that hundreds of thousands of dollars can be saved by only marginally straightening the existing curve or marginally increasing the superelevation, a design exception is requested and approved. The road didn't have a particular safety problem to begin with, and it will have less of one after the project.

Little consideration is given to "context" in this process unless it involves a huge outlay or an actual taking of property (in which case, cost enters the picture). There are exceptions, but the rule is clearly as described. It would not be difficult to extend the same deference, and procedures, to context as are currently applied to cost.

[6] These are median values for Australia, Austria, Canada, France, Germany, Great Britain, Greece, South Africa, Sweden, and Switzerland.

[7] D. Fambro et al., *Determination of Stopping Sight Distances*, National Cooperative Highway Research Program Report 400, Transportation Research Board, Washington, D.C., 1997, pp. 13 and 34. Metric units have been retained from the original source.



CSDEs for 50 Projects	
Shoulder Width	20
Superelevation	13
Vertical Curve SSD	13
Horizontal Curve Radius	12
Vertical Clearance	7
Auxiliary Lane Width	6
Travel Lane Width	5
Bridge Width	4
Horizontal Curve SSD	3
Intersection SD	2
Grade	1
Cross Slope	0

Figure 2.3: Design exceptions in New Jersey, 1997-1999.

Eighty-one design exception reports submitted between 1997 and 1999 were reviewed by the TPI study team (see Appendix A.6). This represents about one-third of all DOT construction, reconstruction, or 3R projects undertaken during the period, a sizable percentage.

Of the 81 design exception reports, 50 gave some consideration to community, historical, or environmental factors. However, other than one project involving historic preservation, land use impacts were always discussed within the context of the cost savings. Figure 2.3 shows the dominance of cost considerations.[8] It also shows that most design exceptions were for substandard design elements unlikely to be found on main streets.

DOT's current design exception policy requires an analysis of crashes and costs, and specifies how these analyses are to be conducted. Yet, when it comes to social and environmental impacts of design exceptions, the policies only encourage a discussion of such impacts "if appropriate."

The TPI study team concludes:

- ❑ Design exceptions are granted liberally in New Jersey, but almost entirely for reasons of cost saving, not "context saving." Social and environmental impacts are given short shrift.
- ❑ Most design exceptions are for controlling design elements ordinarily not a problem on main streets, such as horizontal curve radius. That such elements are so common in design exception cases, and other design elements such as lane width are so uncommon, indicates that design exceptions are either not required or not sought very often on main street projects.

The TPI study team recommends that:

- ❑ DOT's design exception format be revised to include a subsection on social, environmental, and community impacts of constructing to the standard design value vs. the proposed substandard design value; the subsection may simply state "no significant impact" for some projects, as in environment assessments (EAs).
- ❑ DOT provide guidance to its designers on the assessment of community impacts of roadway projects which will, by their nature, lead to higher traffic speeds and volumes; existing guidelines for EAs and EISs may be used for this purpose.

More Complete Analysis of Safety Impacts

It is sometimes assumed by highway designers that wider, straighter, and more open is safer. This is the underlying philosophy of the AASHTO Green Book and other highway design manuals.

The wider-straighter-more open approach to highway design is based on crash research from rural areas, where prevailing speeds are high. The National Cooperative Highway Research Program report, *Effect of Highway Standards on Safety*, summarizes the evidence on rural highway safety and, while mixed, it is compelling.[9] Urban areas are another matter. Not only are speeds lower, but

[8] Other states justify design exceptions in the same terms as New Jersey, that is, in terms of cost saving and lack of documented safety problems. TRB, op. cit., p. 83.

[9] H.W. McGee, W.E. Hughes, and K. Daily, *Effect of Highway Standards on Safety*, National Cooperative Highway Research Program Report 374, Transportation Research Board, Washington, D.C., 1995, pp. 16-37.

contexts are very different. Design options are constrained by active land uses along urban rights-of-way. These same active uses generate pedestrian and bicycle traffic, which has to be a factor in design decisions.

The wider-straighter-more open approach to design will not be safer if it leads to higher speeds and, consequently, more frequent and severe crashes. Higher speeds may also lead to more vehicle miles of travel, increasing crash exposure. There is a real question whether highway "improvements" are collectively improving highway safety.[10]

Consider the following recent urban highway safety research:

- A study presented at the 2001 Transportation Research Board Annual Meeting determined that 23 "road diet" projects, involving the reduction in cross section from four lanes to three lanes (two through lanes plus a center turn lane), reduced crash rates by 2 to 42 percent.[11]
- A study published in the ITE Journal in 2000 found that pedestrian crash rates were primarily a function of traffic speed. An increase in average speed from 20 to 30 mph was associated with 7.6 times the risk of pedestrian injury.[12]
- An analysis of 20,000 crashes in the City of Longmont, Colorado, found that two out of 13 physical characteristics of streets were statistically related to injury crashes. Crash rates increased exponentially with street width, and were higher for straight than curvilinear streets.[13]

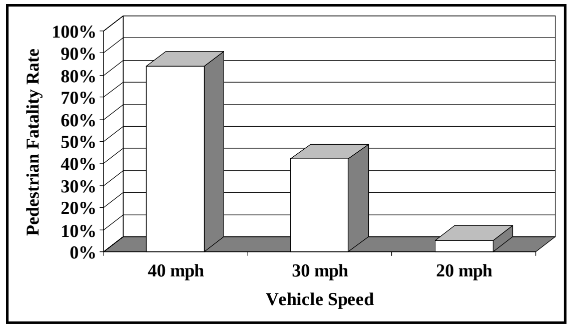


Figure 2.4: Vehicle speed vs. potential fatality rate.

Simple physics tells us that pedestrians hit by vehicles are thrown farther and the force of impact is greater the faster the speed of the vehicle. Lowering speeds from 40 to 30 mph, only 25 percent, halves the fatality risk. Between 30 and 20 mph the benefit is even greater (see Figure 2.4).

From reviews of DOT's current design exception policy and recent design exception reports, two shortcomings are evident with respect to traffic safety analysis. One is general. The other specific to urban streets.

One general shortcoming is that indicator crashes for each Controlling Substandard Design Element (CSDE) are assessed in percentage terms, relative to the total number of crashes within the project limits. Thus, unless indicator crashes are over-represented relative to other crashes on a stretch of roadway, when compared to statewide average percentages, no safety problem is detected. What if all types of crashes are significantly more common on a stretch of roadway than exposure levels would suggest? Still no problem is detected. The DOT design exception policy provides that crash analyses

[10] A study presented at the 2001 Annual Meeting of the Transportation Research Board found that, controlling for demographic changes, increased seatbelt use, and improved medical technology, highway improvements over the past 14 years had actually had a negative effect on highway safety. There were an estimated 2,000 additional fatalities, and 300,000 or more additional injuries, due to such "improvements." Increases in lane widths accounted for over half of the total increase in fatalities and about one-quarter of the increase in injuries. R. Noland, "Traffic Fatalities and Injuries: Are Reductions the Result of 'Improvements' in Highway Design Standards," paper presented at the 80th Annual Meeting, Transportation Research Board, Washington, D.C., 2001.

[11] H.F. Huang, C.V. Zegeer and J.R. Stewart, "Evaluation of Lane Reduction 'Road Diet' Measures on Crashes and Injuries," paper presented at the 80th Annual Meeting, Transportation Research Board, Washington, D.C., 2001.

[12] P. Peterson et al., "Child Pedestrian Injuries on Residential Streets: Implications for Traffic Engineering," *ITE Journal*, Feb. 2000, pp. 71-75. Also see W.A. Leaf and D.F. Preusser, *Literature Review on Vehicle Travel Speeds and Pedestrian Injuries*, National Highway Traffic Safety Administration, Washington, D.C., 1999.

[13] P. Swift and D. Painter, "Residential Street Typology and Injury Accident Frequency," pending.

should include "the overall accident rate" and "the statewide average accident rate for highways of similar cross section." The reference is to crash *rates*, not to crash *percentages*. Clearly, the intent is to compare safety across roadways of similar type. From our review of design exception reports, this policy is not being followed.

A second shortcoming is that crash analyses focus almost exclusively on motor vehicle crashes, ignoring pedestrians and bicyclists. In New Jersey, pedestrians represent 20 percent of all traffic fatalities, the fourth highest percentage in the U.S. In some urban areas, the percentage is double or triple this number. And there are 14 pedestrian injuries for every pedestrian fatality. All of this suggests that pedestrian (and bicycle) safety is a serious problem worthy of attention in highway design.[14]

Yet, in only one of 81 design exception reports reviewed were pedestrian or bicycle collisions mentioned. It is not clear why, even considering the predominance of rural and suburban projects among the roadway projects for which design exceptions were sought. Perhaps it is because vehicle-pedestrian collisions are listed among the indicator crashes for only one type of CSDE, limited sight distance. Or it may be because the threshold for a crash analysis is five accidents, and at many locations, this threshold is not reached. Given the underreporting of vehicle-pedestrian collisions unless fatalities result (35 to 80 percent underreporting by some estimates), the paucity of reported vehicle-bicycle and vehicle-pedestrian crashes may be a poor indicator of pedestrian and bicycle safety.

The TPI study team concludes:

- ❑ In the design exception process, crashes are not assessed in a manner that reflects the true safety implications of alternative designs, particularly for pedestrians and bicyclists.

The TPI study team recommends that:

- ❑ DOT require its designers to assess whether roadway projects will lead to higher traffic speeds, and hence greater crash frequency and severity.
- ❑ DOT require analyses of indicator crash rates for roadways relative to statewide averages. Pedestrian accidents should be analyzed for all main street projects, regardless of the number of such accidents or the CSDEs involved.

Pedestrian-Friendly Features as Controlling Design Elements

While DOT is paying more attention nowadays to pedestrians and bicyclists in its design practice, its design exception policies have yet to catch up. DOT's existing set of controlling design elements and minimum standards are intended largely for the convenience and safety of motorists. In certain other states, we find more balanced approaches to design exceptions (see Table 2.3). A level of care has been extended to pedestrians and bicyclists.

In most states, design speed is a controlling design element. This means that minimum design speeds for any given functional class and location can be breached by design exception. By contrast, in New Jersey's urban areas, the minimum design speed on reconstruction projects is 30 mph, 5 mph over the minimum posted speed of 25 mph. The minimum design speed on new construction projects is 35 mph, 10 mph over the minimum posted speed. These are high speeds for a pedestrian environment. The possibility of adopting lower design speeds is discussed in Section 2.5.

From other states surveyed, controlling design elements are added sometimes to give higher priority to pedestrians and cyclists. Consider the case of medians on multilane highways. While the RDM declares medians "highly desirable" on arterials with

[14] Surface Transportation Policy Project (STPP), *Mean Streets 2000: Pedestrian Safety, Health and Federal Transportation Spending*, June 2000.

four or more lanes, medians do not rise to the level of controlling design element. No justification is required for a road widening that excludes a median.

As part of Main Street Overlays, raised medians or crossing islands would become controlling design elements for multilane roads. Minimum widths would be established (at least 6 feet, the distance between the front of a stroller and the back of the person pushing it, or the length of a bicycle). Medians would be raised at least six inches with barrier-type curbs. The median in Figure 2.5 would conform; the median in Figure 2.6 would not. While the standards

	NJ	CT	NM	NY	OH		VT		WI
					const reconst	3R	const reconst	3R	
Design Speed		X	X	X			X	X	X
Level of Service				X (Interstate only)			X		
Lane Width	X	X	X	X	X	X	X	X	X
Shoulder Width	X	X	X	X	X	X	X	X	X
Stopping Sight Distance	X	X	X	X	X	X	X	X	X
Cross Slope	X	X	X	X	X	X	X		X
Superelevation	X	X	X	X	X	X	X	X	X
Minimum Curve Radius (horizontal curves)	X	X	X	X	X	X	X	X	X
Minimum Curve Radius (vertical curves)	X		X		X (including grade breaks)	X	X	X	X
Minimum and Maximum Grades	X	X (maximum only)	X	X	X	X	X		X
Through-Lane Drop Transition Length	X								
Auxiliary Lane Length (interchanges)	X								
Bridge Width	X	X	X	X	X	X	X	X	X
Horizontal Clearance				X	X	X	X	X	X
Vertical Clearance	X	X	X	X	X	X	X		X
Structural Capacity	X	X	X	X	X	X	X		X
Guard Rail and Bridge Rail									X
Signs, Signals, and Pavement Markings							X	X	
Accessibility Requirements for the Handicapped			X						
Bicycle Lane Width							X		
Median Width				X					

Table 2.3: Design elements subject to design exceptions in various states.

could be breached, this would occur only by design exception.

The TPI study team concludes:

- ❑ DOT's design policies differ from those of certain other states in two important respects: design speeds are not subject to design exceptions, and no pedestrian- or bicycle-friendly design features qualify as controlling design elements.

The TPI study team recommends that:

- ❑ DOT provide for lower design speeds on main streets (as discussed in Section 2.5).
- ❑ DOT elevate certain pedestrian- and bicycle-friendly features to controlling design elements as part of Main Street Overlays (as discussed in Section 2.4).

Exemptions for Certain 4R Projects

3R projects are fundamentally different from new construction projects. There is a crash history for 3R projects from which to judge the adequacy of designs. There is no crash history for new construction projects. Even if a roadway has substandard design elements by current standards, the true test of safety is how the roadway is performing in its context. And this is known for 3R projects. The draft AASHTO Bridging document acknowledges this fundamental difference:

> *For projects involving resurfacing or rehabilitation, AASHTO Green Book criteria do not apply. Such projects by definition do not include substantive changes in the geometric character of the road. Most agencies employ special design criteria for 3R projects. Criteria generally reflect an acceptance of existing features regardless of whether they meet current agency criteria for a new highway.*[15]

Reconstruction projects may be more like 3R projects, when reconstruction is largely occurring within existing curb lines, or more like new construction, when a new cross section or new alignment is being established. In the former case, there is a relevant crash history to draw on; in the latter, there is not.

To a limited degree, the draft AASHTO Bridging document acknowledges the 3R-like nature of some reconstruction projects:

> *Where a project involves reconstruction of an existing highway which includes locations with nominally substandard vertical curvature and thus insufficient SSD, designers should study the known crash history of the road and the locations to determine the extent of actual safety risk. Research and experience suggest that marginally deficient SSD may not translate into actual safety problems.*[16]

Figure 2.5: Conforming median, Burlington, Vermont.

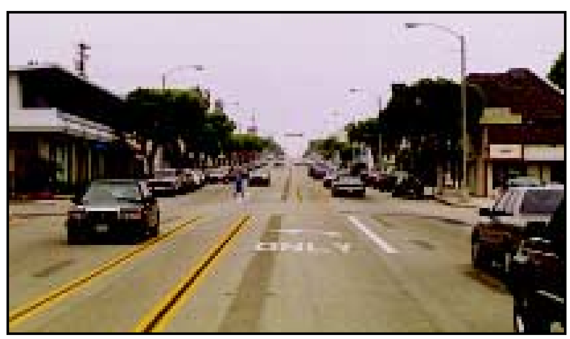


Figure 2.6: Nonconforming median, Los Angeles, California.

[15] American Association of State Highway and Transportation Officials (AASHTO), *Context-Sensitive Design for Integrating Highway and Street Projects with Communities and the Environment*, Chapter 1: Project Development Process, NCHRP 20-17-114, final draft, Feb. 2000, p. 16.

[16] AASHTO, op. cit., p. 8.

DOT's design policies distinguish between 3R and new construction projects. But are the distinctions commensurate with the differences discussed above? And should some reconstruction projects also qualify for special treatment?

Non-Interstate 3R projects are eligible for various Programmatic Design Exceptions (PDEs). These are categorical design exceptions requiring no justification or approval. There are PDEs related to lane width, shoulder width, stopping sight distance, and several other design elements. The various design exception possibilities are listed in Table 2.4.

Without reviewing project fact sheets, the TPI study team cannot tell how frequently PDEs are invoked. But on their face, the eligibility criteria for PDEs appear highly restrictive. An example follows.

Effectively, a PDE is not available for substandard lane width, since the minimum qualifying lane width for a PDE is at or above DOT's minimum design standard. A PDE is available for substandard shoulder width, but only if travel lanes are of standard width and only if shoulders are within a couple feet of the minimum design standard (see Table 2.5).

While restrictive, DOT's design exception policy for 3R projects is not out of line with the policies of most other states. Indeed, the availability of any programmatic design exceptions for 3R projects sets New Jersey apart from other states. DOT's design exception policy for reconstruction projects is also consistent with the policies of other states. No special treatment is given.

Controlling Design Elements	Eligibility for Design Exceptions	Eligibility for Programmatic Design Exceptions	Requirement of Problem Statement
Design Speed			
Lane Width	X	X	
Shoulder Width	X	X	
Stopping Sight Distance	X	X	X
Cross Slope	X		
Superelevation	X	X	
Minimum Curve Radius (horizontal curves)	X		X
Minimum Curve Radius (vertical curves)	X		X
Minimum and Maximum Grades	X	X	
Through-Lane Drop Transition Length	X		
Auxiliary Lane Length (interchanges)	X		
Bridge Width		X longer bridges	X
Horizontal Clearance			
Vertical Clearance	X	X 2R projects only	
Structural Capacity	X		

Table 2.4: DOT eligibility for design exemptions and programmatic design exemptions.

	Construction and 3R Desirable	Construction and 3R Minimum	PDE Minimums 10% or More Trucks	PDE Minimums Less Than 10% Trucks[17]
Lane Width	3.6 m (12 ft)	3.3 m (11 ft)	3.6 m (12 ft)	3.3 m (11 ft)
Outside Shoulder Width	3.0 m (10 ft)	2.4 m (8 ft)	1.8 m (6 ft)	1.8 m (6 ft)

Table 2.5: Lane and shoulder widths.

One state surveyed, Maryland, has taken a different tack. Under Maryland's new design policy, main street projects that remain within existing curb lines are exempt from design standards as long as crash analyses demonstrate no particular safety problem related to substandard design elements. This policy is now applied to all main streets in Maryland. See Subsection 3.3.5.

The TPI study team concludes:

- Crash histories can be used to judge the safety of existing highways for 3R and even reconstruction projects that remain within existing curb lines; such histories are far better indicators of safety *in context* than are comparisons of existing design values to current standards.
- On first reading, DOT's current design exception policy seems more permissive than those of most other states. Yet current programmatic design exceptions may be so limited as to have little practical effect.

The TPI study team recommends that:

- DOT exempt 4R projects (3R and reconstruction projects) on main streets from current geometric standards as long as curb-to-curb width is maintained and crash history is acceptable. Since crash analyses are already required for PDEs, this policy change would simply give these analyses more weight in design decisions.
- Regardless of context and crash history, DOT continue to impose new construction standards on any CSDEs viewed as too hazardous to permit blanket design exceptions for 4R projects. The three conditions currently requiring problem statements may fall into this category.[18]

[17] The minimums shown are for highways with ADTs over 2000 vehicles per day, which is typical of main streets.

[18] The three conditions are: (1) safe speed on horizontal curve more than 15 mph below posted speed and ADT greater than 750 vpd; (2) crest vertical curves where: curve hides major hazards such as intersections; or V calculated of vertical curve is more than 20 mph below project design speed; and (3) usable bridge widths below width of approach lanes plus some width which depends on ADT.

2.4 Main Street Overlays

The design of rural highways could be described as "centerline out." The designer begins with a standard cross section and bends the alignment around large, immovable objects so as to maintain the cross section. Roadside objects that cannot be avoided are removed. Designing in the urban setting is more of an "outside in" exercise. Tight geometrics may be required to pack all design elements into the space between property lines. This point is best illustrated in the Washington Township case study (Section 3.2.4). Washington Township will assume jurisdiction over two highways passing through its Town Center rather than build to state or county design standards.

As a means of fostering context-sensitive design, the TPI team recommends the adoption of Main Street Overlays. The idea of Main Street Overlays is simple. Highway segments that qualify as main streets would receive a special designation on the state system. For these segments, certain design standards, favoring motor vehicles, would be relaxed to AASHTO Green Book minimums. Other design features, favoring pedestrians and bicyclists, would be elevated to the status of controlling design elements. An array of new typical sections would be adopted, with the appropriate typical section depending on traffic conditions and land-use context.

"Ideal" Design Values

During the CSD training course conducted for DOT (see Section 1.3), DOT engineers were asked to define geometric and other characteristics of the ideal main street. They generally agreed on the following minimum design values:

- 25 or 30 mph design speeds,
- 10- or 11-foot travel lanes,
- No shoulders,
- Parking lanes with curb extensions,
- Two- to five-foot lateral clearance from curb to street trees and street furniture,
- 15- to 25-foot curb return radii at intersections,
- Six-inch vertical curbs,
- Five-foot sidewalk widths,
- Crosswalks on all intersection approaches, and at midblock locations on longer blocks, and
- Medians or refuge islands on multilane streets.

When asked to define the ideal main street, the engineers had a specific context in mind, a highly urban setting with low vehicle operating speeds, heavy pedestrian traffic, and limited rights-of-way. These minimums would not apply to rural roads, nor to all urban streets. But in the context of a main street, they seem reasonable.

RDM vs. AASHTO Minimums

The minimums suggested by DOT engineers are consistent with AASHTO Green Book guidelines. They are not, in all cases, consistent with roadway design standards of DOT. New Jersey's *Roadway Design Manual* (RDM) states: "Separate design standards are appropriate for different classes of roads." Yet, as a matter of design practice, flexibility is limited by typical sections that make no distinction between urban and rural, or between main street and standard urban arterial. Regardless of location, a typical two-lane "land service highway" has the cross section illustrated in Figure 2.7.

