A Guide for Achieving *Flexibility* in Highway Design

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introduction

Context-sensitive solutions (CSS) are an emerging concept in highway project planning, design, construction, and maintenance in recent years. CSS reflects the need to consider highway projects as more than transportation. CSS recognizes that a transportation facility, by the way it is integrated within the community, can have far-reaching impacts (positive and negative) beyond its traffic or transportation function. The term CSS therefore refers to an approach or process as much as it does to an actual design or solution.

The term *Flexibility in Highway Design* was adopted by the Federal Highway Administration (FHWA) in their groundbreaking publication (issued in 1997) that demonstrated how agencies could accomplish the objects of CSS within accepted design processes and criteria. The core theme of the FHWA publication was flexibility—in design approaches, use of criteria, execution of design solutions, and incorporation of special or "unique" features:

> *This Guide* [*Flexibility in Highway Design*] *encourages highway designers to expand their consideration in applying the Green Book criteria. It shows that having a process that is open, includes good public involvement, and fosters creative thinking is an essential part of achieving good design.*

The terms *context-sensitive solutions*, *context-sensitive design*, and *flexibility in highway design* are used interchangeably by some. Other terms expressing the concepts include *place-sensitive design* and *Thinking Beyond the Pavement*. These terms all refer to the same process and result: a highway or transportation project that reflects a community consensus regarding purpose and need, with the features of the project developed to produce an overall solution that balances safety, mobility, and preservation of scenic, aesthetic, historic, and environmental resources.

A national conference sponsored by the Maryland State Highway Administration and FHWA in 1998 produced a definition of context-sensitive design that has been adopted by many:

> *Context sensitive design asks questions first about the need and purpose of the transportation project, and then equally addresses safety, mobility, and the preservation of scenic, aesthetic, historic, environmental, and other community values. Context sensitive design involves a collaborative, interdisciplinary approach in which citizens are part of the design team.*

CSS or flexibility in highway design therefore represents a comprehensive process that attempts to bring all stakeholders together in a positive, proactive environment with the objective being the completion of projects that meet transportation needs and are viewed as improvements or enhancements to the community through preservation efforts and sensitivity to local values. CSS recognizes the need to consider that transportation corridors may be jointly used by motorists, pedestrians, cyclists, and public transit vehicles. In addition to the movement of people, CSS also considers the distribution of goods and the provision of essential services.

The values presented in this guide do not imply that the existing streets and highways are unsafe, nor do they mandate the initiation of improvement projects. This guide is not intended to be a detailed design manual that would supersede the need for the application of sound principles by the knowledgeable design professional, nor is it intended to establish guidelines, criteria, or standards for the design of roadways. The use of the terms *guideline* or *criteria* in this document are not to be considered as a substitute or synonym for the word *standard*.

Historic Background on Flexibility in Design

The great interest in achieving flexibility in design is the culmination of many years of increased involvement of the public in transportation projects. Many State Departments of Transportation (DOTs) have experienced projects in which their rigid application of established criteria, practices, or solutions has come into conflict with community values. Some examples of these conflicts include the value of mature trees versus clear zones, lane width and capacity needs versus provision for bicycle lanes, road widening to meet a prescribed level of service. While the issues are many and complex, and tend to vary by location, transportation providers are recognizing these concerns and are now seeking to provide solutions that reflect appropriate sensitivity to community values.

Public policy objectives dealing with resource preservation and community values are highlighted by a range of national and state legislation on environmental and cultural resource protection, beginning with the National Environmental Policy Act of 1969, and continuing with more recent federal legislation such as the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, the National Highway System (NHS) Designation Act of 1995, and the Transportation Equity Act for the 21st Century (TEA-21) of 1998. This legislation demonstrates a clear, strengthened federal commitment toward the preservation of historic, scenic, and cultural resources in the development and implementation of transportation projects.

In response to these trends and legislation, a number of national initiatives and publications have encouraged and demonstrated more flexible and creative approaches to highway project development, including the American Association of State Highway and Transportation Officials' (AASHTO's) *Design Flexibility Case Study Report,* 1997; FHWA's *Community Impact Assessment,* 1996; FHWA's *Flexibility in Highway Design,* 1997; and FHWA's *Community Impact Mitigation Case Studies,* 1998.

Flexibility in Highway Design and the Design Profession

Flexibility in highway design has provoked some measure of discomfort and some misunderstandings both inside and outside the highway engineering design profession. Some have interpreted the initiative as advocating an end to the practice of design as it has been done in the past, or the abandonment of proven design criteria, guidelines, or design standards. Others have been concerned with perceptions of adverse outcomes from projects that are *flexibly* designed. Such

concerns tend to focus on compromises in the safety of the solution, or on increased risk to the owning agency associated with potential tort lawsuits.

In the view of AASHTO, established processes and design guidance are not in conflict with the movement. Furthermore, a well-designed, *context-sensitive* design solution need not increase the risk of a tort lawsuit to an agency. AASHTO supports the concepts and principles of flexibility in highway design and feels that all professionals responsible for highway and transportation projects should understand how to accomplish a flexible design solution within current design processes and approaches.

