EXECUTIVE STRATEGIES TO DELIVER PRACTICAL DESIGN

Prepared for:

NCHRP Project 20-24 (102) Panel

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Preface

Since the early 1990s (post Interstate era), the transportation community has faced uncertainty in funding at federal, state, and local levels. These cycles of high and low funding tended to be challenging but relatively short, and they were typically followed by long-term funding/financing solutions. In recent times, the low funding periods have been extended for many years with only short-term solutions, or "fixes". This funding uncertainty has forced states to review their policies, processes, and practices for delivering transportation improvements by stretching available funding as far as possible. This resulted in the development and use of Practical Design and related initiatives by a number of states to ensure that projects were not being over designed.

The objective of the National Cooperative Highway Research Program (NCHRP) 20-24(102) is to assist the American Association of State Highway and Transportation Officials (AASHTO) in engaging senior state transportation agency leaders in defining a program that will advance an understanding of Practical Design principles and practices and identify areas in which a potential work plan will help AASHTO advance the state of the practice.

This final report provides a proposed AASHTO work plan and performance measure report. Previous interim products included:

- Results of a Practitioner Workshop (Task 2).
- A survey conducted to gather feedback (Task 3).
- Results of a Senior Leadership Forum (Task 5).
- Compendium of a comprehensive literature review (Task 3).
- Five focused working papers prepared by the research team (Tasks 3, 4 and 5).

CHAPTER 1

Introduction and Research Methodology

Historically, highway engineering has been a cost-conscious, flexible, forward-thinking, and innovative discipline. That approach has served the nation well by contributing to construction of a robust transportation system. Agencies responsible for planning, designing, constructing, and managing road systems have come to rely on well-defined guidelines, standards, and engineering processes to shape roadway geometrics and other design details.

The transportation community has launched and pursued many initiatives designed to influence and streamline the practices and processes used in delivering roadway projects to the customers being served; i.e., the public. These initiatives have included:

- Expanding the modal solutions considered,
- Increasing public involvement,
- Streamlining project development processes,
- Using innovative engineering techniques in construction,
- Establishing a focus on performance management over strict engineering procedures, and
- Using new technologies to expedite location and design decision-making.

At their heart, each of these initiatives affects one or more of the three dimensions that drive effective project delivery: quality, cost, and timeliness. The challenge faced by agencies is finding the balance among community acceptance, environmental compatibility, safe and enduring engineering, and living within the fiscal constraints caused by increasing costs. Agencies have initiated various programs intended to achieve this balance. Examples include Context Sensitive Design, Flexible Design and Practical Design.

Many states have implemented a policy or practice of Practical Design, the basic concept of which is to plan, design, construct and maintain solutions that address the purpose of and need for a given project. To achieve that end, agencies encourage flexibility and innovation to solve the problem. Practical Design principles encourage evaluation of all components throughout project development to avoid unnecessary project cost without sacrificing safety, performance, durability, operations, community livability, economic development, or environmental stewardship. The research for this project focused on defining Practical Design, identifying possible impediments to implementation, recommended AASHTO initiatives and a report on performance measures.

Research Methodology and Findings

The research team used four tasks to gather information: review of existing literature and interaction with senior state department of transportation (DOT) practitioners and agency leaders involved in an established Practical Design program. Additionally, the research team conducted a survey of states attending the 2015 AASHTO Sub-Committee on Design meeting in Seattle, Washington. Finally, the research team, held a leadership forum in Washington, D.C., with state DOT leaders, AASHTO, and representatives of the Federal Highway Administration (FHWA) to discuss the findings to date and to gather additional research for the final report.

Literature Review (Appendix A)

Researchers identified and reviewed pertinent literature related to Practical Design concepts and practices. Using an established research method, the team reviewed 35 documents and captured information in an independent synopsis. Major findings included the following:

- In several identified instances, AASHTO design guides have been re-interpreted/codified as standards by a state DOT.
- No reported effect from tort liability has been identified with respect to flexible design practices or Practical Design.
- Many states have adopted common practical design principles, practices, and definitions.
- There are relatively few examples of Practical Design performance measures, measures of effectiveness, or other cost reduction, quality, on-time, and on-budget measures.

August 2015 Practitioner Workshop with Practical Design-Experienced Department of Transportation Staff (Appendix B)

The research team identified and assembled a panel of practitioners from eight states' with Practical Design experience, that included DOT senior design staff and legal counsel, along with FHWA and AASHTO for a 1.5-day workshop in Minneapolis, Minnesota, on August 19-20, 2015. These practitioners advised:

- Efforts to develop a single Practical Design definition may be counterproductive. However, taking the time to define the driving principles for Practical Design is important.
- AASHTO guidelines are not an impediment, but are difficult to integrate and apply in specific situations.
- Liability is not perceived to be a significant issue.
- Education and training are critical to success.
- Continuity and sustainability of the effort is important.
- Additional information could be obtained with a Practical Design survey of the Subcommittee on Design.

November 2015 Leadership Forum (Appendix C)

The research team met with 14 DOT leaders, FHWA, and AASHTO staff for a 1.5-day forum in Washington, D.C., on November 9-10, 2015 to discuss the research compiled to date and to gather additional input for the research memorandum. The research team developed and provided working papers to participants in advance along with prior meeting minutes and the draft literature synopsis to allow thorough discussion.

The participants advised:

- They are not worried about the specifics of a title or having an absolute definition. Principles, not a rigid definition, should drive the concepts surrounding Practical Design.
- Practical Design is ***not*** an excuse to cut cost beyond what should be cut. It is about spending money wisely on solutions that have long-lasting benefits. It should ***not*** compromise safety or community values in order to reduce costs.
- DOTs understand how to do their job, but do not understand how to do their consultants' jobs. The consultants' goal is to please the customer (DOT) and may not always push back when something is unnecessary or insufficient.
- The engineering culture is too dependent on AASHTO's A Policy on Geometric Design of Highways and Streets (the Green Book). Engineers use it as a standard rather than the guidance it was intended to be. It allows them to turn off their critical thinking and fit the same solution to every problem, whether

it is a good solution or not. In addition, bicycle and pedestrian documents are separated from the main guidance document, which sends a message they are less important.

- The Capability Maturity Concept, similar to the model produced by AASHTO to improve Transportation Systems Management and Operations, should be used as a tool to measure the readiness of an organization to engage in Practical Design and to indicate where to focus their efforts. The tool measures system development from the stage of being an *ad hoc* method to the point where it becomes a mature business process.

September 2015 AASHTO Subcommittee on Design Survey (Appendix D)

Participants at the Minnesota workshop suggested that additional data be gathered prior to and during the regional breakout sessions at the annual Subcommittee on Design (SCOD) meeting held in Seattle, WA, on September 21-24, 2015. Researchers developed the survey and provided it to SCOD attendees prior to the meeting along with Practical Design definitions and principles, which had been previously gathered and developed.

The survey validated the conclusions and advice provided by the August practitioner workshop participants.

CHAPTER 2

Practical Design Defined

Current Practical Design initiatives, while similar, do not share a single definition. Reaching consensus on a definition is further complicated by the fact that each state's goals and objectives for transportation are unique. Developing a one-size-fits-all definition has proven to be elusive.

National Initiatives

Three initiatives that embody a journey similar to that of Practical Design already exist and seem to have found a balance between quality, cost, timeliness, and the many other goals of roadway improvement programs. They are **Value Engineering,** FHWA's **Every Day Counts Initiative,** and **Context Sensitive Design/Solutions**. A significant amount of effort under this investigation focused on understanding the definitions used in each of these initiatives and determining their commonalities and differences.

Table 1. Definitions for Related National Initiatives

RELATED NATIONAL INITIATIVE	DEFINITION
VALUE ENGINEERING	FHWA defines value engineering as the systematic process of reviewing and analyzing a project during the concept and design phases, conducted by a multidisciplinary team of persons not involved in the project to provide recommendations for: 1. Providing the needed infrastructure functions safely, reliably, efficiently, and for the greatest value; 2. Improving the value and quality of the project; and 3. Reducing the time to complete the project.
EVERY DAY COUNTS	FHWA defines Every Day Counts as an initiative dedicated and designed to identify and deploy innovation aimed at shortening project delivery, enhancing roadway safety, and protecting the environment.