In the RDM, minimum lane widths are 3.3 m (11 ft) for all roads, regardless of context. Under DOT's current policy, 3.0 m (10 ft) lanes must be widened to the 3.3 m (11 ft) minimum at the time of resurfacing. In the absence of shoulders, outside lanes must be 4.5 m (15 ft) to accommodate bicyclists. This, again, is regardless of context.

Shoulders are required on all state highways, even main streets. Minimum shoulder widths are 2.4 m (8

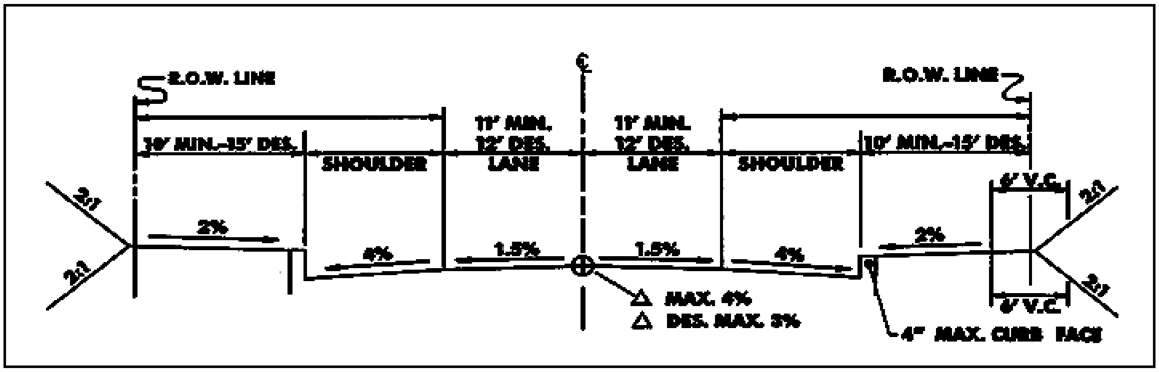


Figure 2.7: Typical section for a two-lane highway from New Jersey's Roadway Design Manual.

feet) on outside lanes and 0.9 meters (three feet) on inside lanes of divided roadways. Parking lanes ordinarily will not substitute for shoulders, and certainly will not substitute for shoulders if periodically interrupted by curb extensions (bulb-outs).

Clear zone distances of at least 4.5 meters (15 feet) are recommended for conditions typical of main streets (design volumes over 6,000 vehicles per day and design speeds less than 40 mph). The RDM does not distinguish between curbed and open roadway sections, nor between design speeds of 40 mph and design speeds well below 40 mph. Even assuming eight-foot shoulders, an additional seven-foot clearance is recommended. Trees of more than 150-millimeter (six inch) diameter are considered fixed objects. Acknowledging the aesthetic and environment appeal of trees, the RDM recommends replacement trees outside the clear zone when trees inside the clear zone must be removed.

Design Element	Minimum
Travel Lane Width	3.0 m (10 ft)
Parking Lane Width	2.4 m (8 ft)
Bike Lane Width	1.2 m (4 ft)
Outside Shoulder Width	none
Inside Shoulder Width	none
Clearance (from curb face)	0.5 m (1.5 ft)
Curb Return Radius (for minor cross streets)	3.0 m (10 ft)

Table 2.6: AASHTO minimum values.

Finally, corner radii (curb return radii) of at least 4.5 meters (15 feet) are recommended in the RDM. Theoretical or effective radii must be at least 9.0 meters (30 feet) are also recommended, considering shoulders and parking lanes that allow vehicles to swing wide when turning. The recommended radii are about twice that required to make a turn in a passenger car, and are designed to "allow an occasional truck or bus to turn without much encroachment."

By contrast, AASHTO minimums for urban arterials are summarized in Table 2.6. Virtually every value is different from DOT's.

The TPI study team concludes:

- ❑ DOT design practice does not distinguish sufficiently between rural and urban roads, or between main streets and other urban arterials.
- ❑ DOT standards are above AASHTO minimums for certain design elements critical to main streets.

The TPI study team recommends that:

- ❑ DOT relax geometric standards for designated Main Streets to AASHTO minimums.
- ❑ DOT qualify streets for this special status using the two criteria specified in Section 1.1: a qualifying score based on the "main streetness" formula, and location in a designated Center under the New Jersey State Plan. Other streets could qualify on a case-by-case basis.

- ❑ DOT include the Main Street designation on the Straight Line Diagram. This would allow the agency and community to decide in early project planning where a Main Street Overlay would begin and end to the tenth of a mile marker.

Minimum vs. Desirable Values

Under the proposed Main Street Overlay Program, design standards for designated Main Streets would equal AASHTO minimums. However, depending on traffic conditions and land use contexts, desirable values may exceed AASHTO minimums. In particular, the need to accommodate the full range of street uses (including buses, bicycles, and parked cars) may result in wider cross sections than AASHTO minimums alone would suggest.

This section provides guidance on cross sectional elements, keeping all street users in mind. The next section presents typical sections for different traffic conditions and land-use contexts.

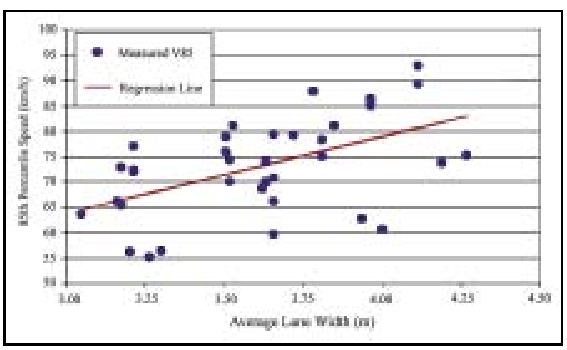


Figure 2.8: Speed in relation to lane width.[20]

Standard Lanes

The popular wisdom is that narrow travel lanes, say under 12 feet, are unsafe. Indeed, they may be in high-speed rural settings, particularly at higher traffic volumes.[19] Urban streets are another matter. As the draft AASHTO Bridging document states:

> *AASHTO policy values for lower speed urban street lane widths are less rigorously derived. There is less direct evidence of a safety benefit associated with incrementally wider lanes in urban areas...*

Wider lanes mean higher speeds. Recent urban and suburban research leaves little doubt about that (see Figure 2.8). Higher speeds mean more severe crashes. Thus, ipso facto, there may be some latitude to reduce lane width on urban streets without compromising safety.

The typical sections for main streets presented in Figure 2.33 (see page 33) and Table 2.9 (see page 33) have standard 11-foot lanes. This is the minimum lane width in the RDM, less than considered desirable by DOT but more than the AASHTO minimum under restricted conditions. It represents a compromise, intended to accommodate the full range of main street users. A review of transit-oriented design manuals disclosed that 11-foot lanes were the absolute minimum deemed necessary by transit operators. Commercial vehicles making deliveries to main street businesses will also appreciate the extra foot of lane width.

[19] Even in rural areas, the empirical literature paints a complicated picture. In a National Cooperative Highway Research Program (NCHRP) study, low-volume rural roads with 9-foot lanes actually had crash rates as low as those with 11- and 12-foot lanes, probably because speeds were lower on the narrow roads. On the other hand, rural roads with 10-foot lanes had the highest crash rates, and particularly when they had substandard shoulders. Such lanes encouraged relatively fast driving, and when combined with narrow shoulders, provided little room for errant vehicles to recover. For a review of the evidence, see E. Hauer, "Safety in Geometric Design Standards I: Three Anecdotes," in R. Krammes and W. Brilon (eds.), *Proceedings of the 2nd International Symposium on Highway Geometric Design*, Transportation Research Board, 2000, pp. 11-23.

[20] K. Fitzpatrick and P. Carlson, "Design Factors that Affect Driver Speed on Suburban Streets," paper presented at the 80th Annual Meeting, Transportation Research Board, Washington, D.C., 2001.

Shared Lanes

Often in main street settings, accommodating cyclists via shared lanes or separate bike lanes conflicts with the desire to maximize pedestrian comfort and safety via narrow streets. At what speeds and volumes can cyclists safely share a lane with motor vehicles? Answers are suggested in Table 2.7 from *NJDOT Bicycle Compatible Roadways and Bikeways, Planning and Design Guidelines*.

These guidelines are the basis for typical sections in Figure 2.33. At 2,000 vehicles per day, typical sections transition from standard travel lanes to wider shared lanes; at 10,000 vehicles per day, they transition to separate bike lanes (see Figures 2.9 and 2.10). Danish bicycle guidelines suggest a transition from bike lanes to off-street bike tracks or bike paths when traffic volumes or speeds get high enough (as in Figure 2.11).[21] This is something for DOT to consider as it revises its bicycle guidelines and incorporates them into the RDM.

The narrowest typical sections in Figure 2.33 will not be applicable to many state highways, as traffic volumes on the state system are typically higher than 10,000 vpd, and nearly always higher than 2,000 vpd. These typical sections are presented anyway for two reasons. First, there are state highways with low traffic volumes, albeit not many of them.[22] Second, it is hoped that these typical sections, when endorsed by DOT, may be adopted by counties and cities for their lower volume main streets.

Facility	20 mph	25 mph	30 mph	35 mph
Existing Lane	<2000	<2000	<2000	<1200
Shared Lane	2-10k	2-10k	2-10k	1200-2000
Bike Lane	>10000	>10000	>10000	>2000

Table 2.7: New Jersey bicycle compatibility guidelines.[23]

Figure 2.9: Wide shared lane, Missoula, Montana.

Figure 2.10: Bicycle lane, Portland, Oregon.

Figure 2.11: Separate bicycle path, Burlington, Vermont.

[21] Road Directorate, Collection of Cycle Concepts, Denmark, 2000, p. 53.

[22] Our search uncovered 8 state route segments with ADTs less than 2,000 vpd, and 122 segments with ADTs between 2,000 and 10,000 vpd.

[23] *NJDOT Bicycle Compatible Roadways and Bikeways, Planning and Design Guidelines*, 1996. Recommended bicycles facilities, urban conditions with on-street parking, Tables 1 & 2, pp. 6, 7 & 38.

Edge Lines and Offsets

Wide shoulders are incompatible with main streets. Shoulders are breakdown lanes—space to slow down and pull over out of traffic. In a rural and some suburban contexts, such space may be essential. In a main street context, a motorist can turn onto a side street to change a flat.

As noted, DOT engineers participating in the CSD Training Course saw no need for shoulders on main streets. However, some did perceive the need for shy distance between travel lanes and curbs. They endorsed parking and cycle lanes to provide such distance. On streets without either, edge lines may be appropriate.

Edge lines have value as visual references under adverse weather and visibility conditions. The Manual on Uniform Traffic Control Devices (MUTCD 2000) requires edge lines on freeways, expressways, and rural arterials with high traffic volumes. MUTCD is silent regarding the use of edge lines on urban streets, other than to say that they "may be excluded...if the traveled way edges are delineated by curbs...."[24]

Figure 2.12: Edge lines with small offsets on Main Streets in Dublin, New Hampshire (top) and Deerfield Beach, Florida (bottom).

There are many examples of main streets with edge lines. They are particularly common in rural hamlets and suburbs, and are often used when cross sectional width varies (see Figure 2.12). Our proposed typical sections for main streets include edge lines with offsets when bike and parking lanes are not present (see Figure 2.33).

Edge lines may not be necessary where curbs are well-delineated. And, of course, they are not necessary on main streets with bike or parking lanes. Ultimately, whether or not to use edge lines on main streets is a judgment call best left to the designer and community.

When edge lines are used, edge lines and offsets should be subtracted from the total curb-to-curb width, not added as is standard practice. For streets with 12-foot travel lanes, the addition of a two-foot edge line/offset results in effective lane widths of 14 feet. This is wide enough to qualify as a shared lane. By subtracting rather than adding edge line and offset widths, the typical sections in Figure 2.33 visually narrow streets and minimize crossing distances for pedestrians while maintaining adequate clearance for motor vehicles.

On-Street Parking and Curb Extensions

While there are capacity and safety reasons to restrict on-street parking on open highways, lower speeds and increased street activity are desirable on main streets. In particular, traditional shopping streets nearly always have on-street parking. It is convenient for shoppers, who seem to prefer curbside to off-street parking. Parked cars act as buffers between the street and sidewalk. Our typical

[24] Federal Highway Administration (FHWA), *MUTCD 2000—Manual on Uniform Traffic Control Devices*, Washington, D.C., 2000, p. 3B-21.

sections for traditional shopping streets therefore incorporate parking lanes (see Figure 2.33).

The typical sections for gateway streets, residential arterials, and other main streets, do not incorporate parking lanes. There is less demand for curbside parking on such streets, and parking lanes, unless well-utilized, are an inefficient use of available space. Moreover, the added clear width associated with underutilized parking lanes may encourage speeding and compromise safety. Regarding safety, the available literature suggests that on-street parking accounts for a significant proportion of urban crashes.[25] Therefore, for these main streets, on-street parking should be provided on a case-by-case basis, only where the community and DOT agree it is appropriate.

Where on-street parking is provided, curb extensions should be constructed at regular intervals. These are used to define and protect parking bays, shorten crossing distances for pedestrians, and provide space for trees, street furniture, and bus stops (see Figures 2.13 and 2.14). Curb extensions, often referred to as bulb-outs, are basic features of good shopping streets. Despite business concerns about loss of on-street parking (as in the Westminster case study, Section 3.3.5), literally hundreds of traditional shopping streets around the U.S. have been improved with bulb-outs.

How far should bulb-outs extend from the curb? Wide bulb-outs, such as the eight-foot variety used in Plainfield, may calm traffic more than the narrower bulb-outs used in South Miami, Westminster, and most other main street applications. By "shadowing" parked cars more completely, wider bulb-outs may also provide a more substantial buffer from traffic for drivers getting into and out of their cars. Yet, when bulb-outs extend much beyond the line of parked cars, they represent an obstacle to passing motorists and bicyclists. In the first year after installation, there were 26 crashes in Plainfield linked to bulb-outs, and the overall crash rate in the business district more than doubled (see the Plainfield case study in Subsection 3.2.2). Thus, without more comparative safety data, the TPI team cannot recommend wide bulb-outs that encroach on the traveled way.

Figure 2.13: Curb extension with space for street furniture, Hollywood, Florida.

Figure 2.14: Curb extension with space for trees, San Fransisco, California.

[25] P.C. Box, "Curb Parking Findings Revisited," Transportation Research E-Circular, Transportation Research Board, December 2000, pp. B5/1-8. Also see Texas Transportation Institute (TTI), "On-Street Parking," *Synthesis of Safety Research Related to Traffic Control and Roadway Elements*, Federal Highway Administration, Washington, D.C., 1982, Chapter 9; and J.B. Humphreys et al., Safety Aspects of Curb Parking, Federal Highway Administration, Washington, D.C., 1978.

Figure 2.15: Five-foot clear width necessary for two strollers, New York, New York.

Figure 2.16: Less than five-foot clear width, Winter Park, Florida.

Sidewalks

The RDM establishes a minimum sidewalk width of 1.2 meters (four feet). This is a bit skimpy for a main street. Five feet is the accepted minimum sidewalk width. This is the minimum clear width of sidewalks, free of obstructions and including shy distances (see Figures 2.15 and 2.16). It will allow a person in a wheelchair to turn around or two people pushing strollers to walk comfortably together. If street furniture (street lights, trash cans, newspaper boxes, etc.) is plentiful, an extra 2-1/2 feet of width should be allowed for clearance. If buildings run up to the sidewalk, an additional 1 to 1-1/2 feet of width is desirable due to the tendency of pedestrians to maintain this clear distance from walls.

In a main street environment, sidewalk widths well above the minimum may be required to accommodate heavy pedestrian traffic. To allow walking at near-normal speeds, sidewalks must provide at least 25 square feet per pedestrian at peak times.[26] More space is required, perhaps 40 square feet per person, to permit maneuvering around slower pedestrians and complete avoidance of oncoming and crossing pedestrians. While still lively, all hint of crowding is eliminated at 100 to 150 square feet per person. Given such considerations, it is easy to see how some leading urban designers have arrived at sidewalk widths of 10, 15, even 20 feet as suitable for high-volume locations (as in Figure 2.17).

Pedestrian Crossings

One of the defining qualities of a main street, as opposed to a commercial strip, is a high degree of interplay between opposite sides of the street. Shoppers, residents, and other users engage in activities on one side and then the other, and the easier a street is to cross, the better a main street functions. Pedestrian movement back and forth

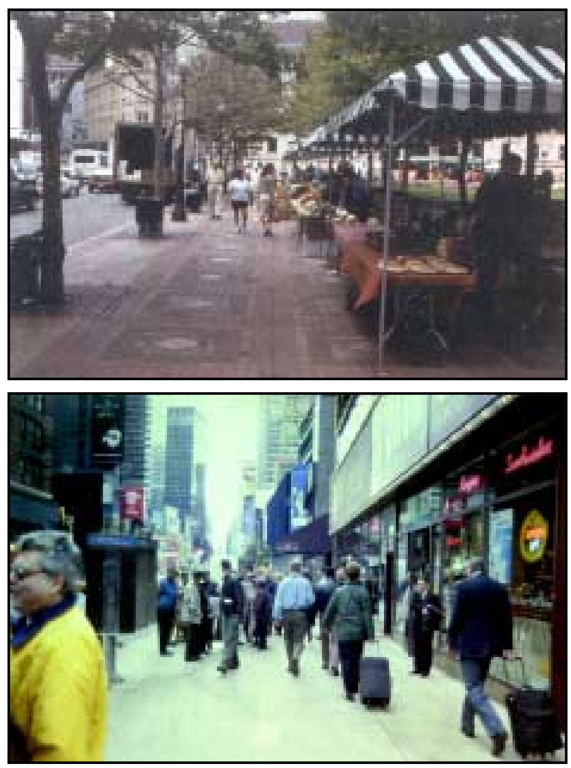


Figure 2.17: Wider sidewalks where needed, Boston, Massachusetts.

[26] J.J. Fruin, *Pedestrian Planning and Design*, Metropolitan Association of Urban Designers and Environmental Planners, Inc., New York, 1971, pp. 42 and 47-50. Fruin's work was the basis for *Highway Capacity Manual* sidewalk standards.

makes drivers behave less aggressively, which in turn makes the street easier to cross. The two phenomena reinforce each other. Pedestrian crossings may be as important in moderating driver behavior as geometric design.

On main streets, marked crosswalks should be provided on all approaches to signal or stop sign controlled intersections. Marked crosswalks both channel pedestrians to a common crossing point and alert drivers to the possibility of pedestrians. To encourage crossing at such points, and discourage jaywalking, pedestrian delays at signalized intersections should be kept to a reasonable minimum. Research has shown that a minute is the longest that pedestrians will voluntarily wait before trying to cross against a light. Therefore, main streets should have relatively short traffic signal lengths. Signals should be pre-timed in most cases to provide crossing opportunities automatically, without motor vehicle or pedestrian activation. Shorter cycles and pre-timed signals are consistent with low speed traffic progression, the desired condition on main streets.

At controlled intersections, the biggest threat to pedestrians is turning conflicts. Motorists making right turns tend to look to their left for oncoming traffic rather than their right for crossing pedestrians. Motorists making left turns under protected conditions tend to make turns without carefully scanning the environment for pedestrians. In New York City, the second leading cause (17%) of pedestrian fatalities is "vehicle turned into pedestrian in crosswalk." Drivers are simply not yielding to pedestrians.

Figure 2.18: First people (left), then cars (right).

The best way to counter this tendency is to reduce pedestrian exposure times and vehicle turning speeds. Tight corners, curb extensions, medians, and refuge islands will have these effects and are recommended in subsequent subsections. At key intersections, there is also the possibility of leading pedestrian intervals (LPI), which give pedestrians time to cross before parallel traffic gets its green light (see Figures 2.18). In one study, leading pedestrian intervals were found to reduce vehicle-pedestrian collisions by 64 percent.[27]

Pedestrian crossing opportunities should be available every 300 feet or so along main streets. Accordingly, some crossings will be located at uncontrolled intersections or midblock locations. In such cases, refuge islands and/or curb extensions should be used to create safe crosses (see Figures 2.19 and 2.20). Marked crosswalks may be used as well. Recent research suggests that marked crosswalks may or may not improve pedestrian safety, depending on street width and traffic volumes (see Table 2.8). On wide, high-volume arterials, marked crosswalks may give pedestrians a false sense of security. However, for the cross sections recommended in this guide, including multilane main streets with medians, pedestrians are at least as safe with marked crosswalks as without them, and probably more comfortable crossing the street.

Particularly at midblock locations, pedestrian crossings should be as attention getting as possible. The MUTCD directs that:

> *Because non-intersection pedestrian crossings are generally unexpected by the road user, warning signs should be*

[27] M. King, "Calming New York City Intersections," Urban Street Symposium, Transportation Research Board, Dallas, 1999.

> *installed and adequate visibility should be provided by parking prohibitions.*[28]

In addition, the MUTCD suggests the use of high visibility pavement markings at locations where pedestrians crossings are not expected, such as at midblock crossings. At such locations, MUTCD favors diagonal and longitudinal marking patterns over standard transverse parallel lines (right and bottom favored over top in Figure 2.21). Even greater visibility can be achieved with wider stripes in a Continental pattern (as in Figure 2.22).

Other ways of drawing attention to midblock crossings include the use of advance warning signs, in-pavement warning lights, and pedestrian-activated signals. Bridgeport Way in University Place, WA, offers a good example in a suburban setting (see Figure 2.23). This particular cross section replaced a five-lane arterial with no provision for pedestrians or bicyclists and crash rates 70 percent higher than today.

Figure 2.19: Curb extensions at a midblock crossing, West Palm Beach, Florida.