This publication was prepared to add technical background to the knowledge base of highway and traffic engineers, planners, and other technical specialists who contribute to transportation solutions. It strives to emphasize that flexible design does not entail a fundamentally new design process, nor does it suggest new or revised design criteria. Rather, this publication sets out to show designers how to think flexibly, how to recognize the many choices and options they have, and how to arrive at the best solution for the particular context.

Achieving a flexible, context-sensitive design solution requires designers to understand the reasons behind processes, design values, and design procedures. Indeed, successful implementation of context-sensitive solutions will be largely based on the skills and abilities of the professional staff to incorporate context-sensitive design principles in each step of the project development process. This publication, combined with *Flexibility in Highway Design* published by the FHWA, represents a major step toward providing guidance to state DOTs and other agencies charged with transportation project development. However, this guide does not establish a set of best design practices or processes, nor does it mandate the use of flexible design concepts. In addition, the application of the concept of flexible design will vary between States and from project to project.

Organization of the Guide

This guide is intended to promote the incorporation of sensitive community and environmental issues into the design of highway facilities. It is organized to provide an overview and summary of key aspects of the highway project development process from initial planning through completion of construction plans.

Chapter 1 addresses the overall project development process, including the major steps of planning through final design, the background, applicability and use of design criteria, differences among project types, and project design decision making.

Lessons learned from successful context-sensitive projects suggest that the *alternatives development and evaluation stage*, early in project development, is where context sensitivity is achieved. Transportation alternatives must reflect early, continuous, and meaningful input from the public, resource and regulatory agencies, and affected stakeholders. Alternatives must also be developed with full knowledge and understanding of all physical and environmental constraints. They should reflect a creative, appropriate application of geometric design criteria and guidelines. This can

occur only with an understanding of how such criteria have been developed, and how they are supposed to be used.

Chapter 1 emphasizes that the highway design process is flexible. The concept of flexibility may not be well understood by some highway designers; through this document and other related efforts, AASHTO is attempting to educate the design community.

Flexibility occurs with the many choices that a designer has, including selection of a design speed, designation of key design parameters such as the design vehicle, and decisions about the level of service to be provided. A context-sensitive design process provides a means for these choices to be presented to the public and discussed.

Flexibility continues with the application of design criteria to alternatives development. There is significant flexibility in the presentation of geometric design values published in the 2001 update to the AASHTO publication *A Policy on Geometric Design of Highways and Streets* (commonly known as the AASHTO Green Book). Designers, for example, have the ability to select a reasonable design speed from among a range of speeds appropriate for the type and location of the road. Flexibility is also imbedded in the presentation of many design elements in the AASHTO Green Book. A context-sensitive designer will take advantage of this flexibility.

Finally, there are occasions in which even the most creative use of design criteria produces an unacceptable or infeasible solution. The judicious application of *design exceptions* (the incorporation of design values outside the typical ranges to avoid a conflict or constraint) is appropriate in the context-sensitive design environment as long as the safety and legal risks are understood by the designer, are considered acceptable given site-specific conditions, and are documented well.

Chapter 1 closes with a discussion of the decision-making process. All involved with the project development process need to understand the decision process as it applies to each project. Transportation agencies, charged with the design, construction, operation, and maintenance of facilities, are normally the final decision-making authority. With this authority comes a responsibility to act in a manner that is open and honest, and that demonstrates sensitivity to the community.

Chapter 2 outlines the processes, tools, and techniques through which agencies can develop an understanding and incorporate such understanding of community interests in projects. Effective public involvement begins early, is maintained throughout the project, and is meaningful to the evolution of project plans and decisions.

Essential to a successful project is the identification and inclusion of all stakeholders, establishment of purpose and need, completion of early and thorough project scoping, and development and execution of a tailored public involvement program. Public involvement activities must be planned, budgeted, and managed like any other critical technical task. Techniques, guidelines, and references for conducting public involvement programs are contained in Chapter 2. This chapter also discusses the use of technologies such as visualization to promote and enhance public understanding of a project's visual attributes.

Chapter 2 also emphasizes the role that highway design professionals must play in the environmental planning process. A successful project not only meets community interests and goals,

but also addresses regulatory requirements and resource agency concerns. Environmental studies and input occur in concert with, not separate from, highway engineering design. Alternatives development should reflect a complete understanding of environmental issues and should strive to demonstrate tradeoffs and choices that reflect such issues.

Many highway projects result in a series of decisions, commitments, and promises to stakeholders. Effective public involvement does not end with design decision making, but continues through implementation. Planning and design decisions made by project staff need to be communicated to agency management and need to be fully documented to assure compliance with commitments and promises as the project continues into construction. With this authority also comes the responsibility to provide a safe and efficient transportation system.

Chapter 3 is aimed at highway design professionals charged with the development and evaluation of highway alternatives. A common interest of both highway designers and the public is the enhancement of safety in every highway project. This task is sometimes easier said than done in the context of constrained corridors and given other community objectives. It is imperative that highway designers working in the context-sensitive environment demonstrate an understanding of the functional, operational, and safety basis behind their agency's design criteria to enable flexible, creative decisions. Chapter 3 provides an overview of key geometric elements, including a discussion of the models and assumptions used in the derivation of AASHTO design criteria, and a summary of current knowledge regarding operational and safety effects of design. Geometric features that are discussed include horizontal and vertical alignment, cross section, sight distance, intersections and access control, and bridges.

