The *Smart Transportation Guidebook: Planning and Designing Highways and Streets that Support Sustainable and Livable Communities*

SPONSORED BY THE NEW JERSEY DEPARTMENT OF TRANSPORTATION AND THE PENNSYLVANIA DEPARTMENT OF TRANSPORTATION, THE *SMART TRANSPORTATION GUIDEBOOK: PLANNING AND DESIGNING HIGHWAYS AND STREETS THAT SUPPORT SUSTAINABLE AND LIVABLE COMMUNITIES* IS THE LATEST EXAMPLE OF A CONTEXT-SENSITIVE ROADWAY DESIGN PRACTICE.

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INTRODUCTION

In the last 10 years, the Federal Highway Administration (FHWA), the Institute of Transportation Engineers (ITE), other professional organizations and state departments of transportation have encouraged roadway design that is sensitive to the built and natural environment. A variety of terms, such as flexible highway design, context-sensitive design (CSD) and context-sensitive solutions (CSS), have arisen to describe this school of roadway design. Texts such as *An ITE Proposed Recommended Practice*: *Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities* showcase these practices.

The *Smart Transportation Guidebook: Planning and Designing Highways and Streets that Support Sustainable and Livable Communities* is the latest example of a context-sensitive roadway design practice (see Figure 1). The guidebook is sponsored by the New Jersey Department of Transportation (NJDOT) and the Pennsylvania Department of Transportation (PennDOT) and was overseen by the Delaware Valley Regional Planning Commission, the metropolitan planning organization for the greater Philadelphia, PA, USA, area, which encompasses counties in both New Jersey and Pennsylvania. FHWA supported this initiative through the participation of its New Jersey and Pennsylvania divisions. The guidebook has been awarded the 2008 FHWA Transportation Planning Excellence Award.

In some respects, the guidebook represents the second generation of context-sensitive roadway design practice. The first generation of guidebooks, exemplified by FHWA's *Flexibility in Highway Design* (1997), urged transportation professionals to take advantage of the flexibility found in the American Association of State Highway and Transportation Officials' (AASHTO) Green Book (*A Policy on Geometric Design of Highways and Streets*).

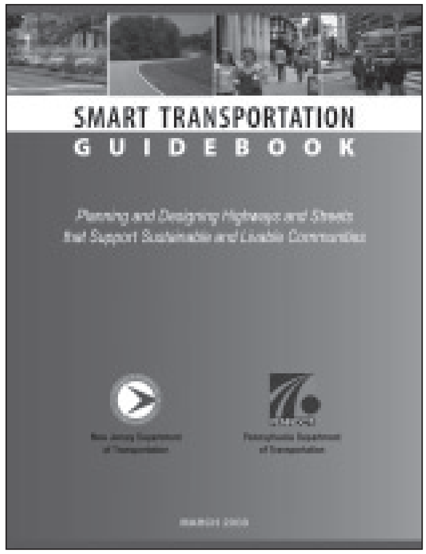

Figure 1. The *Smart Transportation Guidebook: Planning and Designing Highways and Streets that Support Sustainable and Livable Communities.*

Many states released context-sensitive manuals stressing the importance of community involvement and project designs that fit within the community. However, these states typically had not recommended new ranges of roadway design values to better correspond with different land use types. These practices can be found in texts such as ITE's *Context Sensitive Solutions*, the most comprehensive work available on CSD; several state design manuals that have been revised to reflect context-sensitive principles, such as the *Massachusetts*

Highway Design Manual (2006); and now, the *Smart Transportation Guidebook.*

This feature summarizes the guidebook's approach in the following areas:

- purpose and principles;
- process;
- organizing framework; and
- roadway and roadside design values.

Major tenets of context-sensitive road design are discussed, along with the reasons the project team chose a certain approach.

PURPOSE AND PRINCIPLES

The purpose of the book is to provide guidance to those with roles in planning and designing context-sensitive roadways that support livable communities. The smart transportation principles are equally applicable to urban, suburban and rural areas. The ultimate goal is to create transportation facilities that are safe and affordable, responsive to the needs of all users and supportive of community planning goals. Design values are recommended for roadway classes from principal arterials through local streets.