Figure 2.20: Refuge island at a midblock school crossing, Portland, Oregon.

Medians or Crossing Islands

Recent research has found that raised medians significantly reduce pedestrian crash rates on multilane urban arterials.[29] Medians allow pedestrians to deal with one direction of traffic at a time, and to cross half way rather than having to wait for a gap in traffic in both directions. Where continuous medians cannot be provided, short crossing islands will perform as well or better.

Lanes	ADT	Median	Marked Crossing	Unmarked Crossing
1-2	all	–	equal	
3+	<12,000	–	equal	
3+	12,000 - 15,000	yes	safer	
3+	12,000 - 15,000	no		safer
3+	>15,000	–		safer

Table 2.8: Saftey of marked vs. unmarked crossings.[30]

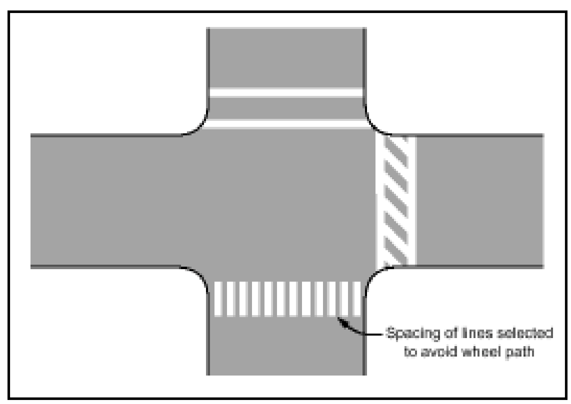


Figure 2.21: MUTCD crosswalk marking patterns.

[28] FHWA, op. cit., p. 3B-35.

[29] Zegeer et al., op. cit. Also see B.L. Bowman and R.L. Vecellio, "Effect of Urban and Suburban Median Types on Both Vehicular and Pedestrian Safety," *Transportation Research Record 1445*, 1994, pp. 169-179.

[30] C. Zegeer, J. Stewart, and H. Huang, "Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations: Analysis of Pedestrian Crashes in 30 Cities", Transportation Research Board, July 2000.

Figure 2.22: *High visibility pavement markings, New York, New York (top) and Sacramento, California (bottom).*

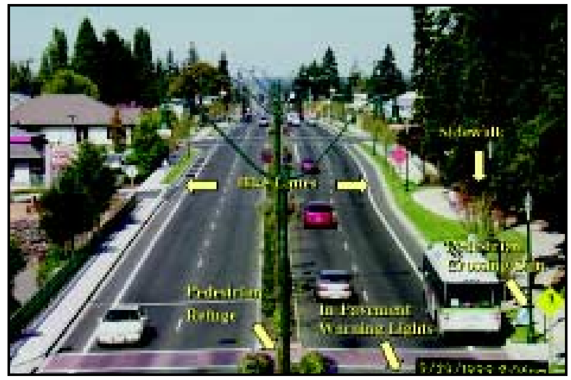


Figure 2.23: Midblock crossing designed for high visibility, University Place, Washington.

No mention is made in the RDM of pedestrian refuge as a function performed by medians, and no consideration is given to this function in establishing minimum median dimensions. While the RDM calls for medians "as wide as feasible," widths as narrow as 1.2 m (4 ft) are acceptable. Such widths are unsafe for bicyclists and pedestrians with carriages, strollers, and other equipment.

Many sources recommend raised medians or crossing islands on multilane highways. Nearly all recommend median or island widths of at least 1.8 m (6 ft) for use as pedestrian or bicycle refuges. This includes AASHTO's Green Book and the old MUTCD.[31] DOT's own pedestrian guidelines recommend a median width of 8 feet or more.[32] Thus, our typical sections for multilane main streets show raised medians or refuge islands of 6-foot minimum width, 8-foot desirable width. If the minimum width is not attainable, it may be better not to provide any pedestrian refuge at all. Better not to deceive pedestrians into thinking they are safe (compare Figures 2.24 and 2.25 on page 30).

Corner Radii

When it comes to corner radii (curb return radii at intersections), even advocates of context-sensitive design, walkable communities, and New Urbanism shy away from bold statements and departures from standard practice. It is one thing to reduce travel lanes to 11 feet or even 10 feet. This is still wider than any design vehicle, including a transit bus or an Interstate tractor-semitrailer (with design widths of 8.5 ft). It is another thing to recommend tight corners when AASHTO's design passenger car has an inside turning radius of 14.4 feet and its design transit bus and single unit truck have inside turning radii of 24.5 and 28.3 feet, respectively. Simple turning requirements seem to demand wide corners.

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[31] American Association of State Highway and Transportation Officials (AASHTO), *A Policy on Geometric Design of Highways and Streets*, Washington, D.C., 2001, p. 630; and Federal Highway Administration (FHWA), *Manual on Uniform Traffic Control Devices*, Washington, D.C., 1988, p. 5B-2. MUTCD 2000 is intentionally silent on geometric issues.

[32] New Jersey Department of Transportation (NJDOT), *Pedestrian Compatible Planning and Design Guidelines*, Trenton, 1996, p. 31.

Figure 2.24: Substandard refuge, Brooklyn, New York.

Figure 2.25: Standard refuge, Berkeley, California.

In main street contexts, there is general agreement that the corner radii should be as small as possible. The Green Book itself states: “For arterial street design, adequate radii for vehicle operation should be balanced against the needs of pedestrians...”[33] An increase in corner radius from 10 to 30 feet adds 15 feet to pedestrian crossing distance and increases the turning speed of autos from a crawl to about 12 mph, putting pedestrians at risk during free right turns.[34]

The question, then, is just how small can corner radii be without jeopardizing safety? In most main street applications, the combination of on-street parking and no-parking zones at corners doubles the effective or usable corner radius for turning vehicles. The actual vehicle fleet requires less space than indicated by AASHTO design vehicles, which are composites. And creative solutions are available for the odd case when these two conditions do not apply. The conflicts-solutions matrix in Section 2.6 offers a range of possibilities, several of which are illustrated by our case studies:

- ❑ Establish an alternate truck route to reduce the need for large radii corners on main streets (see Figure 2.26).
- ❑ Use small corner radii at all but main intersections with heavy cross street traffic and large turning volumes (see Figure 2.27).
- ❑ Use tight mountable corners for the occasional turning truck, a practice endorsed by the Technical Review Committee as safe in low-speed main street environments (see Figure 2.28).
- ❑ Allow the occasional truck to encroach on the opposing lane briefly, as the tight geometrics of Figure 2.29 necessitate. To minimize conflicts in such cases, stop lines on side streets may be set back from intersections far enough to accommodate the swept paths of larger vehicles (see Figure 2.31).

Corner radii of 10 to 15 feet are common in cities, and corner radii as small as five to 10 feet prove workable in many locations. Whatever the theoretical case for large radii, cities make do with small ones, and crashes between turning vehicles and side street traffic appear to be rare, perhaps because turns are made so cautiously under constrained conditions.

The TPI team recommends that DOT discard its guidelines for actual corner radii, and instead set standards for effective or usable corner radii accounting for parking and bike lane widths. Practical minimums should be used. Through the kind of creativity shown in our case studies, effective inside corner radii of 15 feet should prove adequate at most minor cross streets, while 25 feet should be adequate at most major cross streets. On

[33] AASHTO, op. cit., p. 618.

[34] These estimates come from the Green Book. The former estimate assumes that the sidewalk is set back 10 feet from the curb.

Figure 2.26: Twenty-foot corner with alternate truck route, York, Pennsylvania.

Figure 2.27: Five-foot corner at minor intersection, Westminster, Maryland.

Figure 2.28: Fifteen-foot mountable corner, South Miami, Florida.

Figure 2.29: Twenty-foot corner with planned encroachment, Plainfield, New Jersey.

corners without curb extensions, the corners themselves may have radii of 15 feet or less (as in Figures 2.30, 2.31 and 2.32 on Page 32).

The TPI study team recommends the following design values for use in the Main Street Overlay Program. Values in bold type would become controlling design elements for designated main streets; they could be breached only by design exception.

- ❑ Standard Travel Lanes—11 feet.
- ❑ Shared Lanes—14 feet (or 13 feet with an edge line and one-foot offset).
- ❑ Bike lanes—**5 feet**—for use at higher traffic volumes and speeds.
- ❑ Parking lanes—**8 feet**—on traditional shopping streets.
- ❑ Sidewalks—**5 feet**—sized to provide public space and avoid crowding.
- ❑ Medians or Crossing Islands—**6 feet** and raised or not at all.
- ❑ Shoulders—Never on main streets.
- ❑ Vertical Curbs—Always on main streets.
- ❑ Clear Zones—AASHTO minimums for curbed sections.
- ❑ Edge Lines—In rural hamlets and suburban settings.
- ❑ Pedestrian Crossings—Every 300 feet or so—at all controlled intersections and other locations with special treatments.
- ❑ Corner Radii—Effective inside radii of 15 feet at minor cross streets, 25 feet at major streets.
- ❑ Traffic Signals—Timed for 60-second maximum pedestrian wait.

Figure 2.30: Two-foot corner on a traditional main street, Dade City, Florida.

Figure 2.31: Fifteen-foot corner with stop lines set back, Princeton, New Jersey.

Figure 2.32: Fifteen-foot mountable corner with truck tire tracks, Queens, New York.

Typical Sections

Main street projects profiled in Chapter 3 fall into two distinct classes: traditional shopping streets and gateway streets. The gateway streets include approaches to main street, other commercial streets with small building setbacks, and main roads with fronting residences. In these case studies, traditional shopping streets typically get curb extensions and midblock crosswalks; gateway streets typically get medians or refuge islands and bicycle lanes or extra-wide shared-use lanes. Almost every main street gets wider sidewalks, and many get additional street trees and/or textured paving. That projects differ by class indicates that different design elements belong in different contexts.

With this in mind, the TPI team has prepared two different sets of typical sections, presented schematically in Figure 2.33. Typical sections are derived from Table 2.9.

Typical sections A through C and G are applicable to traditional shopping streets. Sections D through F and H apply to other main streets. The main difference between the two sets is in the provision of on-street parking on traditional shopping streets, as shoppers and delivery services value the ability to park in front of stores. Not shown in the typical sections (since the perspective is cross sectional) are periodic curb extensions on traditional main streets to create safe crosses and protected parking bays.

Both minimum and desirable design values are shown on the typical sections. The minimums come from AASHTO, the desirables from the preceding discussion of pedestrian- and bicycle-friendly design features. All assume a design speed of 25 mph, which for a Main Street Overlay, would be equal to the posted speed.

The TPI study team concludes:

- ❑ New typical sections are required for main streets. These typical sections should be multimodal and sensitive to both traffic conditions and land-use contexts.

The TPI study team recommends that:

- ❑ DOT adopt these typical sections for use on designated state highways under the Main Street Overlay Program.

Land Use Context	Average Annual Daily Traffic	Parking Lane	Bike Lane	Median	Section (Figure 2.34)
Traditional Shopping Street	>10000	X	X		A
	2000-10000	X			B
	<2000	X			C
	higher volumes	X	X	X	G
Other Main Street	>10000		X		D
	2000-10000				E
	<2000				F
	higher volumes		X	X	H

Table 2.9: Main street design controls and cross sections.

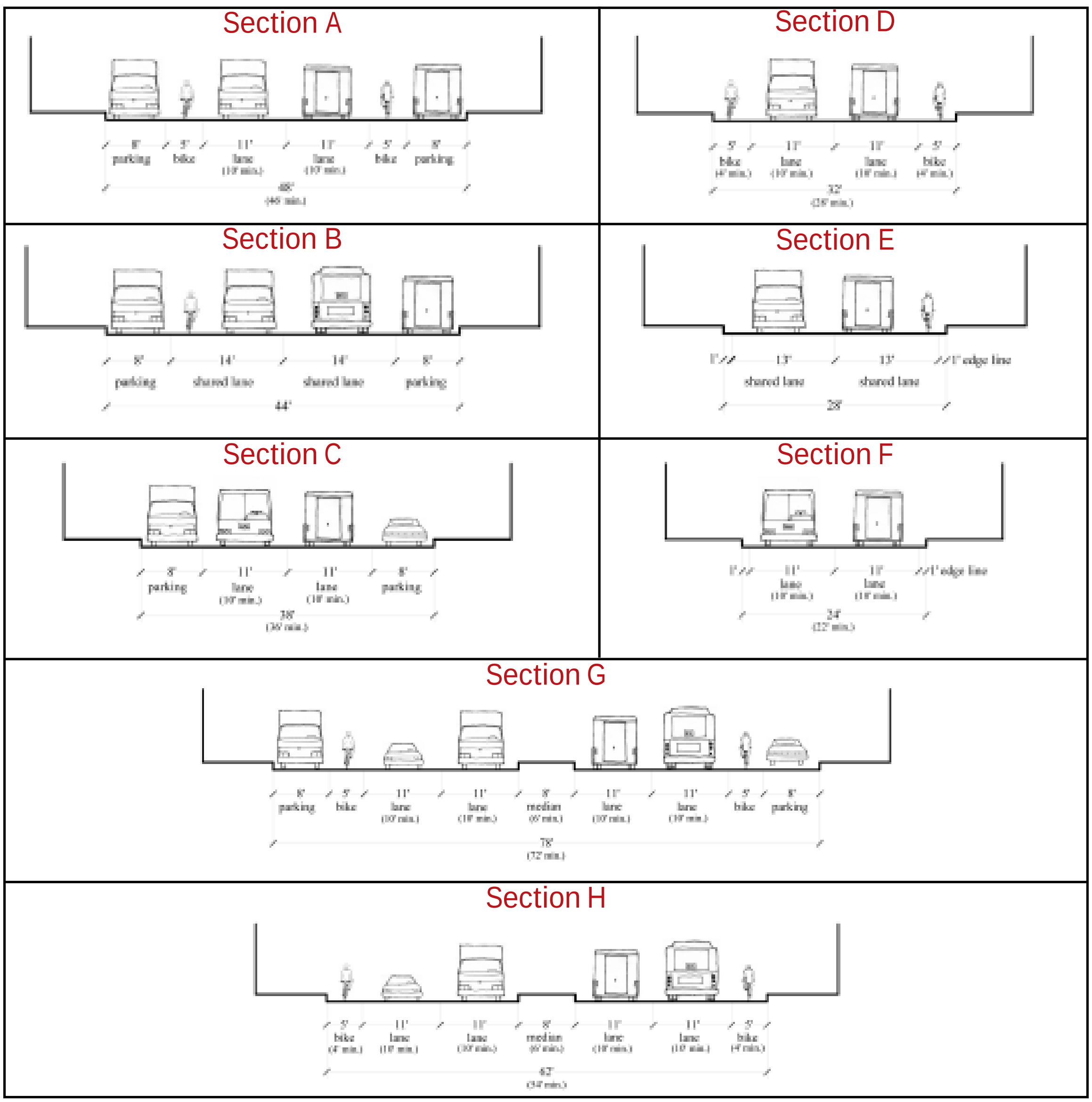

Figure 2.33: Typical cross sections for main streets.

2.5 Traffic Calming

In the TPI survey of New Jersey localities, three localities with recent DOT work on their main streets expressed dissatisfaction with resulting speeds. Two had wanted traffic calming elements to be part of these projects (see Appendix A.3).

These localities are caught in a vicious cycle. Their main streets are designed for speeds well above the posted speed. Since vehicle operating speeds often exceed design speeds, speed surveys done at some later date will likely find 85th percentile speeds high enough to justify raising speed limits. Higher speed limits, in turn, will raise minimum design speeds for all future roadwork. The result: current New Jersey policies do not discourage, and may actually encourage, higher speeds on main streets.

Figure 2.34: Traffic calmed main street in Recklinghausen, Germany.

Figure 2.35: Traffic calmed main street in York, Pennsylvania.

Nature of Traffic Calming

Traffic calming is integral to context-sensitive design in Europe.[35] Europeans use physical design to "enforce" low operating speeds and roadway appearance to "explain" to motorists how they should behave on a given roadway. Hence the use of the terms "self-enforcing" and "self-explaining" to describe the European approach to CSD.[36]

In a couple of case studies, sponsors referred to their main streets as "traffic calmed." They stretch the definition. Not to detract from the projects studied, for they are laudable by United States standards, but all fall short of the best European examples of traffic-calmed main streets (see Figure 2.34). We may beautify our main streets, or make them more pleasant to walk or bicycle along and easier to cross. But we seldom apply traffic calming measures, which compel motorists to slow down. When we begin narrowing our main streets to 18 feet or less at choke points, raising our intersections to sidewalk level, inserting dramatic lateral shifts into their alignments, and generally following European practice, we can lay claim to traffic calmed main streets—but not until.

Only one of our 15 case studies entails anything like European traffic calming, that being the redesigned Market Street in York, Pennsylvania (see Figure 2.35). Not only is Market Street choked down, but a shift in alignment produces lateral forces on motorists that cause them to slow down naturally. This tendency to slow down on curves does not require police enforcement, or heavy pedestrian traffic, or drivers pulling in and out of parking spaces. In this sense, it is self-enforcing 24 hours a day.

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[35] R. Ewing, *Traffic Calming: State-of-the-Practice*, Institute of Transportation Engineers/Federal Highway Administration, Washington, 1999, Chapter 9.

[36] J. Brewer et al., *Geometric Design Practices for European Roads*, Federal Highway Administration, Washington, D.C., 2001.

Lower Design Speeds

The TPI study team compared New Jersey's design standards and design exception policies to those of several other states (see Section 2.3). Design speeds, it turns out, are treated differently in New Jersey. Most other states have set minimum design speeds by facility type and allow design exceptions to these standards in low-speed environments.

High design speeds are promoted in the RDM: "For through roads, every effort should be made to use as high a design speed as practicable to attain a desired degree of safety, mobility and efficiency." DOT backs into design speeds through posted speed limits (see Table 2.10), and excludes design speed from the set of controlling design elements subject to design exceptions (see Table 2.11). Given New Jersey's presumptive speed limit in business districts of 25 mph, the minimum design speed for existing main streets is 50 kph (30 mph) and for new main streets is 60 kph (35 mph). These speeds are too high for most main street applications. Compare these to Vermont's minimum design speed for urban arterials (as low as 40 kph or 25 mph) or Idaho's (as low as 30 kph or 19 mph). These two states took advantage of the flexibility in ISTEA to adopt sub-AASHTO design standards for non-NHS roads. Design speed was among the few AASHTO minimums they considered too high (see Table 2.12).

A reasonable minimum design speed for traditional main streets might be 25 or even 20 mph. For their traffic calmed streets, the British have established 20 mph per hour zones, and northern Europeans 30 kph (19 mph) zones. Traffic calming measures are used to enforce these low speed limits. Pedestrians and motor vehicles comfortably coexist at such speeds. Pedestrian-motor vehicle crashes are rare at these speeds, and, when they occur, are seldom fatal. The British main street in Figure 2.36 is traffic calmed by means of a raised crosswalk and lateral shifts. The average travel speed is only 20 mph.

Posted Speed	Design Speed	
	Existing	New
25 mph	50 kph (30 mph)	60 kph (35 mph)
30 mph	60 kph (35 mph)	60 kph (35 mph)
35 mph	60 kph (35 mph)	70 kph (40 mph)

Table 2.10: New Jersey design speeds in relation to posted speeds.

Cross Slope
Travel Lane Width
Shoulder Width
Horizontal Curve Radius
Grade
Stopping Sight Distance
Intersection Sight Distance
Superelevation
Auxiliary Lane Length
Through Lane Drop Transition Length
Bridge Width
Structural Capacity
Vertical Clearance to Structures

Table 2.11: New Jersey controlling design elements.

	CT	ID	VT
Design Speed		X	X
Design Year Volume	X	X	
Level-of-Service			X
Travel Lane Width			X
Parking Lane Width	X		
Shoulder Width			
Intersection Sight Distance	X		
Stopping Sight Distance			X
Horizontal Curvature			X
Vertical Curvature			
Maximum Grade	X		X
Horizontal Clearance			
Vertical Clearance			
Grade			
Superelevation			

Table 2.12: Sub-AASHTO design standards adopted by three states.

Figure 2.36: Traffic calmed to 20 mph.