Chapter 3 also addresses in detail two specific concerns that repeatedly occur in context-sensitive projects: roadside design and traffic calming. Resolving potential safety conflicts with trees, decorative walls, and other roadside objects is a frequent problem in reconstruction projects. Designers faced with tradeoffs between maintaining the scenic character of a road and enhancing safety require an understanding of roadside design principles. With respect to traffic calming, the public frequently expresses concern about inappropriate speeds of traffic through towns, business districts, and residential streets. Providing a highway that promotes low-speed operation while meeting safety and mobility objectives is among the most prevalent context-sensitive design issues. Designers need to understand principles of traffic calming, what is effective (and what is not), and how to work with communities to develop effective traffic-calming projects where these are the proper approach to a problem.

Chapter 4 addresses major issues and concerns of agencies and design professionals regarding their responsibilities. Developing a project to meet the context-sensitive environment will take creativity by individuals and agencies charged with assessing design tradeoffs and making project decisions.

Design engineers are concerned with the legal implications of implementing design solutions outside the usual ranges. Many agencies have experienced lawsuits stemming from crashes. There is a widespread concern among design professionals that embracing context-sensitive design will increase an agency's and even an individual's exposure to the risk of being sued should a crash occur.

Design professionals and the public need to understand basic concepts of tort liability and sovereign immunity. Although state laws vary, tort laws generally draw important distinctions between

discretionary and *ministerial* actions. Planning and design decisions that require the assessment of tradeoffs are considered to be discretionary functions, which are generally immune from tort actions. The legal principle is that judges and juries should not substitute their judgment for those of professionals in technical matters. The courts generally provide broad protection for those decisions where it can be shown that reasonable discretion was exercised. Ministerial actions generally involve clearly defined tasks performed with minimal leeway for personal judgment. These are typically implementation actions such as maintenance or construction at the operational level. It is these types of actions for which agencies are held liable if they are not performed adequately. This is not to say that the risk of a lawsuit involving design decisions is negligible. Note that state laws vary, and state court precedents may also vary. All highway designers need to understand the laws and regulations in place for the jurisdictions where they work.

A hindrance in the acceptance of context-sensitive design approaches by some has been a concern about the legal ramifications of design decisions that incorporate nontraditional design solutions. Chapter 4 notes that experience varies across the country. In some jurisdictions, very few successful tort actions involving highway agencies actually result from geometric design issues. In others, tort claims related to design are a continuing concern, and the risk of these claims needs to be understood. In general, it appears that the nature of tort laws and recent history suggests that designing innovative solutions should not necessarily increase the risk to an agency as long as appropriate risk management measures are undertaken.

Chapter 4 summarizes how highway design professionals can successfully accomplish flexibility in design while protecting the public and the legal interests of the owning agency. Transportation design professionals, as individuals as well as representatives of or consultants to agencies, have duties and responsibilities to act in a reasonable manner and to demonstrate adherence to good practice. Among the factors of great importance in the context-sensitive environment is the need to fully evaluate and document all reasonable alternatives. Thus, it would seem that the requirements for a successful context-sensitive project are consistent with good practice to minimize risk: openly developing and evaluating multiple alternatives, assessing tradeoffs among many variables including safety, and documenting all decisions.

The above is not to say that the context-sensitive design environment will be risk-free with respect to tort liability. Again, state laws, precedents, and practices vary. Furthermore, it is an unavoidable fact that DOTs face public and legal scrutiny for virtually all their actions. However, if a design team works closely with stakeholders, is creative within the bounds of good engineering practice, and fully documents all decisions, they will have gone a long way toward minimizing the risk associated with a future tort action should that occur.

As in the AASHTO Green Book, design values in this document are presented in both metric and United States (U.S.) customary units and were developed independently within each system. The relationship between the metric and U.S. customary values is neither an exact (soft) conversion nor a completely rationalized (hard) conversion. The U.S. customary values are those that would have been used had the figures been presented exclusively in U.S. customary units; the metric values are those that would have been used if the figures had been presented exclusively in metric units. Therefore, AASHTO advises the user to work entirely in one system and not attempt to convert directly between the two.

The experiences of states and other agencies that have led the way in context-sensitive design demonstrate many benefits. Incorporating meaningful public involvement; developing multiple,

creative alternatives; and integrating environmental processes produce better context-sensitive solutions. The process, when applied successfully, is efficient in that it minimizes project delays and the need to re-design or re-study the project. In some cases, projects that have stalled or been shelved for long periods of time have been successfully completed through the application of context-sensitive design approaches. For these reasons, AASHTO encourages highway designers, transportation planners, traffic engineers, and others responsible for highway project development to familiarize themselves with the principles and concepts of context-sensitive design as outlined here, in the AASHTO Green Book, and in the Federal Highway Administration publication *Flexibility in Highway Design.*