RELATED NATIONAL INITIATIVE	DEFINITION
CONTEXT SENSITIVE DESIGN/SOLUTIONS	A way of thinking that creates a project that will leave a lasting positive impact on the people it serves and the area it impacts. A philosophy defining a project as harmonious with the community and the environment. FHWA defines this as a collaborative, interdisciplinary, holistic approach to the development of transportation projects. It involves all stakeholders, including community members, elected officials, interest groups, and affected local, state, and federal agencies. It puts project needs and both agency and community values on a level playing field and incorporates all trade-offs in the decision-making process.

State Initiatives

Beyond the national-level initiatives described above, many states have their own Practical Design initiatives, each with a slightly different but generally similar definition that supports the driving principle of finding a balance among quality, cost, and timeliness considerations. An additional definition, developed at the August 2015 Practitioners Workshop in Minneapolis, is also included.

Table 2. Definitions for Related State Initiatives

RELATED STATE INITIATIVE NAME AND LOCATION	DEFINITION
PRACTICAL DESIGN As defined by Missouri, Oregon, Utah and Florida Departments of Transportation (combined)	A philosophy that maximizes improvements to the transportation system by focusing resources on project needs that deliver the highest return on investment. This objective is accomplished in two parts: 1. Developing the scope of work to meet the project's purpose and need. 2. Utilizing design flexibility based on desired safety and operational performance. The philosophy requires critical thinking and sound engineering judgment to meet system improvement needs while maintaining a safe and efficient transportation system**.**
PRACTICAL DESIGN As defined by Washington State Department of Transportation	Practical design is an approach to making project decisions that focuses on the need for the project and looks for cost-effective solutions. It engages local stakeholders at the earliest stages of defining scope to ensure their input is included at the right stage of project design.

RELATED STATE INITIATIVE NAME AND LOCATION	DEFINITION
PRACTICAL SOLUTIONS As defined by Kentucky Transportation Cabinet	The appropriate use of limited resources to meet the transportation needs of the state. • Through fiscal constraint on one project, funding becomes available to spread improvements more widely across the system. • It is essential to find the balance among operational efficiency, safety, and cost in order to design a suitable roadway to meet the needs of the state.
PRACTICAL IMPROVEMENTS As defined by Kansas Department of Transportation	A philosophy that guides decisions that affect project cost and scope in order to stretch transportation improvement dollars further while still maintaining a safe and efficient highway system.
PRACTICAL DESIGN Practitioners Workshop, August 2015	The state of the practice of delivering highway improvements. It is a multi-modal approach of delivering transportation projects that improves safety and manages assets in a cost effective manner that is sensitive to context and customer needs.

Potential Definition

While states vary their definitions of Practical Design, there are a number of common themes among them. The research team engaged current and former practitioners to achieve a potentially acceptable definition of Practical Design for use by all agencies.

A definition encompassing those themes was developed at the August 2015 Practitioner Workshop and follows:

> Practical Design is the current state of practice for delivering highway improvements. It is a multi-disciplinary approach for delivering transportation projects that focuses on the well-being of the entire system, improves highway safety, manages assets in a cost-effective manner, and is sensitive to context and customer needs.

This definition was not universally agreed to at the November 2015 Leadership Forum for a number of reasons. Some argued that this definition is very similar to the Context Sensitive Solutions definition. The research team believes this to be an indicator that the concept of Practical Design has evolved from a simple cost savings program to include principles of project context and community involvement. Some participants noted that a multi-modal approach is important to include in any definition because many states' senior executives spend the majority of their time on modes other than highways.

Thus the focus of ongoing discussions and work plans on this project may not need to be driven by the goal of finding a common definition, but rather by that of identifying practical design principles and action items that create and sustain the art of highway design.

Practical Design Principles

The research suggests that many practitioners believe Practical Design is better defined by a group of principles that will drive its implementation rather than a simple definition. These principles provide the flexibility to allow each state to create an initiative that matches its unique needs without losing sight of where the program will lead. These principles include:

- Maximizing available funding to achieve the best ***system*** outcomes possible.
- Achieving the best possible balance between a project's cost, quality, and timeliness of delivery.
- Emphasizing adding value rather than only reducing cost.
- Involving the local community and stakeholders throughout the program delivery process, including the identification of the purpose of and need for the project.
- Determining purpose and need for a project by:
  - Focusing on doing as much as possible across the entire network to yield the greatest benefit.
  - Reviewing the entire corridor, not just the project location, along with parallel and perpendicular road networks.
  - Accounting for all aspects of the program delivery process from initial planning through construction and into operations and maintenance.
  - Having multiple tiers of performance-based outcomes as well as non-measurable outcomes (i.e., community benefit and approval).

This definition and driving principles notwithstanding, practitioners involved in the research generally agree that Practical Design will not become standard industry practice until special slogans and definitions fade, and the concepts enumerated above are simply thought of as "design" or program / project delivery.

CHAPTER 3

Regulations, Constraints, and Legal Issues Inhibiting Practical Design

While current practices at most state transportation agencies agree on the intent of Practical Design, the approaches may vary significantly based on the use and interpretation of the guiding documents for design professionals. Such documents include:

- AASHTO's *Roadside Design Guide*,
- AASHTO's *A Policy on the Geometric Design of Highways and Streets* (the "Green Book"),
- AASHTO's *Highway Capacity Manual*, and
- State design manuals.

Newer analysis tools, such as those contained in AASHTO'S *Highway Safety Manual*, incorporate a methodology for analyzing design elements in the context of an individual project and can result in substantially safer designs. However, differences in terminology and procedures among guidance documents and agency practices can hinder consideration of the potential consequences of these standards in some instances. The most common concern is that project scope and cost will increase unnecessarily by simply following a standard without evaluating the solution in terms of the project's purpose and need.

Before an agency can establish a Practical Design program of any significance, it must identify and manage potential challenges or constraints. That was a key focus on this research effort. Implementation challenges or constraints are grouped into the following categories for discussion and analysis, and discussed in detail in the following sections:

- Leadership
- Communication
- Education
- Policy
- Legal Issues
- Perception or Culture

Leadership

Three aspects of agency leadership are crucial to the success of Practical Design:

1. Need for full support: The executive management of an agency can be an impediment to Practical Design success. A common thread among successful programs, as identified by the states participating in the workshop, was that aggressive and tenacious support at the very top of the organization is essential to success. An effort as large and far-reaching as Practical Design will not survive long unless leadership support is in place.

2. Acceptance of risk: The workshop participants identified encouragement of risk, acceptance of failure, and a passion for creativity as the leadership traits most critical to sustaining a Practical Design effort of value. Inversely, the absence of those traits poses an impediment.

3. Continuity at the agency executive level: No matter how enthusiastic or supportive of Practical Design executive leadership may be, they are only as effective as the length of their tenure in office. In those states where agency executives are appointed, there is frequent turnover. The average tenure of an executive is around 28 months. In 2015, 20 state executives were replaced, in many cases by individuals who did not have a background in transportation. Establishing a lasting Practical Design culture under these conditions is difficult.

Communication

A Practical Design program ***cannot*** exist in a vacuum. Rather, the process requires open and frequent communication with a host of stakeholders. Executive leadership, internal staff, FHWA, state legislatures, vendors, contractors, consultants, the media, and the general public must all be a part of a Practical Design effort if it is to be sustained. Perhaps the most challenging group with whom to communicate is the internal staff. It is difficult to change a culture so deeply ingrained throughout an entire industry for the reasons stated in this chapter.

Communication with the public can also be a challenge because of the time and level of effort involved. Agency staff may believe they do not have enough time to elicit public involvement and include stakeholders in the planning and design processes. This perceived lack of time can also delay critical project risk conversations with higher levels of management.