Within the guidebook, the term "smart transportation" embodies six principles:

1. *Tailor solutions to the context*. The different aspects of a project's context—financial, community, land use, transportation and environmental—determine the design of the solution. Within the guidebook, *land use* is the most prominent context, because that context steers selection of design values for roadway and roadside elements as well as widely varying decisions such as the spacing of traffic signals and spacing of bus stops. However, two contexts provide the backdrop to all transportation projects. The *financial context* is an important reality, given the constrained budgets within both states. Transportation solutions that offer a high value-to-price ratio should be considered, even if they do not meet 100 percent of all identified needs. The *transportation context* refers to the role of the roadway within the overall network—a key smart transportation theme. Designers have more flexibility to design roadways within well-connected networks, which offer greater travel options to motorists, pedestrians and bicyclists alike.
2. *Tailor the approach*. Although the basic steps might remain the same from project to project, the process should be customized to better fit the unique needs on each project. Everything from community involvement techniques to project performance measures can vary.
3. *Plan all projects in collaboration with the community.* An effective partnership between state and local governments extends beyond regular meetings and offering the community greater input into project design. Rather than simply minimizing impact, a good roadway can complement vital community planning goals. Further, the community assumes a vital role in the ability of the roadway to meet future needs. By controlling sprawl and encouraging development of a well-connected street network, the municipality can help manage traffic growth on major roadways, extending the life of the state investment.
4. *Plan for alternative transportation modes*. Whether by installing specific facilities (bike lanes or sidewalks) or by considering the impact on other modes (In an area with heavy pedestrian use, is adding an intersection turn lane worth longer pedestrian crossings?) the needs of pedestrians, bicyclists and transit users should be addressed in all projects.
5. *Use sound professional judgment*. Less emphasis should be placed on achieving the "desirable" roadway cross-section for a particular roadway type; more emphasis should be placed on assembling different roadway elements in a manner that addresses need while fitting within the context.
6. *Scale the solution to the size of the problem*. Especially given constrained transportation budgets in both states, projects should have a clear focus on the problem at hand. As one example, design engineers in both states described how substandard horizontal curves on bridge approaches were regularly straightened out on past bridge replacement projects. Project teams are now making greater use of crash data to determine if a safety problem actually exists at the site. If not, a substandard curve may be left alone. In so doing, the speeds of motorists approaching the bridge will be tempered, reducing the need for a larger replacement structure.

PROCESS

It has long been recognized that CSS is as much about process as outcome; FHWA defines CSS as a "collaborative, interdisciplinary approach that involves all stakeholders." Those same values are noted in the guidebook, along with guidance intended to change the way that problems are defined, opening the door to a broader range of possible solutions and performance measures.

This change in approach is critical to a context-sensitive outcome. If project goals are defined in a manner similar to projects in the past, a study team will have limited options even if it has a wider palette of design options.

To use a common example, corridor studies may require a minimum level of service of C or D for all signalized intersections along a study corridor. If, however, the goal is presented as managing the time needed to go from point A to point B, more solutions may present themselves. The inclusion of performance measures such as corridor travel times, safety improvements, safe pedestrian crossings and cost per trip can be considered on major projects.

ORGANIZING FRAMEWORK

The selection of roadway and roadside design values for a context-sensitive roadway is based upon the organizing framework of land use context and roadway type.

Land Use Context

Seven land use contexts were identified for the guidebook. Similar to the "Transect" system for classifying land uses popularized by Duany Plater-Zyberk and used in ITE's *Context Sensitive Solutions*,