Policies, Procedures, and Standards

The recently revised New Jersey State Plan specifically encourages:

> *...the use of traffic calming techniques to enhance pedestrian and bicycle circulation and safety within compact communities and other locations where local travel and land access are a higher priority than regional travel.*

In its draft "bridging" document, even AASHTO endorses traffic calming in certain settings:

> *In general, the designer should consider traffic calming measures as a tool to address congestion, safety, and quality of life issues in response to one or more of the following:*
>
> *1. …*
>
> *2. A project is scheduled for a village/main street, school zone, or other subarea, and scoping indicates that inclusion of traffic calming would satisfy identified subarea needs such as a significant existing safety problem whose severity could reasonably be expected to be reduced by the application of traffic calming...*[37]

About a half dozen state DOTs have begun to promote traffic calming. Virginia has a pilot program, Pennsylvania and South Carolina have illustrated guidebooks, and New York has application guidelines and a training program. Illinois and Vermont are just beginning initiatives. The most ambitious effort to date is in Delaware. The Delaware Department of Transportation (DelDOT) has established a traffic calming program, developed a traffic calming design manual, and incorporated the manual, through the rule-making process, into the state's roadway design manual (see Figure 2.37). The traffic calming design manual prescribes standard procedures for planning and implementing traffic calming; establishes warrant-like guidelines for when and where different traffic calming measures may be deployed; provides typical geometric designs for different measures and

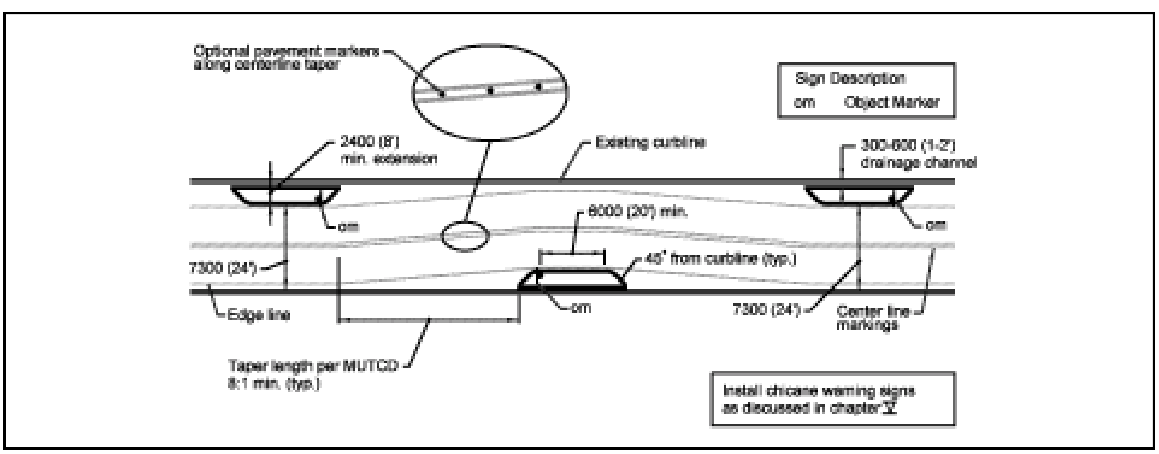

Figure 2.37: Delaware's typical chicane.

[37] American Association of State Highway and Transportation Officials (AASHTO), "Context-Sensitive Design for Integrating Highway and Street Projects with Communities and the Environment," *Highway Geometric Elements—Design And Safety Considerations*, NCHRP 20-17-114, final draft, March 2000, p. 29.

a range of acceptable design alternatives; and establishes standard signing and marking practices for each measure.

DOT has the option of traffic calming its main streets on an ad hoc basis, or establishing policies, procedures, and standards for main street traffic calming as Delaware did. DelDOT chose to institutionalize and codify traffic calming after the ad hoc approach produced public discord in two high profile cases.

The TPI study team concludes:

- To actively engage in European-style traffic calming, DOT would need to lower design speeds on main streets and develop traffic calming policies, procedures, and standards.

The TPI study team recommends that:

- DOT allow design speeds of 25 mph on main streets, equal to the minimum posted speed. This speed should be made self-enforcing via traffic calming measures.
- DOT consider seeking statutory authority for design and posted speeds of 20 mph on traditional shopping streets. Again, this speed should be made self-enforcing via traffic calming measures.
- DOT develop traffic calming guidelines for incorporation into its Roadway Design Manual. The Delaware Traffic Calming Design Manual provides a good starting point for New Jersey.

2.6 Conflicts-Solutions Matrix

Previous sections recommend process changes, design overlays, and new manuals as means of fostering context-sensitive main street design. Yet, as high-level DOT staff stress, such changes are less critical than the exercise of common sense and creativity on the part of highway designers. If designers understand the environmental and community context, and the safety and mobility needs to be addressed, common sense and creativity will usually produce designs that meet everyone's objectives.

To assist designers in this regard, a conflict-solutions matrix was developed. The matrix is intended as a reference for use in everyday design activities. Case studies were also prepared and are presented in the next chapter. They are replete with examples of creative thinking and problem solving in main street contexts.

The matrix has two parts. The first part considers each roadway design control or standard in turn, indicates its effect on roadway geometrics, presents the purpose of the standard from a DOT perspective, identifies the nature and magnitude of conflicts with local objectives, and suggests design solutions that may lessen conflicts without unduly compromising DOT purposes. The second part is the converse of the first. It considers each pedestrian-friendly design feature in turn, presents its purpose, identifies potential conflicts with DOT purposes, and indicates how these conflicts can be minimized.

The matrix was developed with the assistance of the Technical Review Committee (TRC). It incorporates ideas from guidance documents on pedestrian-friendly roadway design, and even more so, workable ideas from our case studies. References are provided in the matrix to the guidance documents and case studies that served as sources or illustrations of particular ideas. Designers are referred to the guidance documents and case studies for more detailed information.

At one point, the project team attempted to screen and prioritize solutions. This proved unworkable. Instead, the final matrix presents ideas for further consideration, and encourages designers to judge their applicability on a case-by-case basis.

In sum, the conflicts-solutions matrix offers a range of possibilities for reconciling the local desire for pedestrian convenience and safety with DOT's policy of accommodating the entire traffic mix.

high minimums generally	see below	see below	see below	high	downgrade functional class of roadway, swap roadways to place main street under local control (Albuquerque/Red Bank), de-designate roadways and transfer to locals (Maplewood/South Miami/Washington Township/Westminster), transfer operation and maintenance to locals (Plainfield), reclassify rural roadway through village as urban (Brooklyn/Danville), (all of these may be used in connection with construction of bypasses or secondary routes that alter state highway functions)
minimum LOS	more traffic lanes, wider intersections, exclusive turn lanes	driver convenience, traffic throughput	faster traffic, aggressive driving, longer pedestrian crossing distances, poor street aesthetics, taking of property, higher construction costs, induced traffic, loss of curbside parking, narrowing of sidewalks	high	waive or relax LOS standard on main streets (Brooklyn/South Miami), adopt a multimodal LOS standard, shorten signal cycle length/retime signals (Maplewood/York), judge LOS on a section basis, adopt a peak period LOS standard, adopt a different design hour volume for LOS determination, widen intersection but not roadway (Albuquerque), use roundabouts instead of signals (Sag Harbor—PFUG/NJPED/FLLC), convert from 4-lane to 3-lane (Anchorage/South Miami/South Orange/Maplewood—OSTA/OMSH—NJPED opposes two-way left-turn lanes), create secondary routes (Washington Township/York—OSTA), enhance local street network (Red Bank/Washington Township), add traffic signals to improve platooning and facilitate turns and crossings (Saratoga Springs/Washington Township), convert to one-way couplets (rejected in Anchorage/Red Bank), create bypass routes (rejected in Brooklyn)
20-year design volume (10-year for 3R projects)	more traffic lanes, wider lanes, wider intersections	driver convenience, life-cycle cost savings	faster traffic, more aggressive driving, longer pedestrian crossing distances, induced traffic	medium	design for planned (desired) traffic (TEA-21), design for projected traffic <20 years out (Anchorage initially—5 year design volume), use conservative growth rate for background traffic (Washington Township)
minimum design speed	larger radius curves, more superelevation on curves, greater stopping sight distance, greater roadside clearance, gentler grades, greater separation between modes, wider lanes (indirectly), wide shoulders (indirectly)	driver convenience, traffic throughput, traffic safety	faster traffic, reduced pedestrian comfort and safety, reduced cyclist comfort and safety, longer pedestrian crossing distances (indirectly), poor street aesthetics, greater crash severity	medium	reduce design speed (Anchorage/Brooklyn/Plainfield/Washington Township), set design speed = to posted speed (APFG/Bennington), set design speed 5 mph rather than the standard 10 mph above posted speed (bypass in Washington Township), set design speed below posted speed (main street in Washington Township/gateway in Danville)

Table 2.13: Conflicts and Solutions for Main Streets (Design Controls and Standards)

Design Control or Standard	Geometric Effects	Design Impetus	Sources of Conflict	Magnitude of Conflict	Potential Solutions
large design vehicle	wider lanes, wider intersections	traffic safety, accommoda-tion of large vehicles, emergency response	faster traffic, higher turning speeds, longer ped-estrian crossing distances	medium	establish alternate truck route (York), prohibit turns by large vehicles, use different design vehicles at different intersections, use one design vehicle for thru movements, another for turns
adoption of a single typical section	wider streets, abrupt transi-tions from rural to urban	design standardiza-tion, reduced liability	faster traffic, poor street aesthetics (out of scale with surround-ings), higher construction costs	high, medium	use multiple sections along a stretch of road (Anchorage/Albuquerque/Sag Harbor/Saratoga Springs/South Miami), discontinue use of typical sections (Maryland)
minimum lane width	wider streets	traffic safety, accommoda-tion of large vehicles	faster traffic, longer ped-estrian crossing distances, higher construction costs	medium	adopt lower design speed, reduce lane width standard (Sag Harbor - may require design exception—down to 10'), (in suburban context, apply NJDOT low cost safety measures)
minimum shoulder width	wider streets	traffic safety, speed enforcement, breakdown lane, bicycle safety	faster traffic, longer ped-estrian crossing distances, suggestion of rural design, higher construction costs, unsafe passing maneuvers	medium, high	use colored or textured materials in shoulders (OMSH on rural-urban transitions), eliminate shoulders on urban streets (Albuquerque/Danville/Sag Harbor), use narrow shoulders (Brooklyn/Bennington/Washington Township), substitute parking lanes for shoulders (Sag Harbor), use gutter pans in lieu of shoulders (as long as "bike safe") (Anchorage/Orlando)
minimum corner (curb return) radius	wider intersections	accommoda-tion of large vehicles, traffic safety, faster emergency response	high turning speeds, long pedestrian crossing distances, poor street aesthetics	high	use mountable curbs at corners with vertical elements set back from the curbs (South Miami), establish alternate truck routes (York), use wide outside traffic, parking, or bicycle lanes to increase effective radius (APFG—use effective turning radius), adopt substandard corner radii (South Miami/York), use compound curves at corners (Brooklyn—OMSH), use simple radius curves with tapers at corners (OMSH), set back stop lines on side streets, place crosswalks upstream/downstream of curb return (Plainfield/York—PM), use larger corner radii in combination with curb extensions (Maplewood/York), design for larger vehicles only at selected intersections (Anchorage/Westminster), accept large vehicles crossing the center line (Plainfield), compute effective radius at corners considering parking lanes, setback stop lines on side streets to allow wider turns off main streets, install triangular islands of special design to create slip lanes (PFUG/NJPED)

Table 2.13: Conflicts and Solutions for Main Streets (Design Controls and Standards)

Design Control or Standard	Geometric Effects	Design Impetus	Sources of Conflict	Magnitude of Conflict	Potential Solutions
minimum horizontal curve radius	no chicanes, lateral shifts, or traffic circles (if interpreted literally)	traffic safety, driver comfort	faster traffic, taking of property, higher construction costs	low (not generally a problem on main streets except in connection with traffic calming)	mark and sign as traffic calming measures, recalculate minimum curve radius, adopt lower speed limit on curve, display lower advisory speed, accept design speed below posted speed (Danville), (in suburban context, apply NJDOT low cost safety measures)
minimum vertical curve radius	no speed humps or tables (if interpreted literally)	traffic safety	faster traffic, higher construction costs	low (not generally a problem on main streets except in connection with traffic calming)	mark and sign as traffic calming measures, recalculate minimum curve radius, adopt lower speed limit on curve, display lower advisory speed, (in suburban context, apply NJDOT low cost safety measures)
minimum stopping sight distance	straighter sections, wider road-side clearance	traffic safety, pedestrian safety	faster traffic, taking of property, tree removal	medium, low	provide warning signs and lower advisory speeds, recalculate stopping sight distances based on new research
right-turn lanes	wider intersections	driver convenience, traffic throughput	longer ped-estrian crossing distances, turning conflicts with pedestrians crossing side streets	medium, low	eliminate turn lanes on main streets (PM with bike traffic), set crosswalks back on side streets to provide yield space out of traffic flow (York), install triangular islands of special design to create slip lanes (Sag Harbor—PFUG), allow right-turn-on-red from shared lanes, use narrow right-turn lanes
left-turn lanes	wider intersections	driver convenience, traffic safety, traffic throughput	longer pedestrian crossing distances, longer pedestrian crossing delays, turning conflicts with pedestrians crossing side streets	low	convert from 4-lanes to 3-lanes with left-turn pockets (Maplewood/South Miami/ South Orange), eliminate turn lanes on main streets (Brooklyn—OMSH for left-turn stacking lanes), use narrow left-turn lanes, install pedestrian refuge islands adjacent to left-turn lanes, convert to one-way couplets, route left turns around block via right turns , convert from 4-lanes to 3-lanes with continuous left-turn lanes
speed-change lanes	wider streets	driver convenience, traffic safety at high speeds	faster traffic, more aggressive driving, longer pedestrian crossing distances, suggestion of rural design, conflicts with bicyclists	medium	eliminate acceleration lanes on main streets (Brooklyn—climbing lanes rejected—OMSH)

Table 2.13: Conflicts and Solutions for Main Streets (Design Controls and Standards)

Design Control or Standard	Geometric Effects	Design Impetus	Sources of Conflict	Magnitude of Conflict	Potential Solutions
through-lane drop transition length	shadow lanes for lane drop at intersections (even if marked as turn lane)	traffic safety	faster traffic, more aggressive driving, poor street aesthetics, suggestion of rural design, conflicts with bicyclists	low, medium	drop lane prior to an intersection and add turn pockets (Saratoga Springs), adopt lower design speeds, establish lower advisory speeds, use mountable curbs and breakaway elements on far side of intersection (Saratoga Springs)
shifting lane transition length	gentler lateral shifts	traffic safety	faster traffic	low	mark and sign lateral shifts as traffic calming measures (York), adopt lower design and posted speeds, establish lower advisory speeds
right turn on red		driver convenience, traffic throughput	turning conflicts with pedestrians crossing side streets	medium	eliminate RTOR on main streets (APFG/OSTA/NJPED), allow RTOR with yield-to-pedestrians signing
minimum lateral clearances	wider median islands (if trees planted in median), wider ROW (if trees planted on edge)	traffic safety, pedestrian visibility, room for utilities	poor street aesthetics, reduced sidewalk clear width	low	place trees behind vertical curbs (Bennington—only 1 ½'/York - only 2'), plant smaller trees of yielding variety (Saratoga Springs), lower design and posted speeds (Saratoga Springs), use object markers with mature trees
offsets at curbs (both edge and median)	wider streets, narrower sidewalks, narrower median islands, poor alignment between old & new curbs	traffic safety	faster traffic, longer pedestrian crossing distances	medium	waive or reduce offset requirements, use mountable curbs, lower design and posted speeds
MUTCD marking and signing requirements		traffic safety, pedestrian safety, universal recognition	poor street aesthetics	low, medium	relax MUTCD requirements on main streets, use landscaping to draw attention to hazards, use textured surfaces to draw attention to hazards, install and remove portable signage as needed

PFUG—FHWA Pedestrian Facilities Users Guide
NJPED—New Jersey Pedestrian Design Guidelines
OSTA—Oregon Special Transportation Areas
APFG—AASHTO Pedestrian Facilities Guide
OMSH—Oregon Main Street Handbook
PM—Portland Metro Street Design Guidelines
FLLC—Florida Livable Communities Directive

Table 2.13: Conflicts and Solutions for Main Streets (Design Controls and Standards)

Pedestrian Friendly Features	Design Impetus	Sources of Conflict	Value to Pedestrians	Potential Solutions
narrow down streets (Anchorage/ Atlanta/ Maplewood/Sag Harbor/South Miami—PFUG)	slower traffic, pedestrian safety, space for wider sidewalks, bike lanes, etc.	traffic safety	high	narrow street at midblock but maintain intersection capacity, eliminate underutilized parking lane, narrow oversized lanes to make room for other design elements (Atlanta)
widen sidewalks (Anchorage/ Atlanta/ Maplewood/ Plainfield/Red Bank/Saratoga Springs/South Miami/ Washington Township/York—sidewalks added in Albuquerque/ University Place—PFUM/PM/FLLC)	pedestrian comfort, space for street furn-iture, space for sidewalk activity	less cross sectional width for traffic, higher construction and main-tenance cost	high	relate sidewalk width to land use intensity, provide a clear width free of street furniture (PFUG), turn over sidewalk maintenance to locals or other agencies (Anchorage/Maplewood/Plainfield/ Saratoga Springs/York)
mark crosswalks at intersections on all approaches (Bennington/ South Orange/ York—PM)	pedestrian saftey	false sense of security for pedestrians	medium	place street lights at crossings (OMSH/NJPED), install traffic signals to create gaps in traffic (Washington Township/Saratoga Springs), use high visibility crosswalk markings such as ladder pattern (PFUG/OSTA/ OMSH/NJPED), extend curbs at crossings to reduce exposure time (many places—NJPED), place pedestrian refuge islands at crossings, install pedestrian-activated flashing inset warning lightsplace only on selected approaches (Maplewood and Saratoga Springs), use textured surface on crosswalks, use textured surface at edges of cross-walks (OMSH), use reflective inlay tape on crosswalks (PFUG), raise crosswalks to sidewalk height or just below, use "countdown" signals, use audible ped-estrian signals (Burlington), place stop lines back from crosswalks (Maplewood)
provide pedestrian push-buttons and signal heads (Saratoga Springs—PM/ NJPED/FLLC)	pedestrian convenience, pedestrian safety, compliance with ADA	driver convenience	medium	install automated pedestrian detection, provide walk phase on every cycle, provide leading walk phase prior to cross street movement (South Orange)
provide raised medians on wide streets (Anchorage/ Maplewood/ Saratoga Springs/ University Place—NJPED)	pedestrian refuge, street beautification, access management, presumed slower traffic, traffic safety	snow removal problems, landscape maintenance, increased construction cost, possible increased speeds	high	turn over landscape maintenance to locals (Anchorage/Saratoga Springs), use minimum median width (Maplewood below minimum with 4'/ University Place at minimum with 6-11'), place trees, object markers, etc. on islands for delineation in snow, use bollards and/or textured surfaces without landscaping, widen medians at locations without on-street parking, make medians mountable (Maplewood), install pedestrian pushbuttons in medians (NJPED)
provide center refuge islands (where not pos-sible to provide a relatively contin-uous median) (Sag Harbor/ South Orange—PFUG/PM/FLLC)	pedestrian refuge, street beautification, slower traffic if done with deflection	landscape maintenance, increased construction cost, conflict with on-street parking	medium	turn over landscape maintenance to locals (Sag Harbor), alternate between center islands and on-street parking bays

Table 2.14: Conflicts and Solutions for Main Streets (Pedestrian-Friendly Features)

Pedestrian Friendly Features	Design Impetus	Sources of Conflict	Value to Pedestrians	Potential Solutions
create gateways (Danville/Sag Harbor/Saratoga Springs/South Orange—OSTA)	slower traffic, smoother transition from rural to urban	traffic safety, landscape maintenance, textured surface maintenance	medium	turn over maintenance to locals (Danville/Saratoga Springs), use monument signage and other vertical elements to mark gateways (Danville/Sag Harbor), install rumble strips for pre-warning (Sag Harbor), install street lights at gateways (Sag Harbor)
install barrier curbs (curb and gutter added in Albuquerque/ Saratoga Springs/ University Place)	pedestrian safety and comfort, inability to park on street edge, suggestion of urban design	wider streets due to offsets, higher construction costs, vehicle instability upon high-speed impact, false security for ped-estrians, loss of emergency parking	medium	adopt lower design speed, use higher curbs to deflect vehicles at low speeds, place fixed objects behind curbs, use mountable beveled curbs (Saratoga Springs)
install curb ramps and median channel (two ramps per corner —PFUG/NJPED)	pedestrian comfort and safety, compliance with ADA	higher construction costs, wider streets (if use curb ramps on medians)	high	use median cutouts rather than median ramps, provide detectable warning at ramps and cutouts for visually impaired, use diagonal curb ramps only where diagonal crossings allowed
provide bicycle lanes (Albuquerque/ Sag Harbor/ University Place/ Washington Township—PFUG/ FLLC)	bicycle comfort and safety, driver convenience, improved sight distance at intersec-tions, traffic buffer for pedestrians, pull-out space for deliveries	wider street, faster traffic, bicycle conflicts with right-turning traffic, bicycle conflicts with parked cars, bicycle con-flicts with pedestrians, impression that bicyclists should ride only on marked streets	low, medium	use colored surface on bike lanes (Sag Harbor—PFUG/ PM through intersections), avoid right-turn lanes on main streets, separate from traffic lane with extra wide stripes (8" in Sag Harbor), adopt low design speed so bikes can use traffic lanes, use extra-wide curb lanes so bikes can share traffic lanes (Sag Harbor/Saratoga Springs/South Orange—PM at lower ADT), separate from traffic lane with flush reflectors (Sag Harbor), recess drainage inlets (as opposed to using catch basins) (PM), use bicycle-friendly drainage grates (Bennington), provide offset from parking lane, provide gutter pan wide enough for bikes (Anchorage/ Orlando), eliminate on-street parking (particularly angled), extend bicycle lanes to intersection (PM), provide skip markings through intersection (PM), place bicycle lanes between through and turn lanes, place bicycle lanes on parallel routes
install midblock crosswalks (Plainfield/South Orange/University Place/ Westminster/York —PM/FLLC)	pedestrian convenience, traffic through-put at intersections	presumed pedestrian danger, driver incon-venience	medium, high (depend-ing on block length)	place temporary object markers at crosswalks, use high visibility crosswalk markings (OSTA and PM), install flashing overhead beacons, place street lights at crossings (OMSH/NJPED), extend curbs at crossings to reduce exposure time (Plainfield/South Orange/ Westminster/York), place pedestrian refuge islands at crossings, install pedestrian-activated flashing inset warning lights (University Place), provide pedestrian activated traffic signals (NJPED), use textured surface on crosswalks (South Orange/Westminster), line up midblock crosswalks with alleys (Maplewood/South Orange), use textured surface at edges of crosswalks (OMSH), raise crosswalks to sidewalk height or just below, angle median cut-out to increase pedestrian visibility, limit midblock crosswalks to long blocks (NJPED)