The relationship that a state has with FHWA can also be a challenge. If a state has a good relationship with its FHWA division office, then communication on issues happens early and often, and ultimately state staff find themselves with more flexibility. If communication between the state and FHWA is less than desirable, states may find themselves more limited in their flexibility.

Education

Beside the communication challenges, there is the issue of student and novice engineers being taught design based solely on the use of standards. There appears to be little choice in the matter due to the level of expertise and extensive base knowledge necessary to apply Practical Design principles successfully. The engineering judgement necessary to responsibly vary from a printed work can only come from the experience gained during a substantial amount of time on the job, using those same standards in practice.

To complicate the matter further, many universities are reported to have deemphasized transportation engineering or dropped it altogether to pursue more lucrative research opportunities. This situation leaves the DOT with the responsibility to teach its novice engineers routine design first, and then slowly —over the course of months or years—move them toward a more practical mindset. Unfortunately, today's tighter budgets often translate directly into reduced staffing levels, which eliminate the luxury of internally training novice engineers slowly over time. Thus, engineers need to be able to produce reasonably practical plans from nearly day one of their employment.

Policy

Initially, transportation leaders erroneously considered larger entities outside of state DOTs to be impediments to the establishment of the Practical Design philosophy. Specifically, the FHWA and AASHTO may have initially been viewed as obstacles.

FHWA: While the concept was new to the FHWA and a handful of their ardent staff insisted on rigid adherence to established design standards, the leadership at the FHWA division office level (in each state) generally remained open and willing to work with the concept. Through constant communication and transparency, the FHWA Division Offices soon became valuable allies of the DOTs attempting to build

Practical Design programs. As it turns out, there is little in the Code of Federal Regulations (CFR) that prohibits the practice of Practical Design.

AASHTO: Likewise, AASHTO policies did not prove to be as overly restrictive as many DOT staffers had initially thought. While this misconception thrived in the early development of Practical Design, increased exposure to AASHTO documents as alternatives to state standards soon revealed a great deal of built-in flexibility.

In cases where more flexibility is needed that what is allowed by the AASHTO guidance documents, some states have chosen design exceptions as the method of achieving a workable solution. This sort of additional flexibility is mentioned in the prefaces of a number of AASHTO publications such as *A Policy on Geometric Design of Streets and Highways* (Green Book) and the *Roadside Design Guide*. However, some senior staffers attending this project's workshop in Minneapolis indicated that the language could be strengthened with specific examples or clarification of the purpose of the document. An additional suggestion was to start each document with a section on how to use the document.

Lack of Flexibility in Standards: Engineering policies are not inherently counterproductive to a Practical Design program. Rather, it is blind adherence to those standards that poses the threat. In a handful of states, such adherence is codified into state law or agency policy. But even in that climate, there is an opportunity for practicality. DOT staff who attended the workshop indicated that their respective states had seized that opportunity and had written additional flexibility into some of their standards and policies.

Negative Perception of Design Exceptions: Irrespective of the amount of flexibility present within a standard, the negative perception of a design exception or variance from that standard is an enormous impediment to practicality. Given decades of new construction, it's hardly surprising that design exceptions have traditionally been viewed in a negative light. There was simply little reason to use one. Today's transportation engineering scene is vastly different, however, with cash-strapped DOTs turning their focus toward taking care of their existing systems and stretching every dollar. Retrofitting or taking care of system projects are activities more prone to needing design exceptions than new construction because of limited project budgets and project-specific constraints. Under this model, design exceptions become a necessity of responsible stewardship.

Legal Issues

Practical Design often involves calculated departures from written standards. On the surface, this approach would seem to be potentially catastrophic in terms of legal liability, but in practice the opposite is being realized. It is important to bear in mind, however, that the entire Practical Design concept may be too young to have received serious legal challenges. An attorney participating in the August 2015 Practitioners Workshop estimated that legal challenges and court rulings arising from Practical Design decisions may still be as much as 20 years away.

One thing is certain: lawsuits citing Practical Design are inevitable in the same way all transportation-related lawsuits are. There are a handful of states that enjoy total sovereign immunity, but the blanket application of such a statute on the national level is unlikely. The same attorney also stressed that when the inescapable suits are filed, he believes that defending sound and reasonably safe engineering judgement will be a stronger legal position than blind adherence to standards. In other words, Practical Design—executed correctly—need not cause a legal liability concern.

That is not to say that the legal arena is free of any impediments to the establishment of a Practical Design program. For instance, if an agency's legal counsel provides advice that is not supportive of the philosophy, then a designer's reliance upon counsel's advice can become a convenient excuse for non-compliance.

While Practical Design decisions themselves are not thought to increase legal liability, inadequate documentation and filing of those decisions may. If the rationale behind the engineering judgement is not

preserved or cannot be produced at the appropriate time, then a future challenger will easily be able to portray otherwise responsible decisions as careless.

The strong legal position under Practical Design can be further strengthened through use of AASHTO's *Highway Safety Manual* (HSM). This publication provides an empirical scientific method to estimate the effect of design decisions on future crashes. Employing the methods described in the HSM can be used to vet proposed practical solutions long before they are built. Although it is a powerful tool, use of the HSM can be time consuming. States may believe they do not have the time and resources to do it for all projects.

Perception or Culture

DOT staff may have a fear of the unknown associated with the implementation of a program as encompassing as Practical Design and what it offers as a new tool that other programs such as Context Sensitive Design/Solutions, Value Engineering, and others don't. Although established Practical Design programs have demonstrated responsible engineering time and time again, a perception of increased risk persists. Perhaps the most common perception is that safety will decrease, causing an inevitable increase in legal liability.

Overcoming the Challenges

This report has examined a number of challenges to Practical Design that, if properly managed, can set the stage for a successful program and implementation. A key deliverable of this research project is a proposed AASHTO work program to identify actions that can be taken at the state level to further the implementation of Practical Design principles, which will be included in the final research memorandum. Several best practices for states to consider when addressing potential Practical Design challenges were identified during the research and include the following:

- Announce a Practical Design effort that articulates clear definitions, overarching goals, and ground rules by which the program will be guided. This should come from the executive level.
- Develop an awareness or understanding of the level of design flexibility employed by the agency.
- Develop a spirit of cooperation among DOT leadership and staff, FHWA division staff, political leaders, private industry, and transportation users.
- Use technological advances in communication, such as real-time video conferencing to enhance collaboration among peers to develop and implement innovative solutions.
- Provide an implementation oversight function by tasking an individual or committee to ensure projects adhere to Practical Design principles.
- Conduct face-to-face meetings among executive level staff, internal staff, and private industry partners to explain the program and demonstrate leadership's enthusiasm and tenacity for implementation.
- Measure and track progress toward implementation at the organizational and project levels. A reward structure can also be helpful at this stage, as can formal competitions among internal staff and even consultants.

Conclusions and Moving Toward a Proposed AASHTO Work Program

A significant amount of time has been spent reviewing literature and speaking with current and past practitioners about the topic of Practical Design. The information gathered can be summarized to include the following points:

- There is clear pride of ownership for each state's version of the definition.
- Practical Design can be achieved by focusing on individual purpose and need statements for all projects to keep design teams focused on the task at hand. Doing so will achieve better results than across-the-board application of printed standards.

- Many states have implemented or are currently implementing Practical Design principles, although they may call it something different.
- There is a relationship between Practical Design and Context Sensitive Solutions/Design. In fact, in their purest form, they're synonymous.
- It's not all about saving money; it's about adding value.
- Financial savings may go away as agencies get better at Practical Design and projects are programmed having been practically scoped.
- Communication with the public and stakeholders is a key to determining purpose and need as well as for successful Practical Design implementations.
- Practitioner inputs seemed to indicate that engineers are not worried about the specifics of a *title* or having an absolute *definition*. Rather, they seemed to look for ***principles*** that drive the ***concepts*** surrounding Practical Design.
- The concept of Practical Design, as discussed, is heavily focused toward the engineering community and discipline.
- Practical Design is the current state of the practice. It rejuvenates practices from sound highway engineering principles.
- Practical Design needs to be part of the program delivery process from initial planning through maintenance and operations for it to be sustainable in the long term.
- The focus has to be on system results rather than solely on individual project results.