	Rural	Suburban Neighborhood	Suburban Corridor	Suburban Center	Town/Village Neighborhood	Town Center	Urban Core
Density Units	1 DU/20 ac	1 DU/ac - 8 DU/ac	2 - 30 DU/ac	3 - 20 DU/ac	4 - 30 DU/ac	8 - 50 DU/ac	16 - 75 DU/ac
Building Coverage	NA	< 20%	20% - 35%	35% - 45%	35% - 50%	50% - 70%	70% - 100%
Lot Size/Area	20 acres	5,000 - 80,000 sf	20,000 - 200,000 sf	25,000 - 100,000 sf	2,000 - 12,000 sf	2,000 - 20,000 sf	25,000 - 100,000 sf
Lot Frontage	NA	50 to 200 feet	100 to 500 feet	100 to 300 feet	18 to 50 feet	25 to 200 feet	100 to 300 feet
Block Dimensions	NA	400 wide x varies	200 wide x varies	300 wide by varies	200 by 400 ft	200 by 400 ft	200 by 400 ft
Max. Height	1 to 3 stories	1.5 to 3 stories	retail -1 story, office 3-5 stories	2 to 5 stories	2 to 5 stories	1 to 3 stories	3 to 60 stories
Min./Max. Setback	Varies	20 to 80 feet	20 to 80 ft	20 to 80 ft	10 to 20 ft	0 to 20 ft	0 to 20 ft

Figure 2. Land use contexts.

Roadway Class	Roadway Type	Desired Operating Speed (mph)	Average Trip Length (mi)	Volume	Intersection Spacing (ft)	Comments
Arterial	Regional	30-55	15-35	10,000-40,000	660-1,320	Roadways in this category would be considered "Principal Arterial" in traditional functional classification.
Arterial	Community	25-55	7-25	5,000-25,000	300-1,320	Often classified as "Minor Arterial" in traditional classification but may include road segments classified as "Principal Arterial."
Collector	Community	25-55	5-10	5,000-15,000	300-660	Often similar in appearance to a community arterial. Typically classified as "Major Collector."
Collector	Neighborhood	25-35	<7	<6,000	300-660	Similar in appearance to local roadways. Typically classified as "Minor Collector."
Local	Local	20-30	<5	<3,000	200-660	

Figure 3. A new roadway typology was proposed for the guidebook to give greater flexibility to designers.

these land use contexts are arrayed in order of intensity. Unlike Transect, the study team opted for common place types, using terms like "town center" that would be easily understood in any community. As shown in Figure 2, guidelines are provided to define the context based on characteristics such as density, lot size and building coverage. However, communities should feel free to define their own contexts.

The agreement on the use of different land use contexts to guide the selection of design values is a key step in any context-sensitive guidebook. The only land use contexts recognized by the AASHTO Green Book are "urban" and "rural." In the Green Book, urban design values are used on both urban and suburban roads, even though the expectation of motorists in town centers can be very different from motorists on suburban corridors. The provision of three different urban contexts and three different suburban contexts in the guidebook enables a more precise fit for a roadway within a community.

Roadway Type

The roadway type comprises the other half of the organizing framework. An important question early in the project—and one confronted on other CSD manuals—was how to classify roadways. Some transportation experts have advocated revising the existing functional classification system, and a number of jurisdictions have followed through on this idea. ITE's *Context Sensitive Solutions* essentially combines function with form in its road classification system. Some professionals have called for the elimination of functional classification as a basis for design because they see this system as contributing to out-of-context roadways.

The role of the principal arterial came under particular scrutiny in this study. As stated in the Green Book, "arterials are expected to provide a high operating speed," and service to land uses "should be purely incidental" to the primary function of mobility. This emphasis on high operating speed and mobility for principal arterials creates a dilemma for roadway designers. It is common in Pennsylvania and New Jersey towns for principal arterials to serve as the "Main Street."

The project team recognized that new town centers—viewed as a desirable smart growth goal—would take root along principal arterials in at least some cases. Even outside a town center context, low to moderate operating speeds and frequent access to adjoining land uses characterize many principal arterials in the two states. These qualities contradict the definition of principal arterials in the Green Book.

A new roadway typology was proposed for the guidebook to give greater flexibility to designers (see Figure 3). This typology retains the broad functional classification system of arterials, collectors and local streets but categorizes streets based on attributes such as desired operating speed, average trip length, volume and intersection spacing. Roadways on which regional traffic movements are a high priority are referred to as "regional" arterials, not principal. Arterials with a smaller trip length and operating speed are referred to as "community" arterials, even if their underlying classification is principal arterial. Main streets, for example, would often be found on community arterials.

The guidebook emphasizes that the new roadway typology will serve as a planning and design overlay only, and that the existing functional classification (principal arterials, etc.) would remain in place for all roadways in both states. The project team decided that from a practical perspective, it would be difficult to revisit the functional classification for roadways in both states.