Table 2.14: Conflicts and Solutions for Main Streets (Pedestrian-Friendly Features)

Pedestrian Friendly Features	Design Impetus	Sources of Conflict	Value to Pedestrians	Potential Solutions
extend curbs at pedestrian crossings (Maplewood/ Plainfield/Red Bank/Sag Harbor/ South Miami/ South Orange/ Washington Township/ Westminster/York —OSTA/NJPED/ FLLC)	shorter pedestrian crossing distances, slower traffic, streetscape improvement, no illegal parking in crosswalks	loss of on-street parking when used at midblock, loss of transit pull-out space, problem for large vehicles turning at intersections, obstruction for storm-water runoff	high	delineate individual parking spaces (Westminster), delineate curb extensions with bollards, trees, or other vertical elements (Plainfield/Westminster/York), provide mountable curbs with vertical elements set back from the curbs (South Miami), set back stop lines on side streets (Plainfield/South Orange), use larger corner radii in connection with curb extensions (Maplewood/York), maintain standard travel lane widths (all cases), make curb extensions no wider than parked cars (South Miami/Westminster), provide edge lines and offsets (Plainfield), provide catch basins on upstream side of extensions (Plainfield/ Sag Harbor/York), use reverse pavement slopes to channel drainage around extensions (Plainfield)
provide buffer zone (Anchorage/ Washington Township on CR 526—PFUG/NJPED/ OMSH at rural-urban transitions)	street beautification, traffic buffer for pedestrians, traffic buffer for property owners	landscape maintenance	medium	turn over landscape maintenance to locals (Anchorage/Sag Harbor/Saratoga Springs), use only where less intense pedestrian traffic, use low-maintenance, drought-resistant vegetation
plant street trees (Plainfield/ Saratoga Springs/ South Miami/ Washington Township/ Westminster/ York—PM)	street beautification, weather protection for pedestrians, traffic buffer for pedestrians, traffic buffer for property owners	danger to traffic, landscape maintenance, obstructed view of store fronts and signs, obstructed sight lines at crossings, root damage to streets and sidewalks, reduced functional clearance for pedestrians	high	place trees in wells with tree grates (PM), turn over landscape maintenance to locals (Plainfield/Sag Harbor/Westminster/York), place trees behind barrier curbs (most places), place trees on curb extensions (Westminster/York), plant taller trees with higher crowns, trim trees to maintain clear stem heights, use root barriers, allow variable sidewalk widths to accommodate existing trees (Plainfield), plant smaller trees of yielding variety (Saratoga Springs)
convert to two-way operation (York—already on George St and planned for Market St—PFUG)	slower traffic, presumed pedestrian safety, improved business access	reduced traffic throughput, increased delays for drivers	high	accept lower LOS, time for progression in peak direction, ban turns during peak hours, upgrade signal system to traffic-responsive or traffic-adaptive control
time signals for lower speeds (Maplewood/ Washington Township—OSTA)	speed reduction, increased traffic throughput	lower LOS for drivers, poor progression in one direction	low, high (depending on signal spacing)	accept lower LOS, install demand-actuated signals, upgrade signal system to traffic-responsive operation, upgrade signal system to traffic-adaptive operation
provide exclusive pedestrian phase in signal cycle (PM/FLLC)	pedestrian convenience, pedestrian safety	lower LOS for drivers, poor progression	low	only use at high pedestrian volumes
narrow or consolidate driveways (Maplewood—PFUG/NJPED)	pedestrian safety and comfort, traffic safety, increased traffic throughput	taking of property or easements, business opposition	medium	other access management measures such as continuous medians and right-in, right-out operation (PFUG), provide median dividers on wide driveways (PFUG)

Table 2.14: Conflicts and Solutions for Main Streets (Pedestrian-Friendly Features)

Pedestrian Friendly Features	Design Impetus	Sources of Conflict	Value to Pedestrians	Potential Solutions
add on-street parking (Washington Township/York—OSTA/PM/FLLC)	easy access to property, traffic buffer for ped-estrians, slower traffic, reduced need for off-street parking	wider streets, reduced traffic through-put, higher crash rate but possibly less severe crashes, obstructed view of pedestrians	medium	combine with curb extensions at crosswalks (PM and OMSH), provide only in high intensity areas, prohibit on-street parking near crosswalks, choose parallel parking over angle parking due to safety concerns (Red Bank), leave gaps between parking spaces, combine with wide outside lane to allow passing while cars are parking (South Orange), use back-in angle parking, use parallel parking only (PM with bike traffic and OMSH)
install textured surface materials (brick, cobble-stone, concrete pavers, etc.) (Maplewood/Plainfield/Red Bank/South Orange/Westminster/York—PM/FLLC)	street beautification, unified pedestrian realm	higher noise levels with some materials, rougher surface for disabled, slippery in wet weather, higher construction costs, higher maintenance costs	low	use stamped asphalt or concrete rather than pavers, turn over pavement maintenance to locals (Westminster—locals also maintain in Maplewood, Plainfield, Red Bank, York, etc.), supplement with white lines when used on crosswalks, use construction techniques that avoid settling of bricks or pavers, used tinted rather than textured materials (South Miami), extend textured materials to the entire pedestrian realm (Maplewood/South Orange—tinted materials are extended in South Miami), use pavers with rough surfaces (Red Bank), strip asphalt to reveal old bricks (Atlanta/Orlando)
install street lights (Sag Harbor—PFUG/NJPED/FLLC)	pedestrian visibility	higher construction costs	low	fund with special assessments, use only at inter-sections and other conflict points, provide special pedestrian-oriented lighting (NJPED)
square off inter-sections (Sag Harbor—two examples—OMSH)	shorter corssing distance, slower turns, better angle of vision for entering traffic		low	align stop lines perpendicular to travel lanes at diagonal intersections (Maplewood)
install traffic calming measures (York—PFUG)	slower traffic, safer motor vehicle operation, safer pedestrian crossings, street beautification	reduced throughput, higher construction and maintenance costs, slower emergency response, slower snow clearance	high	fund with special assessments, design for emergency vehicles and snow plows, use volunteers for land-scape maintenance, use special snow plowing equipment

PFUG—FHWA Pedestrian Facilities Users Guide
NJPED—New Jersey Pedestrian Design Guidelines
OSTA—Oregon Special Transportation Areas
APFG—AASHTO Pedestrian Facilities Guide
OMSH—Oregon Main Street Handbook
PM—Portland Metro Street Design Guidelines
FLLC—Florida Livable Communities Directive

Table 2.14: Conflicts and Solutions for Main Streets (Pedestrian-Friendly Features)

Chapter 3
Case Studies

3.1 Case Study Comparison

In researching context sensitive design (CSD) for this guidebook, the existing literature was not of much help. The field is in its infancy, and available literature is largely promotional. So a knowledge base had to be constructed from case studies. In all, 15 case studies of context-sensitive main street projects were conducted; of these, 10 were written up and appear in this chapter.

The case studies came to the TPI team via nomination. Some were nominated by their respective state transportation departments. Others were suggested by the Technical Review Committee. Those in New Jersey were nominated by DOT engineers.

In writing the case studies, the TPI team let the facts speak for themselves—for better or worse. They are not meant to be promotional.

Synthesis

As a way to distill salient points from the case studies, the TPI team reviewed case studies for common and contrasting themes. The idea: If the same elements appear time-and-time-again, then these elements may be considered fundamental to context-sensitive main street design.

The case studies are summarized in four tables below. The first table (Table 3.1) establishes the context of the project, the original design (where one was proposed), and the original purpose of and need for the project. Only six of the 15 case studies involve traditional main streets, that is, pedestrian-oriented shopping streets. The rest involve highways through villages, main streets of suburban communities, gateway streets to downtown, or residential arterials. For almost half of the projects, another design was proposed originally and a more context-sensitive design solution was developed in reaction. These "reactive" projects most often occurred in settings other than traditional main streets, and had conventional purposes such as highway safety improvement, pavement restoration, utility replacement, or capacity enhancement. By contrast, projects involving traditional main streets tended to be proactive and have enhancement of the street environment as their main purpose.

The second table (Table 3.2) identifies impediments to CSD that were at work, at least to a degree, in the individual case studies. The main impediments were:

- State or county geometric design standards above AASHTO minimums,
- Level-of-service standards requiring additional lanes,
- Reliance on typical sections insensitive to context,
- Reluctance to approve design exceptions for purposes other than cost savings,
- Application of new construction standards to 3R and reconstruction projects,
- Misclassification of roads with respect to function or location, and
- Reluctance to maintain enhanced streetscapes.

Less common impediments included construction budget limitations and emergency response concerns. These impediments are described and illustrated in Appendix A.2. Note the relatively small role played by geometric standards in the scheme of things.

The third table (Table 3.3) summarizes the effects of the case study projects. In nearly all cases, the road was made more pedestrian-friendly through installation or widening of sidewalks, addition of crosswalks, construction of barrier curbs, and the like. In fewer than half of the cases, the road was also rendered more bicycle-friendly through the addition of bike lanes or extra-wide shared-use lanes. In nearly all cases, street aesthetics were improved by means of street trees, colored or textured paving, antique streetlights, undergrounding of utilities, and similar measures. Safer motor vehicle operations were a less common outcome of these projects. While travel ways were narrowed in many cases, this is not always the case in context-sensitive projects. Indeed, six of the 15 projects studied involved modest road widening. Finally, only one of the projects, the one in York, included measures that could be classified as traffic calming, in that they compel motorists to slow down through changes in vertical or horizontal alignment, or through dramatic narrowings.

The final table (Table 3.4) lists the design elements included in each case study project. Studying this table, it is apparent that main street projects fall into distinct categories: traditional shopping streets get curb extensions and midblock crosswalks; gateway streets get medians or refuge islands and bicycle lanes or extra-wide shared-use lanes. Almost everyone gets wider sidewalks, and many get additional street trees or textured paving. That projects differ by category indicates that there is no single way to design or re-design a main street, and that different design elements belong in different contexts. At the same time, the repetition of certain combinations of elements suggests that main street templates could be developed for different contexts. Indeed, the typical sections in Section 2.4 are an attempt to develop such templates.

	Context	Original Design Proposal	Original Purpose
Albuquerque	highway through town	5 lanes throughout with sidewalks added	safety and LOS improvement; accommodation of pedestrians
Anchorage	highway through town	conversion to one-way pair	safety improvement
Bennington	approach to town	wider lanes and shoulders	pavement reconstruction; utility replacement
Brooklyn	highway through village	rural cross section with high design speed	safety improvement
Maplewood	traditional shopping street	none	restoration of main street
Plainfield	highway through town	none	sense of place at rail station
Red Bank	traditional shopping street	none	restoration of main street
Sag Harbor	highway through village	none	safety and LOS improvement; accommodation of pedestrians
Saratoga Springs	approach to town	none	pavement restoration; accommodation of pedestrians/cyclists; drainage improvement
South Miami	traditional shopping street	none	restoration of main street
South Orange	traditional shopping street	none	restoration of main street
University Place	highway through town	5 lane reconstruction with sidewalks added	safety improvement; accomodation of pedestrians/cyclists
Washington Township	highway through town	cloverleaf at 130/33/526	LOS maintenance in face of growing traffic
Westminster	traditional shopping street	wider lanes	pavement reconstruction; utility replacement
York	traditional shopping street	none	restoration of main street

Table 3.1: Context, Original Design, and Original Purpose.

	High Geometric Standards	LOS Standards	Typical Sections	Limited Use of DEs	Treatment of 4R	Misclassification	Maintenance Concerns
Albuquerque		X	X			X	
Anchorage	X		X	X			X
Bennington	X				X		
Brooklyn		X		X		X	
Maplewood		X				X	X
Plainfield	X						
Red Bank	X						X
Sag Harbor							X
Saratoga Springs			X	X			X
South Miami	X	X				X	
South Orange		X					X
University Place							
Washington Twp.	X	X		X		X	
Westminster	X			X	X	X	X
York							X

Table 3.2: Impediments to Context-Sensitive Design.

	More Pedestrian-Friendly	More Bicycle-Friendly	Better Aesthetics	Safer for Motorists	Narrower	Traffic Calmed	Other Effects
Albuquerque	X	X	X	X			cost savings more parking spaces urban revitalization
Anchorage	X	X	X	X	X fewer lanes		more snow storage
Bennington		X	X				uniform cross section
Brooklyn	X			X			
Maplewood	X		X		X fewer lanes		
Plainfield	X		X		X narrower lanes		
Red Bank	X		X		X narrower lanes		
Sag Harbor	X	X	X		X narrower lanes		uniform lane widths
Saratoga Springs	X	X	X	X			improved LOS
South Miami	X		X		X fewer lanes		
South Orange	X	X	X		X fewer lanes		
University Place	X	X	X	X	X fewer lanes		access managed
Washington Twp.	X	X	X				access managed
Westminster	X		X				uniform cross section
York	X		X		X fewer lanes	X	

Table 3.3: Effects of Context-Sensitive Design.

	Curb Extensions/ On-Street Parking	Medians/ Refuge Islands	Wider Sidewalks	Bicycle Lanes	Midblock Crosswalks	Street Trees (new)	Special Pavement Surfaces
Albuquerque		X	X	X			
Anchorage		X	X			X	X
Bennington							
Brooklyn		X					
Maplewood	X	X	X				X
Plainfield	X		X		X	X	X
Red Bank	X		X			X	X
Sag Harbor	X				X		
Saratoga Springs		X	X			X	
South Miami	X	X				X	
South Orange	X	X	X		X	X	X
University Place		X	X		X	X	X
Washington Twp.	X	X	X	X		X	
Westminster	X				X	X	X
York	X		X		X	X	X

Table 3.4: Design elements.

Appendix A.1

Technical Review Committee

The first task of this project was to establish a Technical Review Committee (TRC) of leading experts and practitioners in the field of context-sensitive design. These professionals were identified through outreach to prominent planners and engineers, postings on national e-mail list serves, and recommendations from DOT.

The TRC played a significant role in this project. The group met at the midpoint of the project to review and comment on progress, and redirect efforts as necessary.

The TRC also participated in a Main Street Visual Preference Survey to help the TPI team better understand what constitutes a main street, and what attributes make a particular main street a good one. Results of the survey are presented in Appendix A.4.

Finally, the TRC was consulted on the nature of conflicts between DOT standards and community objectives, and on means for resolving them. The end product is the conflicts-solutions matrix in Section 2.6.

Brief biographies of the members follow.

Charles B. Adams, RLA, Director of Environmental Design with the Maryland State Highway Administration. Mr. Adams is chair of the Community Involvement Subcommittee for Maryland's "Thinking Beyond the Pavement" initiative. The stated goal of the initiative is to integrate highway development with community and environment preservation. Maryland has taken the lead in a national effort, coordinated by AASHTO and the National Highway Cooperative Research Program, to promote context-sensitive design.

Janine G. Bauer, JD, Executive Director of the Tri-State Transportation Campaign, Inc., New York, NY. Ms. Bauer coordinates and supervises collaborative projects of thirteen member organizations promoting "centered" land use, rail freight, sustainable port investments, expanded transit, and environmentally-friendly transportation infrastructure spending. She conducts policy and legal analyses associated with transport, economic, and environmental issues facing New York, Connecticut, and New Jersey.

James M. Daisa, PE, Fehr & Peers Associates. Among his publications, Mr. Daisa authored *Creating Livable Streets: Street Design Guidelines for 2040* for Portland Metro (Portland, Oregon's metropolitan government). The publication won the Environmental Protection Agency's "Way to Go" Award in 1998. Mr. Daisa has been in charge of most of the traffic engineering for land development projects planned by Peter Calthorpe, a leading New Urbanist planner.

Michael Moule, PE, City Traffic Engineer, Asheville, NC. Before starting his current job as City Traffic Engineer of Asheville, Mr. Moule was Bicycle and Pedestrian Facility Specialist at Oregon DOT. There, he rotated among offices of highway construction, preliminary highway design, and bridge design. Mr. Moule uses his experience with alternate transportation modes and his background in transportation engineering to provide the City of Asheville with a balanced transportation system.

Carlos Rodrigues, PP, AICP, New Jersey Office of State Planning. Mr. Rodrigues is coordinator of Designing New Jersey. He is responsible for policy development in the areas of physical planning and urban design and is involved with a variety of activities related to implementation of the community design vision of the State Plan. He has worked in Europe, Asia, and Canada, for a variety of private and public organizations.

David Scott, PE, Director of Project Development with the Vermont Agency of Transportation. Vermont is the acknowledged leader among states that have taken up the ISTEA challenge to tailor highway design standards to state needs. Mr. Scott is charged with developing projects according to the new policies and standards, and as such has daily involvement with context-sensitive highway design.

Ben Yazici, PE, Director of Public Works/Financial Services, Sammamish, WA. Mr. Yazici has 19 years of management experience, 10 years as Assistant City Manager/Public Works Director/City Engineer. He is a registered Professional Engineer in the States of Washington and Oregon. His context-sensitive design projects in Sammamish, University Park, and Gig Harbor recently won Mr. Yazici a national award from the Surface Transportation Policy Project, *Walking* Magazine, and Walkable Communities, Inc.

Appendix A.2
From Highway to My Way

by Reid Ewing

Reproduced from *Planning* magazine, January 2000 (some material deleted during the editorial process has been reinserted).

You know the world is changing when everyone from the Federal Highway Administration to state and local transportation officials uses words such as "flexible" and "context-sensitive" to describe highway design. Now that the nation's highways are nearly complete, transportation professionals are turning their sights on local communities and the inherent links between transportation systems and surrounding land uses.

There is a lot of confusion about exactly what constitutes context-sensitive highway design, what latitude exists under current standards and guidelines, what tort liability attaches to such efforts, and what effect context-sensitive designs will have on traffic safety and service levels. This article seeks to sort out myth from fact.

Main Street Destroyed

In the course of writing Best Development Practices (APA Planners Press, 1996), I visited every medium-sized town with any historic character in the state of Florida. I was on a quest for the best traditional small towns in the state, hoping to find lessons applicable to contemporary development projects. In fact, I found very few good examples, mostly because of what happened along Main Street.

Main Street, usually part of the state highway

Figure A.2.1: Preserved main street, Dade City, Florida.

system, no longer functioned as a comfortable shopping street. It was too wide, and on-street parking had been removed, street trees replaced with asphalt, and sidewalks narrowed. Strip commercial development seemed the only practical land use. The traditional towns that did end up in the book, such as Dade City, had somehow managed to evade the standard DOT definition of "progress."

The problem of context-insensitive highways is not, of course, unique to Florida, nor to small towns, nor to state highways. Instead of gracious boulevards, avenues, and shopping streets, America's urban areas are crisscrossed by arterials and collectors that move traffic but have no power to move mens' souls.

DOTs vs. dots

Here are several examples proving that change is in the air. U.S. Route 6 narrows to two lanes as it runs through the town of Brooklyn, Connecticut. Sight distance is less than 250 feet at one point, driveways are closely spaced, and there is little roadside clearance should a driver lose control. Yet traffic speeds through the town still range up to 54 mph.

A 1991 state plan sought to correct these dangerous conditions by widening the road to four lanes, straightening the alignment, and adding eight-foot shoulders. The village appealed the plan, and the Connecticut Department of Transportation went back to the drawing board.

ConnDOT's next proposal was for a bypass around the town, which was also rejected. Finally, after years of additional planning, a compromise was reached in 1998. It keeps the existing alignment through the town center, retains the two-lane cross section, adds narrow shoulders and standard-width sidewalks, and realigns the road marginally at the most dangerous curve. Reconstruction will be completed in 2003.

In Albuquerque, New Mexico, Isleta Boulevard is a two-lane road with no sidewalks, no curbs, no landscaping or other amenities. The tendency of drivers to use the shoulder to pass left-turning vehicles on the right makes driving on Isleta Boulevard a free-for-all. The engineers' solution was to widen the southern leg of Isleta Boulevard from two to five lanes, two travel lanes in each direction and a continuous left turn lane in the center.

Activists, who had witnessed the decline of commerce and street life on a nearby street after it was five-laned, challenged the Environmental Assessment (EA) of the project and Finding of No Significant Impact (FONZI). Their grounds: safety problems with the current roadway were not documented, only assumed; land-use impacts were never analyzed; and more context-sensitive highway design alternatives were not considered. FHWA agreed and refused to accept the EA and FONZI. This led to a new hybrid design, with the central section of road widened to only three lanes, sidewalks added, and landscaped median islands installed.

In Anchorage, Alaska, engineers proposed the conversion of 15th Avenue into a one-way couplet with 14th Avenue after a safety study documented high accident rates and substandard geometrics. Residents of the adjacent Rogers Park neighborhood had seen one-way couplets in operation in midtown, and this was exactly what they didn't want. The couplets moved traffic efficiently but divided the community much as a freeway would.

And so began a four-year process of redesign that in 1998 resulted in a four-lane, tree-lined boulevard on the east end, and a narrowed three-lane cross section on the west. When construction is completed later this year (2001), travel lanes will be maintained at their current 11-foot width, and shoulders excluded. Instead of shoulders, wide gutter pans will provide a refuge area and bike-friendly surface. Sidewalks will be set back from the street for the first time.

In Westminster, Maryland, the base layer of East Main Street needed reconstruction, underground utility lines had to be replaced, and the storm drain system needed upgrading. After checking the Maryland *Roadway Design Manual*, the district engineer proposed widening the road to 40 feet.