The results of the literature review and extensive involvement of practitioners and senior leaders in the AASHTO community guided work plan development. Key themes include:

1. Shared ownership of the initiative. Initiative partners could include entities like FHWA, the Institute of Transportation Engineers (ITE), AASHTO, the American Council of Engineering Companies (ACEC), and the American Society of Civil Engineers (ASCE) to ensure the broadest possible reach to the engineering and transportation community.
2. AASHTO to organize a shared ownership approach.
3. The lessons learned (solving problems, citizen involvement, and project development) in the late 1960s and early 1970s have eroded over the last 25 years. This can be attributed to cutbacks in training programs; programmatic changes in the era of the Intermodal Surface Transportation Efficiency Act (ISTEA); and the recent focus on technology solutions, innovative financing, asset management, and performance management drawing focus away from maintaining skills and innovation in engineering and Practical Design.
4. There is an opportunity for AASHTO and its partners to address the impression that troubles with projects belong to the engineers. The work plan could help shift perceptions from "engineer as villain/victim" to "engineer/project manager as hero or innovator."
5. A work plan must be forward thinking so that it will stand the test of time and be relevant into the foreseeable future.

The research highlights a grouping of underlying work plan initiatives that will facilitate helping professionals and DOTs to accomplish their program and project goals. These include:

- **Supporting visionary leadership** both at the national and state levels. Each new agency executive should be encouraged to embrace the concept as a means of helping their agency further Practical Design concepts and principles.
- **Ensuring the connection and understanding** between the planning and programming functions so that early requirements do not exert disproportionate control over parameters or limit creative freedom.
- **Revising and adapting** key AASHTO guides and manuals to create and authorize flexible and innovative design environments.

- **Addressing needed educational tools and programs** to assist new staff and support continuing education for experts.
- **Learning without a fear** of potential failure.
- Presenting and promoting results.
- **Supporting development of skills** in writing, listening, public speaking, negotiating, managing consultants, marketing decisions, dealing with stress and time management, and in the art of making an argument.

Implementing a few significant initiatives at the national level to support each state's individual efforts will facilitate achieving a level of flexibility in highway design that will overcome most, if not all, of the challenges associated with the use of Practical Design. Proposed initiatives for AASHTO to consider as part of a Practical Design work program are included in Chapter 4.

CHAPTER 4

Proposed AASHTO Work Program

The research identified a number of actions that can be taken by AASHTO that would contribute to Practical Design being better understood and accepted nationally. The proposed work plan that follows lists actions that can be done in the short term (1-3 years), medium term (2-5 years) and long term (3-7 years) to drive Practical Design toward an industry standard. The estimated cost for each initiative is also included.

Research Observations that Drive an Effective Work Program

The research team has identified the critical elements related to shaping an effective work program for the purposes of developing, communicating, implementing, and sustaining a Practical Design program.

Understanding the Power of AASHTO Design Guides

The documents developed and maintained by AASHTO are rich in technical information and are intended to "guide" rather than restrict decision making. However, some have viewed these guides as a strict set of standards; thus, a key to success is showing the flexibility that exists within the guidance.

The Power of Shared Ownership

There needs to be a strong, shared ownership of any initiative. It cannot be perceived that any one entity (FHWA/ITE/AASHTO/ACEC/ASCE) is dominant or trying to control the results. AASHTO can be the convener of a shared ownership approach.

Re-Establishing a Lost Set of Skills

The research shows that practitioners believe there has been a loss of practical highway engineering design skills. The lessons learned (solving problems, citizen involvement, and project development) in the late 1960s and early 1970s seem to have been overlooked or deemphasized during the last 25 years. This can be attributed to cutbacks in training programs, ISTEA-era program changes, and a shift in focus toward technology solutions, innovative financing, asset management, and performance management, all of which have drawn attention away from maintaining skills and innovation in highway engineering and practical design.

Engineer as a Solution Leader (Hero or Villain)

This initiative represents an opportunity for AASHTO and its partners to deal with the impression that project-related issues can be attributed to the engineer's inflexibility. This project's work plan helps move the needle from "engineer as villain/victim" to "the engineer/project manager as leader/innovator." The perception of engineers as inflexible and standards-driven can be changed, so that the engineer can be seen as flexible, innovative, and receptive of outside input to address a project's purpose and need. Public and stakeholder acceptance of project solutions will increase, and states will be able to address more transportation needs.

Long-Term Success (Sustainability)

A work plan, once it is framed and agreed to, must also stand the test of time. It cannot be perceived as the "flavor of the day" or the latest term coined by a new leader or administration; if it is, professionals will view it as a passing phase and will not embrace it as good for the profession or sustainable for the long-term. Ultimately, it must be viewed as a core mission for AASHTO and the transportation engineering community.

Recommended Implementation Initiatives and Actions for AASHTO

Implementation ideas generated during the research were categorized into five work plan initiatives: leadership moving forward, institutional / sustainment activities, policy or guidance, tools and technology, and outreach. Estimated costs as well as recommended implementation priority (short, medium, long term) is included in Table 3.

1. Leadership Moving Forward (LD)

Leadership that keeps Practical Design at the forefront of the discussion within AASHTO is critical to its long term sustainability. The following action is suggested to provide leadership on Practical Design until it becomes embedded as a normal part of highway design activities: This category includes the following suggestions:

- LD-1: Initiate a task force or special committee on Practical Design to oversee implementation of the proposed AASHTO work program for this project. Individuals on this committee will coordinate directly with those on the appropriate other committees regarding implementation efforts. This will signal the importance of Practical Design within the AASHTO structure.

2. Institutional / Sustainment Initiatives (IS)

Recommended actions in this initiative keep Practical Design at the forefront of the discussion within AASHTO. Ultimately, these should continue until the Practical Design concept becomes embedded as a normal part of highway design activities. This category includes the following suggestions:

- IS-1: Modify the strategic plans for all appropriate committees to include Practical Design Implementation. Strategic plans guide each committee's efforts, so inclusion of Practical Design in the plans ensures that the intended design flexibility becomes institutionalized over the long term.
- IS-2: Pursue a national partnership agreement with the significant leaders in engineering and innovative design. These could include AASHTO, the Institute of Transportation Engineers (ITE), the American Council of Engineering Companies (ACEC), the American Society of Civil Engineers (ASCE) and FHWA. This partnership ensures Practical Design is an overarching engineering effort rather than an endeavor pursued by AASHTO alone. Because the groups mentioned develop engineering guidance, making this an industry effort will help sustain the concept universally in the long term. These groups may also have a way to assist financially with the cost for the work program. The program could be similar to the SHRP2 implementation with FHWA.
- IS-3: Include Practical Design information in AASHTO's new executive orientation.

3. Policy or Guidance Initiatives (PG)

It is clear from the research that AASHTO documents, although intended to be used as guidance, are often used as strict standards for highway design. It is very important that these documents reflect the importance of flexible highway design and the Practical Design philosophy and guiding principles. Research indicates that updates to these documents can take several years to occur. Therefore, to expedite the process, several actions should be pursued:

- PG-1: Develop common language regarding Practical Design and decision-making flexibility for use in all AASHTO guidance documents. This language should include an emphasis that the document provides guidance and is not a strict standard. The language should be provided at the beginning of the documents and reiterated as needed throughout the document.
- PG-2: Update the documents on a more frequent basis.
- PG-3: Create a bridge document that provides guidance on how to use all of the guides together, an interpretive document for design professionals. This document would also emphasize the flexibility available to the designer as well as the importance of the project setting in determining project options and solutions.

4. Tools and Technology Initiatives (TT)

AASHTO can provide tools and technology solutions that can assist agencies in their implementation of Practical Design.