The project team thus opted for a fine-tuning of the existing classification system and greater acknowledgment of the role of a roadway within the community rather than a complete overhaul. While it is possible to define the function of a roadway in a more comprehensive manner than found in the Green Book, that redefined function still has a key task in determining roadway design.

ROADWAY AND ROADSIDE DESIGN VALUES

Once the land use context and roadway type are determined, appropriate design values may be selected for each roadway and roadside element. In the guidebook there are five different roadway types and five tables. Guidance is also provided on the design for main streets. Figure 4 provides the design value matrix for the community arterial roadway type, and Figure 5 shows an example of the land use and roadway transect. The content of the design value tables is roughly similar to that found in ITE's *Context Sensitive Solutions*; that text was an important source in helping establish the range of values.

Following is a discussion of each roadway and roadside element on a community arterial:

- *Lane width.* Travel lanes may be 10 to 12 feet for most land use contexts, although a minimum of 11 feet is recommended for rural and suburban corridor contexts. The use of 10-foot lanes is a departure from the existing NJDOT and PennDOT design manuals but is in line with the Green Book, which recognizes their use on lower-speed urban streets. The choice of 14 feet for outside lanes if desired for bicyclists indicates the complexity of accommodating bicyclists in CSD. The table has three different facilities that can accommodate bicyclists—wide outside lane, paved shoulder, or bike lane—but leaves it to each project to determine the best facility for that situation.
- *Paved shoulder*. Constructing a shoulder is not typically done on new roadways in urban areas. On the other hand, communities might wish to stripe 4- to 6-foot shoulders on urban roadways with wide travel lanes as a traffic calming measure and to better accommodate bicyclists. Some older villages in the two states rely upon shoulders to accommodate pedestrians in the absence of sidewalks.
- *Parking lane.* The desirable parallel parking lane width is 8 feet (7 feet in constrained situations). The Green Book recommends a parking lane width of 10 to 12 feet—and 8 feet if the parking lane will not be used for travel in the future—but very few parking lanes in urban areas are 10-feet wide.
- *Bike lane*. The standard bike lane is 5 feet, but 6-foot bike lanes are employed in some situations.
- *Median.* Medians built to accommodate left turns may be 12 to 18 feet but only 6 to 8 feet if needed as a pedestrian refuge.
- *Curb return.* A fairly wide range is provided for the curb return radius, recognizing that the smaller radius (15 feet) works well in many urban settings. Context-sensitive practice recommends use of the smallest radius that can reasonably accommodate large design vehicles.
- *Travel lanes.* The typical number of travel lanes is cited, ranging from two to four.

The roadside is divided into three zones:

- *Clear sidewalk width*—part of the sidewalk unhindered by street furniture (such as lamp posts, waste containers and hydrants). A wide range of 6 to 14 feet is recommended for busy urban contexts and a minimum of 5 feet for less traveled roadways.