Figure A.2.2: Section of Isleta Boulevard requiring reconstruction, Albuquerque, New Mexico

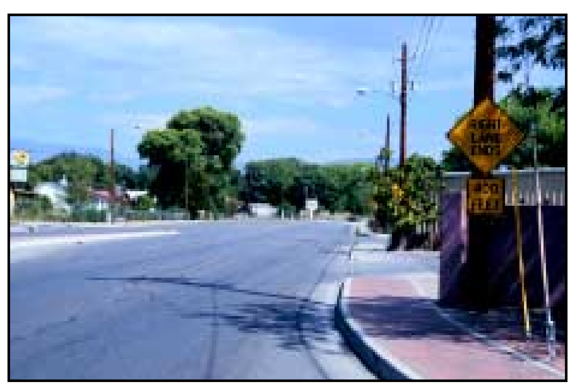

Figure A.2.3: Reconstructed northern section of Isleta Boulevard, Albuquerque, New Mexico

Figure A.2.4: East Main Street during reconstruction, Westminster, Maryland

Figure A.2.5: East Main Street as reconstructed, Westminster, Maryland

Widening would have provided 12-foot travel lanes and eight-foot parking lanes on each side. It also would have eliminated nearly all street trees and reduced the sidewalk width to two feet in places.

After learning about the widening, a local resident began a campaign to preserve the street's historic character. She appealed to the mayor, who convinced the Maryland State Highway Administration to reconstruct within the street's existing dimensions. The result is a classic main street with "bulb-out" curb extensions at intersections, midblock crosswalks, hundreds of additional street trees, and brick surfacing in the crosswalks.

In these and many other cases uncovered in our research, the need for road improvements was undeniable, but standard design solutions were unacceptable to the people most affected by them—those along the right-of-way. The resulting tension between DOT and community goals led to compromise and context-sensitive designs.

Reform at the Top

Before 1991, all roads built in the U.S. and paid for even in part with federal funds had to meet guidelines in the American Association of State Highway and Transportation Officials (AASHTO) Green Book (*A Policy on Geometric Design of Highways and Streets*). If officials wanted to do something different, their only options were to seek design exceptions from the Federal Highway Administration or to build entirely with state and local funds.

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) changed all of that by creating a National Highway System made up of the interstate system and other high-performance state highways, 160,000 miles of roadway in all. Other roads became eligible for federal funding under a separate surface transportation program. For roads not on the NHS, ISTEA gave states latitude to adopt alternative design, safety, and construction standards.

ISTEA was followed by two other milestones. The National Highway System Act of 1995 provided that even NHS highways (other than Interstate highways) could be designed to take into account the environmental, scenic, aesthetic, historic, community, and preservation impacts of any proposed activity. Two years later, the Federal Highway Administration published *Flexibility in Highway Design*, which forcefully advocates flexible design of highways running through communities, encouraging highway designers to exercise flexibility within existing AASHTO guidelines.

Reform in the States

At the state level, much of the effort to promote context sensitivity has been process- and people-oriented. Five states (Connecticut, Kentucky, Maryland, Minnesota, and Utah) are participating in a joint FHWA/AASHTO effort to train engineers in context sensitivity through the National Cooperative Highway Research Program (NCHRP). Many states, including New Jersey, have launched training efforts of their own. The New Jersey training consists of five day-long sessions on such unconventional topics (at least for highway engineers) as place making, respectful communication, conflict management, and traffic calming.

While such efforts are laudable, they inevitably run up against engineering constraints unless DOT standards and policies are revised. Michael King, a consultant on the NJDOT flexible highway design project, surveyed more than a dozen states to find out about their efforts to develop new standards and policies. His conclusion: Substantive changes are happening all over the United States.

Don't Blame the Green Book

King found that few states have adopted sub-AASHTO geometric standards. Among those that have, deviations from Green Book values are relatively slight. The difference between the cross sectional width of a two-lane urban arterial under Vermont's much heralded design standards and that under the Green Book minimums is only three feet (43 vs. 46 feet). Notably, Dave Scott, Director of Project Development and keeper of the Vermont standards, has advised our New Jersey study team not to recommend anything less than AASHTO minimums because there is little to gain on urban main streets.

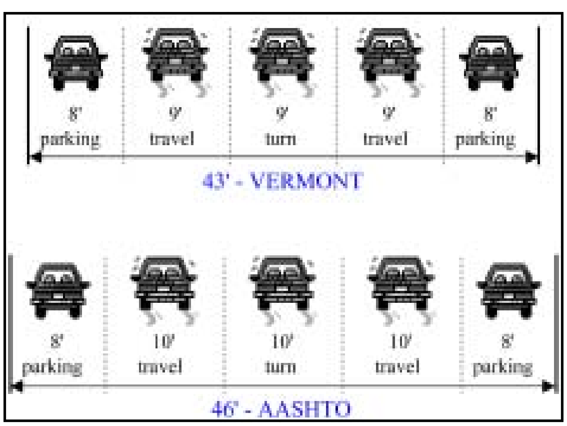

Figure A.2.6: Vermont vs. AASHTO minimums.

This is not to say that the AASHTO Green Book is without shortcomings. Its design guidelines are often based on studies dating from a time when tires, braking systems, pavements, and vehicle dimensions were less forgiving than today's. However, these guidelines mostly affect the design of high-speed rural roads. The issue in the New Jersey study is whether good urban streets can be accomplished under AASHTO guidelines.

Here are some of the AASHTO guidelines for urban arterials:

- ❑ Design speed. AASHTO allows design speeds as low as 30 mph in central business districts and intermediate areas. Posted speeds would ordinarily be considerably lower.
- ❑ Lane width. The minimum lane width is 3.0 m (10 ft) for urban arterials with little or no truck traffic. A minimum of 3.3 m (11 ft) is prescribed for general traffic on urban arterials designed for speeds up to 37 mph.
- ❑ Shoulders. AASHTO declares shoulders "desirable on any highway, and urban arterials are no exception." However, in urban contexts where right-of-way is limited, the Green Book neither requires shoulders nor establishes minimum widths.
- ❑ Setback of street trees. On curbed sections, the minimum clearance from the curb face is 1.5 feet. A 3.3-foot clearance is considered desirable, particularly near intersections and driveways where turning vehicles may overhang the curb.
- ❑ Midblock crosswalks. AASHTO is neutral on these.
- ❑ On-street parking. Parallel parking is allowed where adequate street capacity is available.

- Corners. Corner radii of 10 to 15 feet are reasonable under constrained conditions. On arterials carrying high volumes, larger radii are recommended (in some cases, much larger) to facilitate turns to and from the through lanes.
- Pedestrian refuge islands. Median islands are encouraged where space permits.
- Sidewalks. The minimum border width, including sidewalk and planting strip, is 8 feet; a 12 foot border is preferred.
- Barrier curbs. Barrier curbs are encouraged in areas of high pedestrian traffic and speeds up to 37 mph, or on discretionary basis, up to 50 mph. At higher speeds, barrier curbs do not act as barriers anyway.

The conclusion: It appears that we cannot place too much blame on the Green Book for the sorry state of urban streets.

Liability Isn't the Issue, Either

Governments used to have general immunity from tort liability, but that has changed since the 1960s, as various courts and legislatures made it possible for individuals and groups to sue in cases where government fails to exercise due care in its decisions.

Government decisions are now divided into two classes: discretionary (planning decisions) and ministerial (operational decisions). Discretionary decisions involve a choice among valid alternatives and are generally immune from tort claims. Ministerial decisions leave minimal leeway for personal judgment and are not immune.

As part of our study for NJDOT, we surveyed statutory and recent case law in 16 states. With the sole exception of local roads in Vermont, all states had replaced sovereign immunity with more limited discretionary immunity.

New Jersey has a Tort Claims Act that leaves the state almost completely immune from tort liability resulting from design-related decisions. All it takes is for the right body or person to approve a design (or the standards on which a design is based).

At the other extreme is Georgia, whose supreme court held in DOT v. Brown (1996) that the design of a roadway is an operational function, not covered by discretionary immunity: "Only the decision to build, and not where or how it is built, is immune." Between these extremes are states such as California and South Carolina, which provide design immunity but allow it to lapse as conditions change. From our 16-state survey, we don't find tort liability much of an excuse for the sorry state of urban streets. Instead, we have identified some real culprits.

Put the Blame Here

AASHTO's Green Book offers design policies and guidelines, not standards. For each design element, AASHTO typically provides a range of acceptable values, from a minimum value to a more desirable target value.

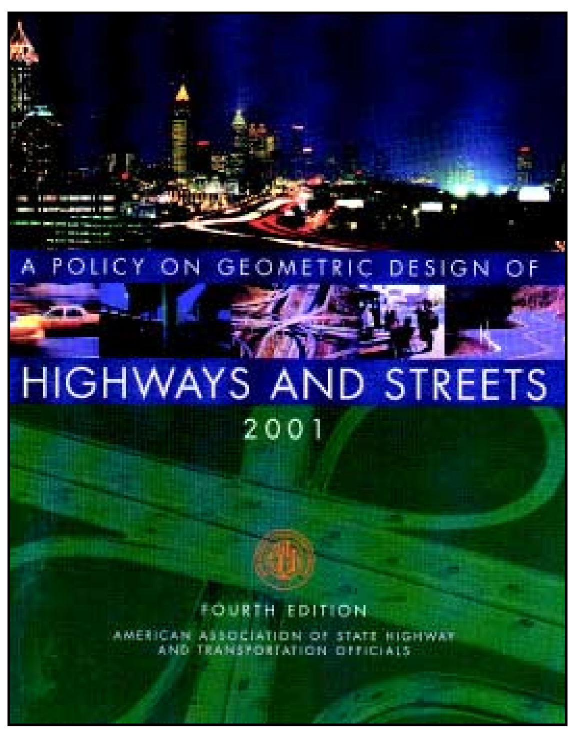

Figure A.2.7: "Green Book" applied by Maryland State Highway Administration.

For an AASHTO guideline to become a standard, it must be adopted by a responsible agency. Many states have adopted standards toward the middle or upper end of the AASHTO ranges, on the theory that if some is good, more is better. County and city engineers have then blindly adopted state standards.

As noted, Maryland's lane width standards would have encroached on trees and sidewalks in the town of Westminster. Those standards exceeded AASHTO minimums. Not only were these particular standards thrown out, but the experience convinced Bob Douglass, the Maryland State Highway Administration's deputy chief engineer, that the standards should be thrown out wholesale.

In 1998, Douglass wrote a memo banning the use of the state's highway design manual. He found that the templates were generally oversized (especially stopping sight distance and vertical curves) and stymied creativity among engineers. The agency was losing legal challenges when an element was below the state minimum value, but above the Green Book value. Now the agency relies exclusively on the Green Book.

In the Wrong Class

Another culprit is misclassification of streets. Streets and highways in this country are classified by location—urban or rural—and by function: arterial, collector, and local. There is a direct relationship between classification and design standards. Classification determines design speed, design vehicle, and cross section (lane width, shoulder width, and type and width of median).

The U.S. classification system has been criticized for ignoring distinctions among contexts and among roadway functions. An urban arterial conforms to the same basic standards whether it is a main street or a bypass.

Misclassification of streets commonly occurs for two reasons. A small town, village, or hamlet fails to meet the definition of urban. That community may end up with a main street designed to rural standards. This was true in Brooklyn, Connecticut, before the compromise described at the beginning of this article.

The simple solution to this problem is to treat any place that is built up as urban, regardless of its census designation. The Federal Highway Administration policy is simple: If it looks urban, use urban standards.

The other common case of misclassification occurs as road functions change over time. In Westminster, Maryland, East Main Street had always been part of Maryland State Route 32. It began functioning more like a local street when the State Road 140 bypass opened. Accordingly, this portion of Route 32 was removed from the Maryland state highway system after the street was reconstructed, and the city assumed responsibility for its operation and maintenance. Other examples of misclassification include Sunset Drive (State Route 986) in South Miami and Springfield Avenue (State Route 124) in Maplewood, New Jersey.

Level of Disservice

Level-of-service standards are yet another obstacle to context-sensitive design. While there is a legal imperative to provide safe roads, there is no such reason to provide free-flowing roads. Some congestion may be desirable in a downtown. After all, a downtown without traffic isn't a very exciting downtown.

Virtually all DOTs have adopted level-of-service standards. Typically, the standard for urban areas is C or D, while the standard for suburban areas is B or C. As traffic volumes increase to the point where the standard is no longer met, a road and its intersections often will be widened regardless of the effects on adjacent land uses.

The alternative is to accept congestion in areas that function as destinations. Since 1993, Florida has allowed its local governments to exempt streets through downtowns and urban redevelopment areas from level-of-service standards. The effective standard becomes level of service F. Many cities and towns have taken this option.

West Palm Beach, for example, has adopted level-of-service E as its standard and is seeking a complete exemption from level-of-service standards for much of the city. This city keeps an eye on both low volume-to-capacity ratios (less than 0.6) and high ones (greater than 0.9). A low volume-to-capacity ratio may offer an opportunity—a place where the street can be narrowed and street life encouraged by means of widened sidewalks, on-street parking, and landscaped curb extensions and islands.

Sunset Drive (SR 986) in South Miami once functioned as the city's main street, and the city wanted to reclaim the street as part of a downtown redevelopment plan. To slow traffic and reduce crossing distance, the existing four- or five-lane cross section has been narrowed to three lanes. The roadway narrowing permits wider sidewalks, additional street trees, and outdoor dining. Florida Department of Transportation (FDOT) initially opposed a decline in level of service on its road. The solution was to de-designate this last section of SR 986, turn the section over to the city, and have the lane reduction occur within the city's jurisdiction. The two eastbound travel lanes continue through the intersection with US 1 (the western boundary of the city), the inside lane ending in a trap left lane a block into the city. Roadway level of service is thus maintained at LOS E on the westbound approach, under FDOT's jurisdiction. The one westbound lane approaching US 1 has less carrying capacity than the previous configuration. But the resulting LOS F falls within the city's jurisdiction.

It is worth noting that several of the context-sensitive projects we studied have improved or at least maintained roadway level-of-service despite narrowed roadways. How? Through clever treatment of intersections, where most delays occur.

The Standard Cross Section

Nearly all state DOTs include typical sections—another culprit—in their road design manuals. If an area is classified as urban, and a road is functionally classified as a principal arterial, the typical section for an urban principal arterial becomes the default roadway.

Typical sections inhibit flexible and context-sensitive design in two ways. First, where right-of-way is constrained, something must be sacrificed to maintain standard travel lanes, and it is usually the sidewalk, landscape buffer, or parking lane. Also, there is a tendency to adopt a single, typical section for an entire stretch of road, even when conditions change along its length. Having a single typical

Figure A.2.8: Sunset Drive before reconstruction, South Miami, Florida.

Figure A.2.9: Sunset Drive after reconstruction, South Miami, Florida.

section is convenient for the design engineer and construction crew, but it is not good policy.

The proposed five-lane section over the length of southern Isleta Boulevard (see above) created excess capacity at the midpoint, and correspondingly higher speeds and higher costs. The hybrid design with a three-lane section in the middle will save $4.5 million on right-of-way acquisition and construction costs. The tendency to use a single typical section is also evident in the Brooklyn case study at the beginning of the article.

An even more dramatic example is found in Saratoga Springs, New York. South Broadway (US 9) changes from a four-lane, semi-rural highway with a striped median and posted speed of 55 mph to a three-lane urban road with a raised median, single northbound lane, and posted speed of 30 mph, all in a stretch of 1,800 feet.

By all accounts, the section in question would have been reconstructed as a uniform four-lane roadway with a flush median, but for two things. First, in 1999, New York State started an Environmental Initiative, with context-sensitive design at its heart. Second, the highway passes Saratoga Spa State Park, the Lincoln Baths, and the Museum of Dance. Something special, more like a gateway, was required. Ultimately, a series of roadway sections got built that make a smooth transition from the high-speed semi-rural environment to the south to the low-speed urban environment to the north (see Figure A.2.6).

The Four Rs

Roads that are being resurfaced, restored, or rehabilitated (so-called 3R projects) do not have to be upgraded to current geometric standards. Instead, states can (and some do) make them subject to special standards below those of AASHTO—

Figure A.2.10: Multiple sections heading into town on US 9, Saratoga Springs, New York.

with the blessing of the Green Book. By contrast, under state and federal policies, roads reconstructed down to their bases must be brought up to current standards.

In a constrained main street environment, there is no reason to treat 3R and reconstruction projects differently. In both cases, designers already know how a road performs based on historical accident and other data. The Maryland State Highway Administration reached this conclusion in Westminster, and now leaves existing cross sections alone unless there is a documented crash problem.

Exceptions to the Rules

The Federal Highway Administration grants design exceptions on the National Highway System, and the same is true for state or local DOTs on non-NHS roads. Between 1997 and 1999, NJDOT engineers requested and received design exceptions for 81 projects, including most major highway projects undertaken by the state.

From our review of the 81 reports, exceptions are typically requested in order to save money, not to preserve context. Here is a typical scenario: A road is being reconstructed, and a sharp curve must to be straightened to meet the standard for horizontal curvature. However, someone's house or business would be taken, some park or cemetery would be encroached on, a lot of extra asphalt would have to poured, or some other big expense would be incurred.

And so the design engineer checks crash statistics for the location in question, focusing on the types of crashes associated with substandard horizontal curves, and finds that the curve in question generates only an average number of crashes compared to state norms. Noting that substantial costs can be avoided by allowing a substandard horizontal curve, a design exception is requested and granted.

Sometimes context also is taken into account, as with a road and bridge project in an historic district of Oxford Township, New Jersey. But this is a rare occurrence.

Let's Use Common Sense

Gary Toth, one of the overseers of our research at New Jersey DOT, keeps saying that context-sensitive design is just a matter of common sense. If the designer understands the safety and mobility needs to be addressed, and then uses common sense to fit sound engineering principles into the environmental and community context, a design will emerge that represents the best of all worlds.

On 15th Avenue in Anchorage, Alaska, the first common sense decision was to divide the roadway section into three segments because traffic turns off as it heads west. Daily volumes drop from 22,000 at the eastern end of the avenue to 4,000 at the western end, implying very different cross sections. Focusing on the westernmost segment, the second common sense decision was to drop a lane, from four to three, the center lane becoming a continuous left-turn lane.

In a third common sense decision, the outer westbound lane was replaced with a five-foot sidewalk and landscape buffer between the road and sidewalk. By reducing the number of lanes, the state is also reducing the amount of snow to be cleared, and creating more storage space for it in the buffer strip. With Anchorage's low sun angle, and the sun blocked by buildings and trees, the engineers expect that three additional weeks of bare pavement a year will result from the decision to place the sidewalk on the north side of the street rather than dropping an eastbound lane and placing the sidewalk on the south side.

The final exercise of common sense was to seek several design exceptions. Some stopping and intersection sight distances, curb return radii, shoulder widths, and clearances to obstructions will remain substandard. However, the project will still improve safety and, with the design exceptions in place, cost about a third as much.

What's Next

Because AASHTO has been responsible for, or at least been blamed for, so much of what of what we don't like about urban streets in this country, it seems fitting to end on a positive note from the AASHTO Bridging document.

> *The notion of designing a "high quality" low speed road is counterintuitive to many highway engineers, yet it is in many cases the appropriate solution.... Context-sensitive design in the urban environment often involves creating a safe roadway environment [by encouraging drivers] to operate at low speeds.*

The document then offers a qualified endorsement of traffic calming, something unimaginable five years ago.

Appendix A.3

Survey of Local Governments

The TPI team surveyed local governments to assess their experiences with DOT main street projects. Questionnaires were sent to the mayors of all 566 localities in New Jersey. Upon receiving written responses, the TPI team conducted follow-up phone calls with localities that provided ambiguous responses. The additional comments are reflected in the tables below.

	Count	Percentage
All surveys	142	100%
No state route	60	42%
State route	82	58%
State Routes	82	100%
No work	39	48%
Planned work	6	7%
Recent work	37	45%
Recent work	37	100%
Positive	19	51%
Mixed	9	24%
Negative	9	24%

Table A.3.1: Summary of Mayors Survey.

General Results

Survey results are summarized in Table A.3.1. One hundred forty-two (25%) localities responded to the survey. Of those, 60 (42%) have no state highways that function as main streets through their communities. This narrows the field considerably in terms of impacts of state highways on community life.

Of the 82 localities with state highways functioning as main streets, 39 (48%) report no work completed during the past five years and no work planned, further limiting the field. Of those reporting work, many have had only resurfacing projects, where the potential for conflict with local objectives is less than with reconstruction, widening, or realignment.

Of the 37 towns with recent DOT experience, 19 (51%) stated that the work generally was consistent with local objectives. Twenty-four percent stated the work was not consistent and the remaining 24 percent gave mixed reviews. In some cases, concerns arose when DOT failed to preserve or recreate main street character. These are the cases of greatest relevance to this project. In other cases, concerns arose for the opposite reason, the failure of DOT to widen roads, relieve congestion, or remove pedestrians and cyclists from the street environment to the degree desired locally. Overall the record is mixed, but with enough legitimate main street concerns to justify policy changes within DOT.

Specific Concerns

To illustrate how conflicts arise between communities and DOT, specific concerns reported in the mayor's survey are broken down by type in Table A.3.2. Included are 18 projects already completed as well as four projects in planning. Of the concerns reported, just over a third involve roadway design elements. In no case did localities have an issue with DOT geometric design standards. Where DOT actions most often conflicted with local objectives was in the failure to calm traffic, provide for pedestrians or cyclists, or beautify the street.