- TT-1: Develop a capability maturity model as a tool to assist agencies in identifying their current state of understanding with regard to practical design, to provide a roadmap to improvement, and to measure agency progress from startup through a mature business process. It will help agencies measure their readiness to engage in practical design and provide direction on where they need to focus their efforts.
- TT-2: Develop Practical Design training programs that could be offered to state and local agencies. This should include on-line training courses that utilize Practical Design principles in conjunction with AASHTO guidance documents.
- TT-3: Develop a Practical Design implementation template and toolbox that provides states that are initiating implementation with a "How To" guide. This can also serve as a resource for states already implementing Practical Design.

5. Outreach Initiatives (OR)

Experienced and inexperienced highway design engineers and technicians could benefit from enhanced continuing education. In order to rebuild and sustain skills in highway engineering, three implementation initiatives are recommended in the outreach category.

- OR-1: Conducting peer-to-peer opportunities at the AASHTO annual and spring meetings as well as select committee meetings.
- OR-2: Promoting Practical Design actively through documentation and aggressive dissemination of a wide range of examples.
- OR-3: Sponsoring a quarterly Practical Design webinars series.

Table 3. Initiative Estimated Cost and Recommended Priority

INITIATIVE NUMBER	DESCRIPTION	ESTIMATED COST	RECOMMENDED PRIORITY
LD-1	Oversight Task Force	$100,000	Short
IS-1	Executive Orientation	$40,000	Short
IS-2	Strategic Plans Change	$20,000	Medium
IS-3	Partnership Development	$150,000	Long
PG-1	Common Language	$150,000	Medium

INITIATIVE NUMBER	DESCRIPTION	ESTIMATED COST	RECOMMENDED PRIORITY
PG-2	Document Update	$400,000	Long
PG-3	Bridge Document	$400,000	Short
TT-1	Capability Maturity Model	$350,000	Long
TT-2	Practical Design Training	$750,000	Medium
TT-3	Practical Design Guide	$750,000	Short
0R-1	Peer to Peer Opportunities	$100,000	Short
OR-2	Promoting Practical Design	$100,000	Short
OR-3	Webinars	$100,000	Short

Recommended Priority Key:

Short-Term = 1- 3 year

Mid-Term = 2-5 years

Long-Term = 3-7 years

CHAPTER 5

Performance Measures

For more than 10 years, the transportation community has pursued a journey to establish performance management and measures as a methodology to shift from incremental reviews and approvals that micro--manage project delivery, to the use of outcomes and expectations from the customer viewpoint. An outcome-based focus would hopefully allow agencies and personnel to be more creative in their solution development.

Implementing performance metrics that are easy to understand support the need for transparency and accountability for a state transportation agency, particularly among elected officials and the public. Performance measures can help sustain a program or initiative beyond a change in leadership. They can provide vital statistics to justify potential funding increases or avoid funding cuts if the legislature or public is not satisfied with project solutions and state DOT direction. In the absence of metrics, project scope creep may enter the process, resulting in the allocation of scarce resources for less efficient or effective projects.

The key lessons related to developing Practical Design performance measures include the following:

1. A universally acceptable set of outcomes and measures has proven to be an elusive target.
2. Performance management/measures need to reflect the unique circumstances of the environment in which the DOT exists.
3. Elected officials, stakeholders, and the public should be involved in the development of measures that will be reported externally.
4. The effort will take time and require patience.
5. In many cases there is no need to "re-invent the wheel"; existing measures may provide metrics for Practical Design.

Measuring the Success of Practical Design

Literature reviews and workshop participants provided significant insights regarding the need for and approach to measuring success.

- States want to show stakeholders, practitioners, and the general public that they are being good stewards of scarce resources and are making best use of available funds to address as many needs as possible. Good stewardship of public funds leads directly to increased public trust and can have a direct impact on additional funding.
- To assist in financial management, many states have moved toward a program that incorporates the Practical Design philosophy and principles. However, efforts to measure Practical Design are still in the early stages.
- Most states have used and continue to use project savings as a key measure of success. While this measure can certainly provide an initial boost to the implementation and marketing of a state's program, it has been criticized for a number of reasons:
  - Initial cost savings can represent the gap between standards-driven engineering and a Practical Design solution to meet a project's purpose and need. However, measuring cost savings can be

portrayed as an indicator that the state is more interested in less expensive projects rather than in delivering a project that meets a specific purpose and need.
  - Another concern is that showing significantly greater savings now can be portrayed as having been wasteful in past decision making.
  - A further dilemma with cost savings as a measure is that full implementation of Practical Design includes the scoping phase of a project. As states improve their process for identifying the purpose and need for a specific project and use Practical Design principles to develop an initial cost estimate, reported savings should dwindle.

Practical Design Performance Measures Framework

The key to successfully developing and implementing a metric system for Practical Design lies not in beginning with a clean slate and adding one set of measures to a field already full; but recognizing the large body of work that already has emerged and taking advantage of the trends already existing and those being adopted. The body of research developed since 2004 clearly indicates that a basic framework of performance measures is coalescing around common dimensions of the transportation business. These appear to be:

- Organization-based (agency) performance measures,
- Network-based (roadway system) performance measures, and
- Project-based (location-specific) performance measures.

There is a significant body of work that points agencies toward the process for developing performance measures. While an illustrative set of Practical Design measures can be developed, it is important that each state engage in an activity that makes these measures "their own" and reflects the unique characteristics of their customers and stakeholders. The challenge is to assemble a group of performance measures that, while not necessarily new, are reflective of Practical Design principles and measure organizational implementation efforts.

Note that each performance measure listed is intended to provoke thought, not to imply that these particular measures are required.

Illustrative Organization-based Performance Measures

Organizational or state-level measures are used to determine how well the state DOT is performing overall. The measures that follow are organizational-level examples of metric types that could reflect Practical Design implementation progress within an agency. A state may already have in place organization-level measures that may be well suited for Practical Design.

1. **Overall public satisfaction with a state's project solutions**. Ultimately, the public will judge the success of any state program. If the state is focused on purpose and need for all projects and communicating with the public throughout the process, the public is more likely to be satisfied with the state's choices. This organizational measure could be a compilation of project-specific or network-specific public satisfaction measures.

2. **Specific state goals.** States have numerous responsibilities that will be considered in decision-making on projects. A state could establish a specific organizational goal--such as using recycled materials in projects-- which can be reported and measured statewide. State-specific goals can differ from state to state and should be considered when determining the success of a program. Additional examples could include walkability or sustainability goals.

3. **Practical Design audits**. Annual project reviews will determine whether Practical Design is being fully-implemented or if the agency is reverting to former practices and unnecessary scope creep has occurred.

Illustrative Network-based Performance Measures

Network-level measures are used to determine how well a particular system is performing. It could be the transportation system as a whole or a subset of the system. These measures tend to be the most familiar to state DOTs and have been measured and reported for many years. The measures that follow are examples of network level metric types that could reflect the impact Practical Design has on the transportation network as a whole. A state may already have in place network-level measures that may be well-suited for Practical Design.

1. **Safety**. This measure is important to show that "cheap" solutions aren't being chosen at the expense of improving or maintaining safety for all road users. Practical Design strategies at the project level can be compiled providing increased network-level safety for the entire system (statewide) or a specific subset of the system such as Interstate or National Highway System (NHS) routes.

2. **State-specific Goals**. States have numerous responsibilities that will be considered in decision making on projects. It is possible that a state could establish a specific goal for a subset of the transportation system, such as implementing a regional bicycle and pedestrian plan. State-specific goals can differ from state to state and should be considered when determining the success of a program. Additional examples could include environmental or sustainability goals.

3. **Asset condition (e.g., bridges, roadway surface, signs, etc.).** If the goal is to leverage scarce dollars to do the most work possible for the system, tracking asset condition can be an indicator of how well agencies are stretching their dollars. However, other factors can affect this measure as well (an increase in available construction funds, for example), so it's important not to attribute too much benefit to Practical Design.

Illustrative Project-specific Performance Measures

Measuring the specific performance of a given project is important because it allows the agency to determine that the purpose and need have been addressed by the solution that was implemented. Measures should not be limited to the design phase, however; the planning and construction phases of a project can be equally important because deviation from Practical Design can take place before and after the design phase as well. The measures that follow are examples of project-specific metric types that could reflect Practical Design use. A state may already have in place project-level measures that may be well suited for Practical Design.