	Community Arterial	Rural	Suburban Neighborhood	Suburban Corridor	Suburban Center	Town/Village Neighborhood	Town/Village Center	Urban Core
Roadway	Lane Width[1]	11' to 12'	10' to 12' (14' outside lane if no shoulder or bike lane)	11' to 12' (14' to 15' outside lane if no shoulder or bike lane)	10' to 12' (14' outside lane if no shoulder or bike lane)	10' to 12' (14' outside lane if no shoulder or bike lane)	10' to 12' (14' outside lane if no shoulder or bike lane)	10' to 12' (14' outside lane if no shoulder or bike lane)
	Paved Shoulder Width[2]	8' to 10'	4' to 6' if no parking	8' to 10'	4' to 6' (if no parking or bike lane)	4' to 6' (if no parking or bike lane)	4' to 6' (if no parking or bike lane)	4' to 6' (if no parking or bike lane)
	Parking Lane[3]	NA	7' to 8' parallel	NA	8' parallel; see 7.2 for angled	7' to 8' parallel; see 7.2 for angled	7' to 8' parallel; see 7.2 for angled	7' to 8' parallel; see 7.2 for angled
	Bike Lane	NA	5' to 6' (if no shoulder)	5' to 6' (if no shoulder)	5' to 6'	5' to 6'	5' to 6'	5' to 6'
	Median	4' to 6'	12' to 18' for LT, 6' to 8' for pedestrians	12' to 18' for LT, 6' to 8' for pedestrians	12' to 18' for LT, 6' to 8' for pedestrians	12' to 18' for LT, 8' to 8' for pedestrians	12' to 18' for LT, 6' to 8' for pedestrians	12' to 18' for LT, 6' to 8' for pedestrians only
	Curb Return	25' to 50'	25' to 35'	25' to 50'	20' to 40'	15' to 30'	15' to 35'	15' to 40'
	Travel Lanes	2 to 4	2 to 4	2 to 4	2 to 4	2 to 4	2 to 4	2 to 4
Roadside	Clear Sidewalk Width	NA	5'	5' to 6'	6'	6' to 8'	6' to 10'	8' to 14'
	Buffer[4]	NA	6'+	5' to 10'	4' to 6'	4' to 6'	4' to 6'	4' to 6'
	Shy Distance	NA	NA	NA	0' to 2'	0' to 2'	2'	2'
	Total Sidewalk Width	NA	5'	5' to 6'	10' to 14'	10' to 16'	12' to 18'	14' to 22'
Speed	Desired Operating Speed	35-55	30-35	35-50	30	25-30	25-30	25-30

1. 12' preferred for regular transit routes, and heavy truck volumes > 5%, particularly for speeds of 35 mph or greater.
2. Shoulders should be installed in urban contexts only as part of a retrofit of wide travel lanes, to accommodate bicyclists.
3. 7' parking lanes on this roadway type to be considered in appropriate conditions.
4. Buffer is assumed to be planted area (grass, shrubs and/or trees) for suburban neighborhood and corridor contexts; street furniture/car door zone for other land use contexts. Min. of 6' for transit stops.

Figure 4. Design value matrix for the community arterial roadway type.

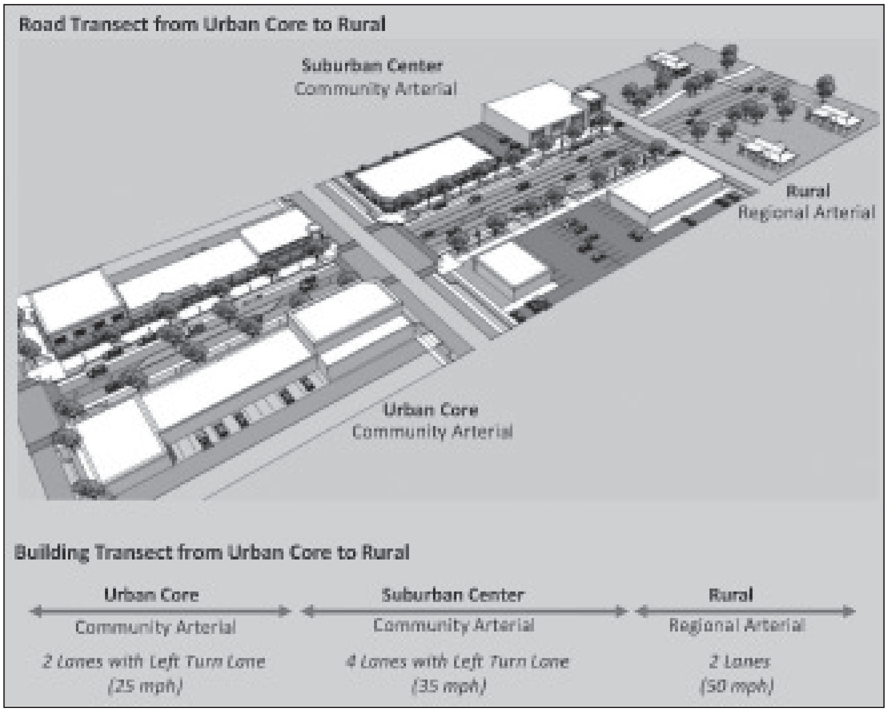

Figure 5. Road transect from urban core to rural.