Town	Route	Locality's issue	State's position	Type of Concern (Design Element/ Other)
Bound Brook	28	Requested left-turn lane	No left turn lane	DE
		6-inch curbs	4-inch curbs	DE
Bridgeton	49	Requested reconstruction	Repave only	Other
Bridgewater	28	Overnight work hours	–	Other
Burlington	130	Requested trees & urban design elements	No trees or urban design elements	Other
Chester	206	Requested additional turn lane	No turn lane	DE
East Amwell	179	Thought that bypass built in 70's negated need for wider road through town	Built wider road	DE
		Requested pedestrian amenities	None built	Other
		Thought new, open road invites speeding, does not preserve community character nor control traffic.	Must build to standards	DE
		Asked that drainage issues be addressed	Not addressed	Other
		Requested traffic calming elements	None included	DE
		Old historic wall destroyed during construction	Wall since rebuilt	Other
Elmer	40 (planned)	Requested reconstruction	Repave only, will reconstruct soon	Other
Fredon	94	Drainage problems remain since two locations continue to hold water and regularly form ice in the winter	–	Other
Lambertville	29 (planned)	Wants 25 mph posted instead of 35 and 40 mph	–	Other
Mannington	45	Reconstruction time too long	–	Other
Maple Shade	73	Requested widened road	No widening	DE
Marlboro	9	Requested drainage issues be addressed	Insufficient resources	Other
		Requested 6-foot high anti-pedestrian fence	No fence	Other
Middlesex	28	Access to businesses limited during construction	–	Other
Morristown	124	Requested additional sidewalks	None built	Other
		Requested new drainage to coordinate with the project's next phase	No additional drainage	Other
		Requested trees	No trees	Other
Netcong	46/183 (planned)	Requested sidewalk ramps	No ramps	Other
		Wants to calm traffic and improve pedestrian conditions in area around to-be-removed traffic circle	–	DE
Princeton Borough	27, 206	Timing of work hurt businesses, night-time work kept residents awake	–	Other
Randolph	10	Requested retention of existing grass median	Installed concrete median	DE
		Requested preserving woodlands and sound buffering along roadside	Eliminated some woodlands to widen shoulder	Other
Ridgefield	1/9, 46, 63, 93	Requested cycle and pedestrian facilities	No cycle or pedestrian facilities	Other
		Did not see need for cycling facilities		Other
		Disagreed with on-street parking prohibition	Prohibited parking	DE
Rockaway Burrough	46	Requested widened road	No widening	DE
Seaside Park	35 (planned)	Concerned with pedestrian safety	–	Other
Vineland	47 (planned)	Concerned with pedestrian safety crossing widened road	–	DE
		Concerned for cyclists on new cycle lanes at freeway ramps	–	DE
Woodbury	45	Concerned with resurfacing around manholes	–	Other

Figure A.3.2: Table of specific issues.

Appendix A.4
Main Street Visual Preference Survey

The recommended policies and practices apply to main streets. But what is a main street? To zero in on the salient attributes of these special roadways, the TPI team developed a *Main Street Visual Preference Survey*. It consists of 50 centerline images of diverse roadways running through villages, towns, cities, and suburbs throughout the United States. It was distributed to the Technical Review Committee (TRC), and these experts were asked to:

1. Rate each street as a good or bad example of a main street (either actualized or potential), and
2. List the attribute(s) that makes the particular street a good or bad example.

The results confirmed our suspicion that main streets are distinguished not so much by geometric design elements as by roadside conditions and relative scale. Results also suggest that main streets appear in many different contexts, not just as traditional urban shopping streets.

Below are some of the best and worst examples of main streets, according to the TRC.

Good Examples

West Chester, Pennsylvania

Albany, New York

Bad Examples

Colorado Springs, Colorado

Berkeley, California

Attributes of Best and Worst

The most common descriptions of the highly rated images were:

- Street and buildings in correct proportions and scale,
- Low speed and volume,
- Pedestrian presence and pedestrian orientation,
- Interesting visually, good lighting, nice tree canopy,
- Vibrant commercial, buildings close to street,
- On-street parking available, and
- Nice gateway feature.

The most common descriptions of poorly rated images were:

- Too wide, too much asphalt,
- High speed,
- No pedestrians,
- Minimal streetscaping,
- Low density, no commercial/retail density, too many curb cuts,
- Typical auto-oriented suburban arterial, and
- Looks rural.

Quantifying "Main Streetness"

At some point, DOT will need to classify its urban highways with respect to context (main street or other), as it presently classifies them with respect to function (principal arterial, minor arterial, etc.). This will be necessary to implement the main street policies recommended herein, such as the use of Main Street Overlays. To assist DOT with this task, the TPI study team analyzed the ratings of street scenes by the TRC. First, a content analysis was performed on each slide, and the salient attributes of the streets and contexts were quantified. Then, average scores assigned the slides by the TRC were modeled in terms of these attributes using multiple regression analysis, with the attributes serving as independent variables.

Twenty-two attributes were quantified and tested for their explanatory power:

(1) Number of pedestrians visible.

(2) Number of travel lanes.

(3) On-street parking—1 if yes, 0 is no.

(4) Curb extensions—1 if yes, 0 if no.

(5) Marked crosswalks visible—1 if yes, 0 if no.

(6) Commercial uses abut—1 if yes, 0 if no.

(7) Mixed uses abut—1 if yes, 0 if no.

(8) Percent visible street frontage with trees.

(9) Percent visible street frontage with active uses (pedestrian generating uses).

(10) Sidewalk width in feet.

(11) Building setback in feet.

(12) Ratio of building height to width from building face to building face.

(13) Number of moving vehicles visible.

(14) Textured pavement visible—1 if yes, 0 if no.

(15) Median—1 if yes, 0 if no.

(16) Median width in feet.

(17) Travel lane width in feet.

(18) Uniform building heights—1 if yes, 0 if no.

(19) Buffer strip width in feet.

(20) Primarily historic buildings visible—1 if yes, 0 if no.

(21) Primarily small-scale buildings visible—1 if yes, 0 if no.

(22) One-way street—1 if yes, 0 if no.

Five attributes proved statistically significant in our "best-fit" regression equation: sidewalk width, percentage of frontage with active uses, percentage of frontage with street trees, building setback from the street, and number of travel lanes. All have the expected relationships to "main streetness"—the first four variables are positively related to slide scores, the fifth is negatively related. The variables collectively explain 79 percent of the variance in slide scores. All but one of these variables—number of travel lanes—measure some aspect of context, as opposed to an attribute of the street itself. Dropping this one variable, the resulting best-fit equation still explains 73 percent of the variance in slide scores. The equation takes the form:

SCORE = 2.22 + 0.0149*TREES + 0.0132*ACTIVE USES + 0.125*SIDEWALK – 0.0258*SETBACK

This equation, or a similar one estimated from a visual preference survey involving more and different respondents, could be used by DOT to identify urban highways as potential main streets. It would only be necessary to establish a threshold score for qualification as a main street, substitute values for individual highway segments into the equation, and see if the segments reach the qualifying level.

Discussion

Beyond the ratings and attributes, this survey generated two important ideas from the TRC. First, placing too much emphasis on traditional main streets would be a mistake. A traditional main street has historic character, is narrow, and is lined by small shops. New Jersey has few of these. There are certainly more state highways running through New Jersey's communities with few (if any) historic buildings, wider cross-sections, and mixed land uses. These routes may warrant special treatment, too.

The other important idea relates to the potential for retrofits. As stated in the questionnaire, the TPI team was looking not only for good examples of existing main streets, but also for streets that might be redesigned to function as main streets. From the survey results, context is all-important. It appears that streets with pedestrian-generating uses, small building setbacks, and similar attributes could be made to function as main streets if the paved widths were narrowed, sidewalks widened, medians added, trees planted, and other design changes were made.

Appendix A.5 Relevant Federal Laws and State Initiatives

by Michael King, Trefor Williams, and Reid Ewing

Adapted from "States Flexing Main Street Design," paper presented at the 2001 Annual Meeting, Transportation Research Board, Washington, D.C.

Design standards tailored to community objectives would not be possible without recent changes in federal and state laws and policies.

Relevant Federal Initiatives

Beginning with the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, and continuing with the National Highway System Act (NHS Act) of 1995 and Transportation Equity Act for the 21st Century Act (TEA-21) of 1998, the US Highway Code now allows, and even encourages, a certain amount of flexibility in highway design—except on the Interstate Highway System. Without federal historic preservation and environment protection laws, less impetus would exist at the state and local levels to exercise flexibility.

Transportation Laws

The specific laws providing flexibility in road design can be found in Section 109, Title 23 of the United States Code. ISTEA changed the law to allow the adoption of individual state standards for highways other than those on the National Highway System (NHS).

> (o) COMPLIANCE WITH STATE LAWS FOR NON-NHS PROJECTS—Projects (other than highway projects on the National Highway System) shall be designed, constructed, operated, and maintained in accordance with State laws, regulations, directives, safety standards, design standards, and construction standards.

The NHS Act added the provision that even highways on the NHS (except Interstate highways) can be designed to minimize adverse community impacts. Also, they can be designed giving due consideration to the needs of pedestrians and cyclists.

> (c) DESIGN CRITERIA FOR NATIONAL HIGHWAY SYSTEM—
>
> (1) IN GENERAL—A design for new construction, reconstruction, resurfacing (except for maintenance resurfacing), restoration, or rehabilitation of a highway on the National Highway System (other than a highway also on the Interstate System) may take into account, in addition to the criteria described in subsection (a)—
>
> > (A) the constructed and natural environment of the area;
> >
> > (B) the environmental, scenic, *aesthetic*, *historic*, *community*, and preservation impacts of the activity; and
> >
> > (C) access for other *modes* of transportation. [emphases added]

TEA-21 changed highway planning requirements. TEA-21's reference to "planned future traffic" permits designing for volumes according to a plan, as opposed to merely accepting more traffic as inevitable. The reference to the "needs of each locality" suggests coordinating highway projects with local objectives and local plans.

> (a) IN GENERAL—The Secretary shall ensure that the plans and specifications for each proposed highway project under this chapter provide for a facility that will—
>
> > (1) adequately serve the existing and *planned future traffic* of the highway in a manner that is conducive to safety, durability, and economy of maintenance; and
> >
> > (2) be designed and constructed in accordance with criteria best suited to accomplish the objectives described in paragraph (1) and to conform to the particular *needs of each locality*. [emphases added]

In addition to the flexibility provided in Section 109 of Title 23, Section 402 calls for each state to positively address speeding and attendant crashes. The language could be used to justify setting design speeds as low as posted speeds on main streets.

> (a) Each State shall have a highway safety program…designed to reduce traffic accidents and deaths, injuries, and property damage resulting therefrom. Such programs shall be in accordance with uniform guidelines [which] shall include programs
>
> > (1) to reduce injuries and deaths resulting from motor vehicles being driven in *excess of posted speed limits*. [emphasis added]

Historic Preservation Laws

Should a roadway project affect a property that is listed on or determined eligible for the National Register of Historic Places, the National Historic Preservation Act (NHPA) of 1966, as amended, requires an assessment of the magnitude of the effect. The NHPA then calls on the lead government agency to adopt measures to avoid, minimize, or mitigate any negative impact. Protected historic transportation resources include sites of significant events (e.g., road from Selma to Montgomery, Alabama), segments of important trading or travel routes (e.g., Route 66), and grand boulevards from the "City Beautiful" period (e.g., Lake Shore Drive in Chicago).

If there is an available avoidance alternative that is both reasonable and feasible, which solves the transportation problem and avoids the negative effect on the resource, Section 4(f) of the Department of Transportation Act of 1966 requires the selection of that alternative. If no avoidance alternative is available, the project must incorporate all possible design changes to minimize or mitigate harm to the affected property.

Innovative street designs may run afoul of historic preservation guidelines and standards if they substantially change the appearance or character of an historic resource, or if they substantially affect the relationship between the street and historic buildings along it. In New York State, for example, the State Historic Preservation Office (SHPO) has rejected curb extensions as inconsistent with the wide, straight streets of the pre-automobile era.

For an SHPO to have legal standing to intervene in such cases, its objections must be based on National Register documents describing why the resource is historic. Then, there must be a finding of sufficient negative impact to justify stopping a project or requiring major redesign or use of alternatives.

Environmental Laws

The National Environmental Policy Act (NEPA) of 1969, as amended, requires the lead government agency to prepare of an Environmental Impact Statement (EIS) or an Environmental Assessment (EA) when a federal action will have or could have a significant impact on the environment. Federal actions subject to this requirement include highway projects funded in part by FHWA. EISs, and to a lesser degree EAs, require consideration of alternatives to proposed actions; assessment of social, economic, and environmental impacts of proposed actions and alternatives; and a plan to mitigate adverse impacts of proposed actions.

Under FHWA regulations, certain types of federally funded highway projects normally require a full EIS, such as construction of multilane road on a new alignment. Other types normally qualify for categorical exclusions from the EIS/EA requirements, such as 3R (resurfacing, restoration, and rehabilitation) projects. And then there are the intermediate projects that may or may not significantly affect the environment. They normally receive an intermediate level of scrutiny via EAs. Whatever the mechanism, NEPA has been used to challenge and modify many federal highway projects, including some involving main streets. An example from our case studies is Isleta Boulevard in Albuquerque (see Appendix A.2).

Federal Technical Assistance Initiatives

Since passage of ISTEA, FHWA has generally supported flexibility in highway design and has sponsored various initiatives toward this end. The federal push effectively began in 1997 with the publication of *Flexibility in Highway Design*. This book encourages highway designers to look for flexibility within the existing guidelines by:

- ❑ Going to the lower end of geometric ranges in American Association of State Highway and Transportation Officials' (AASHTO's) *A Policy on Geometric Design of Highways and Streets* (the Green Book),
- ❑ Lowering design speeds,
- ❑ Reclassifying highways to a lower functional class,
- ❑ Maintaining highway geometry by undertaking 3R-type work,
- ❑ Using design exceptions where environmental consequences are great, and
- ❑ Developing alternative geometric standards for non-NHS roads, especially scenic roads.

Five states (Connecticut, Kentucky, Maryland, Minnesota, and Utah) are participating in a joint FHWA/AASHTO project to train engineers in context-sensitive design (CSD) under National Cooperative Highway Research Program (NCHRP) project 15-19. This is a mostly process-oriented initiative dealing with community involvement, "scope creep," and project management. The initiative began in 1998 with a final report due in 2001. Maryland and Minnesota have emerged as leaders, spurred on by their respective governors' efforts to control sprawl and promote "livability." Lessons learned from this NCHRP project and other state CSD training programs will be incorporated into an upcoming CSD training manual.

Under NCHRP project 20-17, the AASHTO Subcommittee on Design is trying to bridge a perceived gap between *Flexibility in Highway Design* and the AASHTO Green Book. Their guidance document is in final draft, and an advance copy was reviewed for this report. This "bridging" document delves into issues of process, geometric design, roadside safety, and tort liability. Most notably it questions some long held beliefs about design speed, traffic calming, stopping sight distance, and roadside clearance. For example, it states that the "…concept of a wide, object-free clear zone has little meaning in the urban environment…" This quote is illustrative of the direction that AASHTO is taking in the new era of context sensitivity.

TEA-21 instructed FHWA to work with professional groups such as AASHTO and the Institute of Transportation Engineers to ensure that pedestrians are fully integrated into the transportation system. This led to an NCHRP grant (project 20-07, task 105) to produce a pedestrian facility design guide. The draft guide has been submitted to AASHTO for its review, balloting, and publication, hopefully by 2002.

Some proposed guidelines currently under discussion include:

- Posted speed = design speed,
- Ten to eleven foot lane widths unless there is heavy cycle, truck, or bus traffic,
- Sixty-foot maximum unprotected pedestrian crossing distance,
- Use of *effective* turning radii at intersections,
- No *free-flow* right turns, and
- No *roll-type* curbs.

Relevant State Initiatives

Turning from the national to the state role, we find a significant number of state transportation agencies re-examining and changing the way they design and build roads. For the purposes of this study, we surveyed the three states adjoining New Jersey, states in the region with good examples of flexible highway design, states identified in various NCHRP and FHWA reports as leaders in flexible design, and other states known to have progressive DOTs. Six states (Colorado, Idaho, Maine, Rhode Island, South Carolina, Vermont) were identified in *Flexibility in Highway Design* as in the process of revising their roadway design standards pursuant to ISTEA. Three went ahead and did it. Most New England states have scenic or historic preservation laws that affect reconstruction and 3R work. Other states have incorporated flexible policies into their design manuals or practices. Relevant state initiatives are summarized below.

New Standards Adopted and Applicable to Main Streets	
Connecticut	New standards apply to intersection sight distance, design year projections, parking lane width, and allowable grade on non-NHS routes.
Idaho	New standards apply to design speed and design year projections on non-NHS routes
Vermont	New standards apply to design speed, level of service, travel lane width, stopping sight distance, horizontal curve, and allowable grade on non-NHS routes. New standards adopted for rural roads.
Maine	New standards apply to level of service, cross section, and guardrails on secondary roads.
State Standards Discarded in Favor of AASHTO Guidelines	
Maryland	State now relies solely on Green Book.
Policies Adopted and Applicable to Main Streets	
Delaware	New manual establishes guidelines for traffic calming on state roads.
Oregon	Special Transportation Area designation allows for alternate performance standards.
Washington	Livable Communities Initiative establishes performance measures by which projects in towns will be judged.
Scenic/Historic Laws Applied to Main Streets	
Connecticut	Scenic Byway Program limits cross-section width of highway projects on scenic roads.
Rhode Island	Scenic Roadways Board limits projects that would affect the characteristics of a scenic road.
Other	
Maine	Sensible Transportation Policy Act limits new highway capacity in communities.
Maryland	Thinking Beyond the Pavement initiative changes agency approach to planning and design.
New York	Environment Initiative incorporates CSD into design process.

Table A.5.1: Overview of state standards and policies.

Connecticut

The state of Connecticut has passed two laws authorizing and directing the state Department of Transportation (ConnDOT) to design roads more appropriate to local conditions. In 1998, the Connecticut General Assembly passed *An Act Concerning Alternative Design Standards for Roads & Bridges* that instructed ConnDOT to:

> *…establish alternative design standards for bridges,…roads and streets [and in doing so] solicit and consider the views of chief elected officials…, the Connecticut Trust for Historic Preservation, regional councils of governments, the Connecticut Council on the Arts, the Federal Highway Administration, and the Rural Development Council.*

At the time, ConnDOT was in the process of updating its design manual. This act forced the completion by a specific date. The revised standards generally are within Green Book values, but deviate in a few instances.

Since 1989, Connecticut has been designating state routes as scenic if they, among other criteria, abut "land on which is located an historic building or structure" as designated in the national or state historic places registry. While only two roads have thus far received designation, the Merritt Parkway and State Route 169, the program is of interest for its stand on pavement width. When a designated scenic road is to be *improved* or *maintained*, ConnDOT can only extend the width of the pavement 12 inches beyond the existing shoulder. This means that the footprint of the road must essentially remain intact, and that horizontal curves may not be straightened nor lanes widened unless the existing shoulder is narrowed.

State Route 169 was designated scenic in 1991, 190 years after being incorporated as the Norwich and Woodstock Turnpike. The designated portion is 32 miles long and travels through many small towns in the eastern part of the state including Brooklyn with its two historic districts, and Woodstock, with its town commons. According to the law "any alteration of a scenic road shall maintain the character of such road…if practical." Coupled with the restriction on road widening, the de facto standard for this road precludes any large-scale improvement in level of service or upgrade of functional class.

Delaware

The state of Delaware is one of only five states that operate and maintain local streets normally under county or city control. All told, 88 percent of the streets and highways in Delaware are under state control. Accordingly, the state Department of Transportation (DelDOT) has taken an active role in developing policies to make roadways from minor arterial on down the functional hierarchy more context sensitive.

DelDOT has adopted new "skinny" subdivision street standards and a *Traffic Calming Design Manual*, the first of its kind in the nation. The manual has been taken through the rule making process and incorporated into the state *Road Design Manual*. It is viewed as consistent with and supportive of the Statewide Long-Range Transportation Plan, whose goal is to maintain and improve mobility and access, while preserving communities and improving the quality of life. Traffic calming is a means toward the latter ends.

The manual does not mandate traffic calming. Rather, if traffic calming is initiated by residents, local officials, or others, the Department will follow the guidelines contained therein with rare exceptions. Even with standardization of traffic calming in Delaware, design flexibility will remain. The manual sets forth guidelines, rather than rigid standards. The Department reserves the right to deviate from these guidelines in special cases.

Florida

Design standards for roadway construction used by the Florida Department of Transportation (FDOT) generally exceed Green Book values. Yet, FDOT is still concerned about community livability. Toward that end, a new policy directive, *Transportation Design for Livable Communities*, is being incorporated into the roadway design manual.

What makes the directive interesting are the specific treatments called for, or at least allowed, on urban sections of the State Highway System (SHS) and off the SHS. While not constituting a standard, this addition to the design manual could further the cause of flexibility and CSD.

Maine

In 1994 the Maine state legislature passed the Sensible Transportation Policy Act, which directs the state Department of Transportation to give preference to alternatives that will not increase a highway's capacity through a community. The law applies to *significant* projects, those that add capacity, and projects of *substantial* community interest.