1. **Practical Design project review**. Implementation of a project review process that includes Practical Design principles will allow a state to determine if a specific project has been properly scoped (i.e., purpose and need clearly identified). Periodic reviews at specific milestones can be used to verify that purpose and need is being achieved (no more and no less) or if a specific project is slipping back and unnecessary scope creep has occurred. This measure can also be effective in sustaining the Practical Design culture in the early days of implementation.

2. **Public satisfaction with project solutions**. Ultimately, the public will judge a project's success to determine if it solved the problem. Citizens' views on a specific project can be used to make adjustments to the project and, if necessary, the overall Practical Design program. Dissatisfaction at the project level could be an indicator of poor choices for solutions or lack of public involvement early and often in the project.

3. **Safety**. Once again, safety is a universally accepted metric that can be measured at the project level. This measure is important to show that "cheap" solutions aren't being chosen at the expense of safety. The *Highway Safety Manual* can be useful here as it provides the basis to calculate the impact of various solutions versus the pre-project condition (e.g., the expected increase in the frequency of crashes when roadway shoulder widths are reduced).

4. **Cost savings from the initial project estimate**. This measure has been important for a number of states. It shows how much money has been saved through Practical Design and reallocated to other projects. Ironically, this project-level measure could ultimately go away with full implementation of Practical Design, when well-vetted purpose and need statements and initial cost estimates reflect the Practical Design philosophy. At that point, designers will be challenged to find significant additional savings.

Forward Plan

The performance measure framework and illustrative measures discussed in this chapter reflect information that would be reported to the state's customers; i.e., the taxpayers. An evolving internal mechanism for assessing an agency's progress toward implementing a significant initiative is a Capability Maturity Model, mentioned previously in Chapter 4. The Capability Maturity Model recommended in the work plan (Chapter 4) measures progress from startup through mature business process and will help a state measure their readiness to engage in Practical Design. It will also provide direction on where an agency should focus their efforts to continue progress on their Practical Design journey.

Summary

States develop and routinely share performance measure data. As states continue to develop Practical Design programs, more will be discovered about the value of individual measures. Ultimately, the best measures will be those that keep a state on the Practical Design implementation path now and sustain the concept into the future without sacrificing other state goals and objectives.

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ABBREVIATIONS, ACRONYMS, INITIALISMS, AND SYMBOLS

AASHTO	American Association of State Highway and Transportation Officials
ACEC	American Council of Engineering Companies
ASCE	American Society of Civil Engineers
ADA	Americans with Disabilities Act
CAA	Clean Air Act
CFR	Code of Federal Regulations
CSD	Context Sensitive Design
CSS	Context Sensitive Solutions
DOT	department of transportation
FHWA	Federal Highway Administration
HSM	Highway Safety Manual
ITE	Institute of Transportation Engineers
ITS	intelligent transportation systems
IHSDM	Interactive Highway Safety Design Model
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
MUTCD	Manual on Uniform Traffic Control Devices
MOE	measures of effectiveness
MPO	metropolitan planning organizations
NHS	National Highway System
SCOD	Subcommittee on Design
TEA-21	Transportation Equity Act for the 21st Century
VE	Value Engineering

APPENDIX A. Literature Synopsis

Synopsis #	1
Title	***NCHRP Legal Research Digest 57 – Tort Liability Defense Practices for Design Flexibility***
Author(s)	Terry L. Parker, Esq. and James B. McDaniel
Year	2012
URL	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_lrd_57.pdf
Key words	Context Sensitive Solutions (CSS), practical design, tort liability, flexible design, purpose and need
Applicable Tasks	2, 3, 4, 5, 6

Synopsis

Legal Research Digest 57 focuses on tort liability defense practices and cases involving the use of discretion in design. The strategies follow the principles of CSS.

Definitions, Vocabulary, Terminology, Practical Design Principles

N/A

Implementation Issues, Challenges, Hurdles, Impediments

Context Sensitive Design (CSD) and Context Sensitive Solutions (CSS) – Report referenced the definition from contextsensitivesolutions.org website. Key words: collaborative, interdisciplinary, involvement of stakeholders.

Threat of tort claims discouraged design engineers from being innovative designs. Drove them to adhere strictly to guidelines and standards. The best defense for a design engineer is to document their decision making.

California has a Director's Policy in place that directs Caltrans to use CSS for all phases from planning to maintaining and operating the system. Solutions use approaches that integrate and balance community, values with transportation goals. Other issues such as funding feasibility, maintenance feasibility, traffic demand, impact on alternate routes, impact on safety and relevant laws, rules, and regulations must be addressed.

Georgia has a quality control/quality assurance program to ensure decisions are documented and comply with policies, guidelines and standards. They also check for use of design flexibility and cost savings measures.

Oregon uses the term Practical Design as an approach to deliver the broadest benefits to the transportation system within existing resources. They focus on appropriate project scopes and design guidelines to deliver. They focus on the project's purpose and need, and have a clear process for approving and documenting the important design decisions. Engineers must assess adverse consequences, design tradeoffs, and risks to determine a practical solution.

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

The authors recommend that legal counsel review a state's design policy to ensure that policies and practices are aligned. Documenting decisions is very important and is a key component of being able to defend against claims or lawsuits. State decision makers have to understand their tort liability laws and exposure. Some state laws exempt decision makers and the agency from liability from a perceived flaw in the design procedure (e.g., Hawaii), but many of them do not.

It may be helpful for the state to have a policy in place that states that while safety is an important factor that will always be considered in the design of the project, it will be balanced with other equally important factors such as economic, historical, and environmental considerations.

The authors argue that the best strategy for defense is solid documentation of the reason for the decision. Documentation should conform to the policy on flexible design.

In addition, each state's tort liability and immunity laws are slightly different and should be a considered while developing policy.

The authors advise States to use language such as "the agency was in compliance with reasonable engineering principles" rather than "generally-accepted standards" during a case.

Engineering policies must reflect the flexible design practices (e.g., Missouri's clear zone law suit).

Additional Information, Comments

This document appears to use "context sensitive solutions" as the umbrella term along with "practical design" as a related concept under that umbrella.

This would be a good document for use by states' legal counsel to be able to advise agencies as to specific risks.

Synopsis #	2
Title	***NCHRP Synthesis 443 – Practical Highway Design Solutions***
Author(s)	Hugh W. McGee Sr.
Year	2013
URL	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_443.pdf
Key words	Practical design, context sensitive solutions, value engineering, design flexibility, design exceptions
Applicable Tasks	2, 3, 4, 5, 6

Synopsis

This is a synthesis of current practices in Practical Design. It includes a survey of DOTs. Specific information for six DOTs that had adopted formal practical design policies at the time Synthesis 443 was written.

Definitions, Vocabulary, Terminology, Practical Design Principles

- Practical Design (MO, OR, UT), Practical Solutions (KY, ID), Practical Improvements (KS)
- Practical Design – method to determine the most cost effective way to achieve the projects purpose and need. The consistent theme among states isn't a specific definition but rather policies that are written in terms of goals, principles and process.
- Value Engineering (VE) – usually reserved for large scale projects, method to determine the most cost effective way to achieve proposed improvements.
- Context Sensitive Solutions (CSS) – process that addresses the needs of multiple users and functions of the facility, which can sometimes lead to added costs
- Design Exceptions – Decision process to document choosing a design element that is less that what is required by Design Manual
- A common measure has been cost savings over conventional design process.
- Some states believe they are following practical design principles through CSS, design exceptions and VE.

Implementation Issues, Challenges, Hurdles, Impediments

None of the states reported significant barriers to implementation that weren't overcome with training, education and communication. Staff initially concerned when higher level of design not selected for project. There is some confusion between practical design, CSS and VE (how do they relate). Liability issues were considered but did not slow implementation. States have branded their efforts differently. Design exceptions have to be well documented.