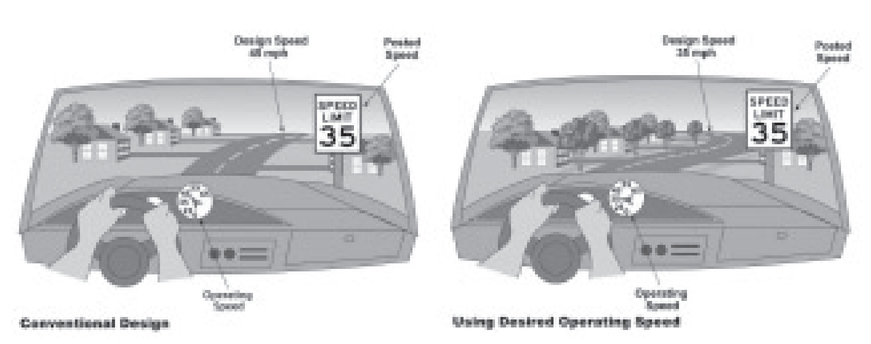

Figure 6. Using desired operating speed.

- *Buffer*—comprising grass in suburban settings and hosting street furniture in urban settings; the buffer separates the walkway from the road. This is normally 4 to 6 feet.
- *Shy distance*—distance from the building in urban contexts, reflecting the fact that pedestrians do not prefer to walk immediately next to structures.

This is different from the approach found in ITE's *Context Sensitive Solutions*, which sub-divides the buffer into an "edge zone" (also referred to as the "curb zone") and furnishings zone. In this case, greater precision is sacrificed for simplicity because the vast majority of buffers can be used to accommodate opened car doors regardless of design.

Desired Operating Speed

The final row in each roadway table states the desired operating speed. This is the speed of traffic that, in the expert judgment of the highway designer and community planner, best reflects the function of the roadway and the surrounding land use context. Informally, the guidebook defines it as the "speed at which we would like vehicles to travel." It is synonymous with the concept of "target speed" used in ITE's *Context Sensitive Solutions*.

Use of this concept is intended to allow alignment of the three other concepts of speed:

- operating speed, at which a typical vehicle operates;
- posted speed, legal speed limit; and
- design speed, used to determine various geometric design features

It is recommended that the desired operating speed for most roadway types be the same as the design speed and the posted speed. However, for roadways posted at 45 miles per hour or above, the design speed should be 5 miles per hour over the posted speed. For higher-speed roadways, the toolbox of speed control measures is reduced in scope.

Designers are encouraged to use all of the controlling design elements related to design speed, such as horizontal and vertical curvature, as well as features not directly related to design speed, such as the presence of on-street parking and street trees (see Figure 6). Roadway elements directly tied to design speed are outnumbered by these other features. This points to the importance of interdisciplinary teamwork in CSD; the planner can help create a roadside environment that will reinforce the desired speed.

Because the desired operating speed is vital in choosing all of the other design values for the roadway, it was identified early as a critical concept by the project team. Agreement on this concept made it possible for the project team to agree on use of design features such as 10-foot travel lanes for arterials, previously not considered a desirable value by either DOT. It was recognized that use of this concept could promote vehicular speeds more appropriate to the surrounding land use context, thus enhancing safety. Several traffic engineers of long standing with the DOTs said that their support stemmed from experience on past projects, in which safe roadways were equated with being "wider and straighter." They described receiving phone calls following roadway reconstruction, with residents complaining that it was now more difficult for pedestrians to cross the street.

The range of design values in this table is fairly broad. Early in the project, team members discussed whether it would be better to narrowly prescribe values to achieve a traditional walkable environment or to offer a more flexible range of values. The team ultimately opted for a more flexible approach, deciding that a narrow range of values could in some cases serve to unwittingly forestall options.

CONCLUSION

The guidebook builds on existing CSD practice to address transportation challenges and foster sustainable communities. It reflects local conditions in both states but is based on many universal design principles. It is hoped to advance the discussion on needed changes in the transportation profession.

Readers may download a free copy of the guidebook from the Delaware Valley Regional Planning Commission Web site at www.dvrpc.org. Click on the "Search all Publications" window on the home page and enter publication number 08030A in "Search by Publication Number." Alternatively, readers may enter the search term "Smart Transportation" on the Publications page. ■

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