General Techniques	SHS-urban	Non-SHS
Landscaping	Allowable	Allowable
Sidewalks Or Wider Sidewalks	Yes	Allowable
Street Furniture	Allowable	Allowable
Bike Lanes	Allowable	Allowable
Alternate Paving	Allowable	Allowable
Pedestrian Signals, Mid-block Crossings, Median Refuge Areas	Yes	Allowable
Techniques To Reduce Speed And/Or Volume		
Speed Humps	No	Allowable
On-street Parking	Allowable	Allowable
Curb Extensions	Allowable	Allowable
Street Narrowings (Chokers)	Allowable	Allowable
"Compact" Intersections	Yes	Yes
Roundabouts	Allowable	Allowable
Chicanes	Allowable	Allowable
Street Closing Or Route Relocation	Allowable	Allowable
Techniques To Support Shift Between Modes		
"Pedestrian-friendly" Crosswalk Design	Yes	Allowable
Mid-block Pedestrian Signals	Allowable	Allowable
Illuminated Pedestrian Crossings At Intersection	Allowable	Allowable
Bike Lanes/Shoulders	Yes	Yes
Area-wide Techniques		
Traffic Calming	Allowable	Allowable
20 Mph Posted Speed	No	Allowable
Limit Lanes	Allowable	Allowable
Avoid Traffic Signals	Yes	Yes
Greenway Corridors	Yes	Yes

Table A.5.2: Techniques applicable to main streets in Florida

Maryland

Maryland's "Thinking Beyond the Pavement" initiative is an outgrowth of the governor's Smart Growth program. The initiative is part of a larger NCHRP project (see NCHRP 15-19 above). A series of stakeholder charrettes, internal awareness training sessions, and implementation workshops were held in 1999. Action teams were then established to investigate further and produce "how-to change" reports.

While Maryland has no statute or rule mandating it, the Maryland State Highway Administration (MSHA) has emerged as a leader in flexible highway design. In 1998, MSHA's Deputy Chief Engineer wrote a memo declaring that the state's highway design manual was no longer to be used. He had found that the templates in the manual were generally oversized (especially stopping sight distance and vertical curves) and stymied creativity among engineers. The agency was losing legal challenges when an element was below the state standard, but above the Green Book minimum. Now the agency relies exclusively on the Green Book, and MSHA design engineers reportedly enjoy the challenge of designing roads rather than applying templates. As more national experience and research become available, MSHA plans to experiment with designs below AASHTO minimums in traffic-calmed settings.

Along with the change in geometric standards, policies have been reworked. MSHA no longer differentiates between reconstruction and 3R work on existing roads, and has a policy of leaving cross-sections alone unless there is a documented crash problem that could be fixed through reconstruction.

New York

In response to the Governor's 1999 Environmental Initiative (EI), the New York State Department of Transportation (NYSDOT) has sought to establish an environmental ethic within the department, advance state and federal environmental policies, and strengthen relationships with environmental agencies and the public.

As with most DOTs, strict regulatory compliance had long been a part of the culture at the NYS-DOT. While this reactive approach did reduce unnecessary environmental damage, and at times gained grudging regulatory agency cooperation, it was not a satisfying way of doing the people's work.

Under the EI, environmental enhancements are provided as part of capital projects, including:

- Street ambience enhancements (benches, paving, period lighting),
- Landscape and streetscape plantings
- Bikeways, paths, routes and greenways,
- Improved pedestrian facilities and crossings, and
- Wetland restoration.

Design manuals and procedures are being updated to incorporate this and other initiatives. The Design Division is conducting staff workshops on CSD, and has instituted an Excellence in Engineering Award to celebrate projects that exemplify CSD.

Oregon

In 1999, as a complement to its highway design manual, the Oregon Department of Transportation (ODOT) and the Oregon Department of Land Conservation and Development published *Main Street…When a Highway Runs Through It…*. In doing so, these agencies sought to bring a "peaceful coexistence to the dual personas of downtown and highway." The following unconventional performance measures were proposed to assess how well a highway project supported downtown or main street functions:

- Target (lower) speeds met,
- Smooth traffic flow (less delay at intersections), and

- Improved comfort in crossing the highway (less pedestrian delay, less turning delay, reduction in crash frequency and severity).

Perhaps the most significant Oregon innovation is the Special Transportation Area (STA) designation. Established in the *Oregon Highway Plan*, this designation allows ODOT and local governments to jointly recognize special roadways where the interests of local residents and businesses are weighed against the interests of through traffic. With STA designation comes greater flexibility in roadway geometrics and performance standards, both of which can be tailored to a particular street.

STA-designated main streets may include:

- Signals synchronized for low speed,
- Conversion to *urban* cross-section (with curb & gutter),
- On-street (parallel) parking with curb extensions,
- Four to three lane conversions (up to 18,000 ADT),
- Shared vehicle/bicycle lanes at speeds of 25 mph or less,
- Medians or refuge islands (minimum eight feet wide),
- Modern roundabouts,
- Intersections aligned at 90 degrees,
- Tightened or extended corners,
- Marked (high-visibility) crosswalks, and
- Gateway treatments at transitions from open highway to downtown.

STA-designated main streets typically exclude:

- Free right-turn lanes,
- Left-turn stacking lanes,
- Speed-change lanes, and
- Large corner radii.

A significant flaw in the STA program is that historic towns with established main streets do not derive much benefit from the designation, and the process is a significant bureaucratic burden. Meanwhile, suburban communities have sought STA designation for streets that are clearly not main streets. For example, one town attempted to designate a freeway interchange and others have designated suburban strips.

Rhode Island

The *Scenic Roadways Design Standards and Scenic Roadways Design Policy*, proposed in 1996, established new standards for design speed, lane width, sidewalk and border widths, and bridges on scenic routes in Rhode Island. The first test case was Ministerial Road in South Kingston, where it was found that the new standards would not preserve the road as desired. Consequently, the new standards were never officially adopted.

However, long before the effort to develop new design standards, the Rhode Island Scenic Roadways Board was established to:

> *...create & preserve rustic and scenic highways for vehicle, bicycle and pedestrian travel... [and to protect and preserve culture & trees, et. al. by] establishing protective standards of scenic highway design, speed, maintenance...*

Regarding construction, repair, or alteration of scenic roadways, the Board has adopted rules limiting changes in grade, vegetation (trees), curb lines, or and anything else that affects the scenic qualities of a road. The state Department of Transportation or municipalities may nominate any road over which they have control for scenic designation. Six highways have been designated so far, with a seventh to be voted on soon. None of the first six are main streets, but the seventh, State Route 114, runs through the heart of Bristol's downtown Historic District as Hope Street.

Hope Street is characterized by unbroken *allees* of mature Linden trees growing in large green buffer zones. It has sidewalks set far back from the curb, and several historic buildings and stone walls along it. The broad right-of-way is part of the town plan laid out in 1680.

Vermont

Over the past ten years, the Vermont Agency of Transportation (VAOT) has undertaken three related flexible design initiatives. Two were procedural: establishment of a Project Definition Team to settle conflicts in the planning, scoping, and project development, before projects are engineered; and reorganization of the agency to a project manager-based system. The third initiative was the development of new design standards for non-NHS routes. Vermont's new design standards were an outgrowth of the long-range planning process required by ISTEA. As part of that process, VAOT found that roads built using the AASHTO Green Book guidelines were sometimes out of context and inconsistent with community values; many projects required design exceptions or were scuttled due to community opposition.

In response, the Vermont Legislature ordered VAOT to develop standards more appropriate to Vermont. The new standards relate to design speed, LOS, travel lane width, clear zone, stopping sight distance, horizontal curvature, and grade. Because Vermont is the only state to largely rewrite its design standards pursuant to ISTEA, it is instructive to consider the timeline. It took five years to get agreement on sub-AASHTO standards.

Two items of note have followed Vermont's new roadway standards. The first is an intergovernmental agreement with FHWA giving VAOT the power to grant its own design exceptions on all highways except Interstates. While state standards for NHS routes are within Green Book guidelines, having the authority to grant design exceptions has caused VAOT to be particularly flexible and responsive.

The second concerns the classification of urban and rural roadways. The Green Book adopts the census definition of "urban place." Many towns in Vermont have smaller populations, but are nonetheless built up. VAOT has taken the position that a road's classification should be based on the surrounding built form, not population or population density. By changing the classification from rural to urban, the agency has greater flexibility with design elements such as roadside clearance, curbs, and shoulder width.

Washington

The current Washington State Transportation Plan calls for "Livable Communities." What that entails is not defined. To address this shortcoming, the Washington State Transportation Commission recently asked a statewide working group to draft recommendations. The group consisted of representatives from the Washington Department of Transportation (WSDOT), environmental advocates, mayors, the National Highway Traffic Safety Administration, transit agencies, and others.

The group arrived at a series of strategies to achieve livability, some of which affect main street design:

- ❑ Preserve existing corridors, both urban & rural,
- ❑ Be flexible in design standards and procedures,
- ❑ Define community values during planning and design,
- ❑ Enhance scenic views, neighborhoods, and historic districts, and
- ❑ Provide focal points along roadways—such as plazas.

To ensure that these strategies are carried out by WSDOT, the working group recommended that the agency:

- ❑ Survey communities every two years to assess their level of satisfaction with projects,
- ❑ Start project outreach and coordination four to six years prior to construction, and

- ❑ Seek alternative funding sources for livable community projects.

The last point is especially pertinent, for funding always influences an agency's ability to respond to community needs. WSDOT wants its livability initiative to be successful, yet strategic and appropriate. To that end the Livable Communities Initiative will provide early notification about projects to communities, help them develop a livable community plan, and work with them to find additional funding for amenities.

References

1. *Flexibility in Highway Design*, FHWA, 1997.

2. *Context Sensitive Design for Integrating Highway and Street Projects with Communities and the Environment*. Chapter 1: Project Development Process. NCHRP 20-17-114, final draft, Feb. 2000.

3. *AASHTO Guide for the Planning, Design and Operation of Pedestrian Facilities*. NCHRP 20-07-105, unreleased.

4. Connecticut Public Act # 98-118, revised 1998.

5. *Traffic Calming Design Manual*. Delaware Department of Transportation, 2000.

6. *Transportation Design for Livable Communities*. FL-DOT Directive 525-030-301-a, 1999.

7. Sensible Transportation Policy Act. Maine Rev. Stat. Ann. Title 23, Section 73, revised 1994.

8. *Thinking Beyond the Pavement*. MSHA, undated.

9. "NYS-DOT Environmental Initiative Guidelines and Procedures for a New Paradigm." Gary McVoy, et al, NY-DOT Environmental Analysis Bureau, undated.

10. *Main Street…When a Highway Runs Through It: A Handbook for Oregon Communities*. Oregon Departments of Transportation and Land Conservation & Development, 1999.

11. *Rules of the Rhode Island Scenic Roadways Board*, revised 1999.

12. "Development of Vermont's State Standards for Roadway Design", Bruce Bender, VT-AOT, undated.

13. "Livable Communities Initiative." WA-DOT, undated.

Appendix A.6

Summary of Design Exceptions 1997-1999

For this project, the TPI team reviewed eighty-one design exception reports filed between 1997 and 1999. Of the eighty-one, fifty reports were found to have given some consideration to community, historical, or environmental factors.

- Several projects required design exceptions to keep 3R projects from becoming full reconstruction projects, with greater attendant community impacts.
- Several projects in village or suburban settings required design exceptions, in part, to lessen community, historic, or environmental impacts.
- Several bridge replacement projects required design exceptions, in part, to lessen community, historic, or environmental impacts.

This record is less impressive than it at first appears. Of the eighty-one design exceptions, eighty appear to be driven primarily by cost savings. In only one case, involving historic preservation in Oxford, New Jersey, was the driving force context savings. In other cases, community, historic, or environmental factors appeared to be somewhat incidental to the design exception.

The 3R projects involved an odd catch-22. The typical 3R project fails to qualify for a programmatic design exception, and therefore requires lane widening, shoulder widening, or some other improvement in cross section or alignment to meet current design standards. With such an improvement, the project is automatically reclassified as a full reconstruction project. So the design engineer seeks one or more regular design exceptions to keep the 3R project what it was always intended to be, a 3R project.

CSDE	Number of Projects
Shoulder Width	20
Vertical Curve SSD	16
Superelevation	13
Horizontal Curve Radius	12
Vertical Clearance	7
Auxiliary Lane Length	6
Travel Lane Width	5
Bridge Width	4
Horizontal Curve SSD	3
Intersection Sight Distance	2
Grade	1
Cross Slope	0

Table A.6.1: Type and frequency of design exceptions.

The bridge projects involve such substantial outlays in most cases that construction costs overwhelm all other factors. In fact, bridges themselves seldom have direct impacts on the communities they serve, as they span water, other highways, rail lines, etc. It is only through their relationship to adjacent highways, and the need for smooth transitions from one to the other, that bridges may have such an impact. In the typical case, a substandard shoulder or lane width is approved on a bridge to avoid the expense of widening to the full width of the adjacent roadway.

For the fifty projects giving some consideration to community, historic, or environmental factors, Table A.6.1 shows the type and frequency of design exceptions approved. The table after that provides details on each project requiring design exceptions.

Note the preponderance of cases with one of four Controlling Substandard Design Elements (CSDEs): vertical stopping sight distance, horizontal curve radius, shoulder width, or superelevation. These particular design elements are ordinarily not a problem on main streets, with the possible exception of substandard width of shoulders which, arguably, should not be required on main streets anyway. That these particular CSDEs are so overrepresented in design exception cases, and other CSDEs such as substandard lane width are so under-represented, indicates that design exceptions are either not required or not sought very often in main street projects.

Washington Avenue Bridge	Somerset	No	Bridge Replacement	Rural Minor Collector	Shoulder Width	X	X	X		Historic District, SHPO involve-ment
Mountain	Somerset	No	Bridge Replacement	Rural Undivided Local Road	Shoulder Width	X	X	X		Consider-ation of historic structures
Route 29 at Parkside Av.	Mercer	Yes	Reconstruction	Urban Freeway	Vertical SSD, Horizontal SSD, Superelevation, Horizontal Curve Radius, Vertical Clearance, Auxiliary Lane Length	X	X			
Greentree Road, Sec. 2	Glouchester	No	Reconstruction		Superelevation	X	X			
Rt 183 Sec 1B	Sussex	No	Reconstruction	Urban Undivided Principal Arterial	Curve Radius, Intersection Sight Distance	X	X		X	
Route 47 (Section 9)	Gloucester	No	Reconstruction	Rural Principal Arterial	Shoulder Width	X	X	X	X	Design exception to minimize impact on building eligible for National Register for Historic Places
Route 47 Section 5D & 6B	Cumberland & Cape May	No	Resurfacing	Rural	Shoulder Width, Horizontal Curve Radius	X			X	
Maple Ave. Bridge over NJ Transit	Camden	No	Reconstruction	Minor Urban Arterial	Vertical Clearance over RR	X	X			
Kinnaman Avenue Bridge	Warren	No	Bridge Replacement	Undivided Rural Major Collector	Sag VCCrest VC	X	X	X	X	
Sussex County Bridge J-05	Sussex	No	Bridge Replacement	Undivided Rural Road	Vertical SSD	X	X			

Table A.6.2: Details on Design Exception Cases 1997-1999

Project	County	NHS	Project Type	Highway Class	CSDEs	Cost	Land Use	Hist	Env	Notes
Sussex County Bridge O-08	Sussex	No	Bridge Replacement	Local Rural Road	Vertical SSD, Horizontal Curve Radius, Intersection Sight Distance	X	X	X		
Maple Grange Road Bridge	Sussex	No	Bridge Replacement	Rural	Lane Width, Shoulder Width, Superelevation	X			X	
Route 563, Green Bank Road Bridge	Sussex	No	Bridge Replacement	Rural Major Collector	Bridge Width, Lane Width, Shoulder Width	X		X		
Route 206 & 15 Ross's Corner Road	Sussex	Yes	Reconstruction	Undivided Rural Principal Arterial	Bridge Width, Vertical SSD, Shoulder Width	X	X		X	
Belford Project	Monmouth	No	Bridge Replacement	Urban	Vertical SSD	X	X		X	
Tuckahoe Road (CR 631)	Cape May	No	Resurfacing	Rural	Lane Width, Shoulder Width	X	X			
Ocean Heights Av. (CR 559 Alt.) Phase 1	Atlantic	No	Resurfacing	Urban Minor Arterial	Shoulder Width, Vertical SSD	X	X		X	
Ocean Heights Av. (CR 559 Alt) Phase 2	Atlantic	No	Resurfacing	Urban Minor Arterial	Shoulder Width	X	X			
Zion Road (CR 615)	Atlantic	No	Resurfacing	Rural	Shoulder Width	X	X		X	
Straight St. Bridge	Passaic	No	Bridge Replacement	Urban	Horizontal Curve Radius	X	X	X		
Route 7, Section 1AG	Essex/ Hudson	No	Bridge Replacement	Urban Principal Arterial	Superelevation, Vertical SSD, Shoulder Width	X	X	X		
Old Texas Road Bridge	Middlesex	No	Bridge Replacement	Minor Arterial	Superelevation	X			X	
Ocean Drive, Ocean City	Cape May/ Atlantic	No	Bridge Replacement	Minor Urban Arterial	Horizontal Curve Radius	X			X	
Mt. Pleasant Place Bridge	Essex	No	Bridge Replacement	Urban Local Road	Bridge Width, Vertical SSD	X	X			
Route 88 @ Clifton Ave.	Ocean	No	Reconstruction	Urban Minor Arterial	Lane Width	X	X			Widths minimized to reduce impacts on new brick pavement
Route 15, Section 4C	Sussex	No	Reconstruction	Rural Principal Arterial	Horizontal Curve Radius, Grade, Vertical SSD	X	X			

Table A.6.2: Details on Design Exception Cases 1997-1999

Route 1&9 (27) Ridge-field Circle Elimination	Bergen	Yes	New Construction/ Reconstruction	Urban	Horizontal Curve Radius, Shoulder Width	X	X			CBD area.
Route 31 Sections 6B & 7E	Hunterdon	Yes	New Construction/ Reconstruction	Rural Principal Arterial	Horizontal SSD	X	X		X	
Black River Road Bridge	Somerset	No	Bridge Replacement	Rural	Superelevation	X	X	X	X	
Route 71 @ Wall Street	Monmouth	No	Reconstruction	Urban Minor Arterial	Shoulder Width	X	X			
Route 202, Bernards-ville	Somerset	No	Reconstruction	Urban Minor Arterial	Vertical SSD, Superelevation	X	X			Design exceptions avoided need to reconstruct driveways
Route 166 Boroughs of Beech-wood & S. Tom's River	Ocean	No	Resurfacing	Urban	Shoulder Width, Lane Width	X	X			Tom's River CBD area Design exceptions avoided need for extensive reconstruc-tion and removal of existing trees
Route 124 Section 1 Boroughs of Madison & Chatham	Morris	No	Resurfacing	Urban	Horizontal Curve Radius, Vertical SSD, Vertical Clearance, Bridge Width	X	X			Design exceptions to minimize impacts on Madison CBD
Route 23 Section 7D & Route 94 Section 8C	Sussex	No	Reconstruction	Rural Principal Arterial	Vertical SSD, Superelevation	X	X			
U.S. Route 202/206	Somerset	No	Reconstruction	Rural	Curve Radius at Jughandle, Auxiliary Lane Length	X		X		
Route 9, Sec 25K & 1F, Borough of Sayreville	Middlesex	No	Bridge Replacement	Urban Principal Arterial	Horizontal Curve Radius	X	X			
Interstate 95/Route 31 Interchange	Mercer	Yes	Reconstruction	Interstate/ Urban Principal Arterial	Vertical SSD, Auxiliary Lane Length	X	X	X	X	

Table A.6.2: Details on Design Exception Cases 1997-1999

Project	County	NHS	Project Type	Highway Class	CSDEs	Cost	Land Use	Hist	Env	Notes
Vincentown-Retreat Road	Burlington	No	Bridge Replacement	Rural	Superelevation	X	X		X	To provide conforming super-elevation would increase impervious cover, making Pinelands permit more difficult to obtain
Route 41, Section 1A and 2A	Gloucester	No	Reconstruction	Urban Minor Arterial	Shoulder Width, Vertical Clearance	X	X		X	
Route 35, Section 12T, Perth Amboy	Middlesex	Yes	Reconstruction/ Bridge Replacement	Urban Principal Arterial	Vertical SSD	X	X			
Route 9, Section 23E	Monmouth	Yes	Reconstruction	Urban Principal Arterial	Curve Radius, Vertical SSD	X	X			
I-80 Sec 20	Bergen	Yes	Rehabilitation	Freeway Principal Arterial	Shoulder Width, Vertical Clearance	X	X			
Route 10 Section 4L	Morris	Yes	Reconstruction	Minor Arterial	Superelevation, Vertical SSD	X	X			Super-elevation design exception required to minimize impact on strip mall driveway
Route 47 Section 1C, Rte 9 KP 11.005 to KP 11.716	Cape May	No	Reconstruction	Rural Principal Arterial/ Rural Minor Arterial	Shoulder Width, Vertical Clearance, Superelevation	X	X			
Route 28, Section 3	Somerset	No	Reconstruction	Urban Principal Arterial	Shoulder Width, Auxiliary Lane Length, Curve Radius	X	X			
Route 9&70 Tri City Plaza	Ocean	No	Reconstruction	Urban Principal Arterial	Auxiliary Lane Length	X	X			
Route 4 Sec 2AE, Rte 17 Section 2P&3G	Bergen	Yes	Reconstruction	Urban Principal Arterial	Horizontal Curve Radius, Horizontal SSD, Auxiliary Lane Length, Superelevation	X	X			

Table A.6.2: Details on Design Exception Cases 1997-1999

Project	County	NHS	Project Type	Highway Class	CSDEs	Cost	Use	Hist	Env	Notes
Route U.S. 1, Section 6T, Route US 130, Section 16B, Route 171, Section 1B	Middlesex	Yes	Reconstruction	Urban Principal Arterial	Vertical Clearance, Shoulder Width	X	X			
Route 17 Section 3H, 5AE	Bergen	Yes	Reconstruction	Urban Principal Arterial	Horizontal Curve Radius, Superelevation	X	X			
Route 17(3)	Bergen	Yes	Reconstruction	Urban Principal Arterial	Horizontal Curve Radius	X	X			

Table A.6.2: Details on Design Exception Cases 1997-1999

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