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

A policy document for the agency is likely needed. Training, education and communication with stakeholders are important. Practical Design must be used throughout program delivery process including planning and scoping phases. Establishing a proper scope for the project at the planning phase is very important. Preparation and documentation of design exceptions is very important where design elements are chosen that are less than what is required by the design manual. The information and procedures in the Highway Safety Manual have helped states evaluate project-specific roadway design tradeoffs.

Additional Information, Comments

None

Synopsis #	3
Title	***NCHRP Synthesis 422 – Trade Off Considerations in Highway Geometric Design***
Author(s)	Paul W. Dorothy and Stephen L. Thieken
Year	2011
URL	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_422.pdf
Key words	Design trade-offs, Context Sensitive Solutions (CSS), Context Sensitive Design (CSD), Performance Based Planning, Choosing by Analysis (CBA), Measures of Effectiveness (MOE)
Applicable Tasks	2, 3, 6

Synopsis

Survey that outlines what agencies are using to evaluate design trade-offs between competing interests. The report highlights gaps in information or analysis processes to support the design decision.

Definitions, Vocabulary, Terminology, Practical Design Principles

Safety is a measure of the freedom from unacceptable risks of personal harm. Several examples of MOEs are provided.

Implementation Issues, Challenges, Hurdles, Impediments

Some agencies did not evaluate trade-offs or had no way to evaluate trade-offs. A few have codified procedures for evaluating trade-offs in highway design. There are limited risk prediction tools or techniques.

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

Common tools to evaluate trade-offs are the Highway Safety Manual, crash history, and life-cycle cost analysis.

Additional Information, Comments

There has to be a process for evaluating alternatives. Engineering judgment should complement that evaluation. Shoulder width is the most common design exception. The majority of the time agencies conduct trade-offs they rely on engineering judgment. Most agencies evaluate trade-offs during preliminary engineering or environmental clearance. Sometimes trade-offs are not raised until a design is nearly complete.

The most common issues are safety, cost and environmental.

There are 13 controlling design criteria.

Synopsis #	4
Title	***NCHRP Report 785 – Performance-Based Analysis of Geometric Design of Highways and Streets***
Author(s)	Brian L. Ray, Erin M. Ferguson, Julia K. Knudsen, Richard J. Porter, John Mason
Year	2014
URL	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_785.pdf
Key words	performance-based, design, project development, impacts, outcomes, performance measures, alternative solutions, flexible, design standards, context sensitive solutions, practical design, community, highway, benefits and costs, tort liability, risk management, geometric sensitivity
Applicable Tasks	2, 3, 4, 5

Synopsis

This report presents ways to use a performance-based analysis with the project development process that includes how to determine and understand the desired project outcomes and selection of performance measures for those outcomes.

Definitions, Vocabulary, Terminology, Practical Design Principles

The motivation for agencies to use performance-based analysis for project development and geometric design decisions is limited resources and the need to consider travel by foot, bike and transit (community values).

It a principles-focused approach that looks at the outcomes of design decisions as the primary measure of design effectiveness.

Principles of performance based analysis design:

- Intended outcomes
- Connection to project development process
- Performance measures of design decisions

Steps in performance-based analysis to inform geometric design:

- Identify intended project outcomes
- Establish geometric design decisions
- Evaluate the performance of the geometric design
- Iterate design and outcomes to optimize
- Evaluate benefit/costs
- Select or advance project or alternatives.

Context-sensitive and flexible design approaches consider “Whom are we serving?” and “What are we trying to achieve?”

This approach supports flexible design solutions or elements to be able adapt to unique project needs.

A key fundamental concept is geometric sensitivity which is the degree to which varying the dimensions related to a geometric element has an impact on performance.

Implementation Issues, Challenges, Hurdles, Impediments

None

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

Designing to standards does not reduce a professional’s risk for being sued. Designing to standards does not always achieve the solution. Performance-based analyses are part of the project design documentation to support decision making.

Documenting design decisions is a key component in managing tort liability. Agencies should have a process for understanding intended project outcomes, and a logical means to consider a range of design choices and solutions. This will give them a reproducible and objective methodology. Adapting a project may lead to design exceptions and some approaches may lead to geometric values or configurations outside published design values.

FHWA and AASHTO publications emphasize the importance of flexibility. Flexibility in geometric design has been supported for years.

Utilizing Interactive Highway Safety Design Model (IHSDM) and Highway Safety Manual (HSM) applications can support and inform design decision making for projects of any context. Documenting the evaluation methods and factors can support a comprehensive risk management strategy.

Additional Information, Comments

The results of geometric design decisions may or may not meet overall project needs. Address transportation needs in terms of project context and performance-based analysis results will support informed decision making.

Transportation performance categories:

- Accessibility
- Mobility
- Quality of service
- Reliability
- Safety

Synopsis #	5
Title	***NCHRP Report 446 - A Guidebook for Performance Based Transportation Planning***
Author(s)	Cambridge Systematics, Inc.
Year	2000
URL	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_446.pdf
Key words	performance-based, transportation planning, performance measures, guidebook, planning process, strategic visioning, analysis, results, process, case studies
Applicable Tasks	4, 6

Synopsis

This project focused on how to use performance measurement and monitoring in the multimodal transportation planning process and establishes the rationale for performance-based planning. The Performance Measures is a listing of performance measures identified by the research.

This report is intended to provide transportation organizations, planners, and decision makers with tools and guidance for considering system performance in the multimodal transportation planning and decision-making process. The performance measures should support transportation investment decisions for specific situations as well as performance needs for major transportation systems. It is presented as a guidebook for a wide range of applications with different scopes and levels of complexity.

Definitions, Vocabulary, Terminology, Practical Design Principles

The benefits to be gained from performance-based planning could be substantial. One of these is the ability to better direct resources to those programs and projects that provide the best return on investment, as measured by progress toward the goals of the local transportation plan or other relevant policy plans and documents.

Implementation Issues, Challenges, Hurdles, Impediments

None

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

Factors that have increased awareness of a more broad range of goals and objectives for transportation:

- The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) legislation with its emphasis on multimodal solutions and its long-range planning, financial planning, management system, and flexible funding provisions;
- Concern about the most effective use of scarce resources;
- Increased awareness about the role of transportation in supporting economic competitiveness;
- Environmental laws and regulations;
- Social and equity concerns;
- Transportation/land use; and
- New technologies that provide a broader range of transportation solutions.

Additional Information, Comments

Performance-based planning must include public outreach and participation, strategic visioning, and analysis.

Synopsis #	6
Title	***NCHRP Report 480 - A Guide to Best Practices for Achieving Context Sensitive Solutions***
Author(s)	Timothy R. Neuman, P.E., Marcy Schwartz, Leofwin Clark, and James Bednar
Year	2002
URL	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_480.pdf
Key words	context sensitivity, transportation agency, project development process, context sensitive design, context sensitive solution, case studies, process, operational solution, AASHTO Green Book, traditional design practices, substantive safety, nominal safety, tort liability, community values, environmental sensitivity, effective decision making, alternatives, design exceptions, flexibility, rigid design standards/criteria
Applicable Tasks	2, 3, 4, 5, 6

Synopsis

Developed as a guide to show transportation agencies how they can incorporate context sensitivity into their projects. It applies to a wide variety of projects.

The report identifies ways to use context sensitive design principles, barriers to implementation as well as strategies to overcome the barriers.

Definitions, Vocabulary, Terminology, Practical Design Principles

Different organizations use their own terminology for Context Sensitive Design (CSD).

Many agencies are concerned with outcomes rather than process. Successful transportation projects include construction, maintenance, and operations in their program delivery process. A Context Sensitive Solution (CSS) includes all key functions of an agency.

All context sensitive projects do not include a design component and an operational solutions may be appropriate in some instances.

Implementation Issues, Challenges, Hurdles, Impediments

Designers will be concerned with how to use proven design criteria and policies published by AASHTO and their respective agency, without increasing the risk to their agency.

Establish the participants in the decision process including who has the authority to make decisions, such as design exceptions.

Most agencies must deal with the issue of tort liability. Agencies are faced with defending design decisions while dealing with lawsuits resulting from traffic crashes. The courts expect that decisions made and actions taken be reasonable for the circumstances.

Six key issues for resolution of court cases:

- Did damages occur?
- Did a potentially dangerous defect exist?
- Was the defect a “proximate” cause of the damages?
- Did the agency have knowledge of the defect?
- Was the transportation agency acting in a “discretionary” or “ministerial” role?
- Did the plaintiff contribute to the crash through negligent behavior?

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

Essential aspects for a successful CSD/CSS project:

- Effective decision making and implementation
- Outcomes that reflect community values
- Outcomes that are sensitive to environmental resources
- Project solutions that are safe and financially feasible

Best practices:

- Consider multiple alternatives
- Evaluate and document design decisions
- Maintain control over design decision making
- Demonstrate a commitment to mitigate safety concerns
- Monitor design exceptions to improve decision making

Context sensitive design is a top down initiative. Where it has been successfully implemented throughout an organization, success can be attributed to leadership at the top of the organization.

Additional Information, Comments

Design exceptions are not essential to successful CSD/CSS. Design flexibility does not mean that an agency ignores design criteria or their established design practices.

AASHTO has emphasizes that the Policy on Geometric Design is a flexible document. There is significant flexibility in technical content and recommended usage. Most design activities are based directly on an agency's design manual. Most design manuals have evolved over the years to be much more rigid.

Rigid design standards are believed to serve three purposes – design and construction efficiency and as a quality control measure. Design staff believes that adherence to standards equals safety and there can be no compromises.

Synopsis #	7
Title	***AASHTO Highway Safety Manual***
Author(s)	AASHTO, joint TRB Task Force
Year	2010
URL	No on-line publication available.
Key words	Safety, performance measures, data-based decisions
Applicable Tasks	2, 3, 4, 5, 6

Synopsis

The Highway Safety Manual provides information and tools for incorporating data-driven consideration of safety into the project planning and development process. The manual allows for determining the impacts of design and other decisions on the expected safety performance of a facility. The AASHTO *Policy on Geometric Design of Highways and Streets* (the "Green Book") and *Roadside Design Guide* present recommended ranges of values for given elements in the roadway or roadside environment, the HSM allows for determining the expected safety impact of using a specific value over another value

Definitions, Vocabulary, Terminology, Practical Design Principles

None.

Implementation Issues, Challenges, Hurdles, Impediments

Performance measures. Qualitative analyses.

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

None

Additional Information, Comments

The HSM provides tools to conduct quantitative safety analyses, allowing for safety to be quantitatively evaluated alongside other transportation performance measures such as traffic operations, environmental impacts, and construction costs. The HSM emphasizes the use of analytical methods to quantify the safety effects of decisions in planning, design, operations, and maintenance. The HSM methods can be applied in each step of the project development process.

Synopsis #	8
Title	***AASHTO A Policy on Geometric Design of Highways and Streets, 6th Edition (2011) Green Book***
Author(s)	AASHTO
Year	2011
URL	No on-line link to publication
Key words	Design, Engineering Judgment
Applicable Tasks	4

Synopsis

Geometric design guidance for Highway Engineers.

Definitions, Vocabulary, Terminology, Practical Design Principles

None.

Implementation Issues, Challenges, Hurdles, Impediments

Notes from foreword: "Good highway design involves balancing safety, mobility, and preservation of scenic, aesthetic, historic, cultural and environmental resources." "…does not supersede the need for application of sound principles by the knowledgeable design professional." "Engineering judgment is exercised by highway agencies to select appropriate design values."

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

None

Additional Information, Comments

No reference to Practical Design, Context Sensitive Solutions, alternative analysis, documentation.

Synopsis #	9
Title	***AASHTO Roadside Design Guide, 4th Edition***
Author(s)	AASHTO
Year	2011
URL	N/A
Key words	Design
Applicable Tasks	4

Synopsis

Guidance document for the design of roadsides (beyond the travelway).

Definitions, Vocabulary, Terminology, Practical Design Principles

None

Implementation Issues, Challenges, Hurdles, Impediments

Preface talks about use of the document as a guide. Section 1.5 has good information regarding the application of the guide.

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

None

Additional Information, Comments

No reference to Practical Design, Context Sensitive Solutions, alternative analysis, documentation

Synopsis #	10
Title	***AASHTO A Guide for Achieving Flexibility in Highway Design, 1st Edition***
Author(s)	AASHTO
Year	2004
URL	No online link to this publication. The following link contains summary/excerpts: http://contextsensitivesolutions.org/content/reading/guide-for-achieving-flexibility/
Key words	flexible design, Context Sensitive Solution (CSS), Green Book, …
Applicable Tasks	2, 3, 4, 5, 6

Synopsis

This AASHTO Guide shows highway 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 situation or context. It also strives to emphasize that flexible design does not necessarily entail a fundamentally new design process, but that it can be integrated into the existing transportation culture. This publication represents a major step toward institutionalizing CSS into State transportation departments and other agencies charged with transportation project development.

This publication demonstrates flexibility in the AASHTO Green Book guidelines in the areas of access control, bridges, decision sight distance, horizontal alignment, intersection sight distance, lane width, medians, pedestrian and bicycle facilities, shoulder width, roadside, vertical alignment.

It also lists mitigation countermeasures in the following areas: decision sight distance, horizontal alignment, lane width, passing sight distance, shoulder width, vertical alignment.

Definitions, Vocabulary, Terminology, Practical Design Principles

None

Implementation Issues, Challenges, Hurdles, Impediments

None

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

None

Additional Information, Comments

None

Synopsis #	11
Title	***Context Sensitive Solutions.org (website)***
Author(s)	n/a
Year	n/a
URL	http://contextsensitivesolutions.org/
Key words	context sensitive, solution, process, product, collaborative, interdisciplinary, holistic approach, comprehensive, collaborative, flexibility, community, transportation, environmental, needs-based, multimodal, alternatives, safe, all users, aesthetic treatments, enhancements, value, preserving, livability
Applicable Tasks	2, 3, 4, 5, 6

Synopsis

This resource is a comprehensive website devoted to Context Sensitive Solutions (CSS). The website has information on the principles, qualities, outcomes, actions, history, and benefits of CSS, as well as many other resources relating to CSS. Some of the additional resources include: links to CSS publications, training/webinars, projects/case studies, videos/images, quotes, facts, and a discussion forum. The website also includes profiles for States in regards to their level of involvement with CSS.

Definitions, Vocabulary, Terminology, Practical Design Principles

FHWA defines Context Sensitive Solutions is a collaborative, interdisciplinary, holistic approach to the development of transportation projects. It is both process and product, characterized by a number of attributes. It involves all stakeholders, including community members, elected officials, interest groups, and affected local, state, and federal agencies. It puts project needs and both agency and community values on a level playing field and considers all trade–offs in decision making. Often associated with design in transportation projects, Context Sensitive Solutions should be a part of all phases of program delivery including long range planning, programming, environmental studies, design, construction, operations, and maintenance.

Implementation Issues, Challenges, Hurdles, Impediments

None

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

None

Additional Information, Comments

There is a section within this website that details the legal and professional basis of CSS by explaining history of CSS and various events that took place to support CSS principles (such as, NEPA, Intermodal Surface Transportation Efficiency Act (ISTEA), FHWA Environmental Policy Statement, NHS Designation Act, Flexibility in Highway Design published, Maryland's Thinking Beyond the Pavement workshop, and much more). This is good background information, showing history of CSS concept.

Synopsis #	12
Title	***FHWA's Flexibility in Highway Design***
Author(s)	FHWA Pub. No. FHWA-Practical Design-97-062
Year	1997
URL	http://www.fhwa.dot.gov/environment/publications/flexibility/flexibility.pdf
Key words	flexibility, design, highway, innovative, sensitive areas, safety, standards, Green Book, balanced road design, flexibility within standards, tort liability, options, constraints, appropriate design, preservation
Applicable Tasks	2, 3, 4, 5, 6

Synopsis

A guide about designing highways that incorporate community values and are safe, efficient, and effective. It is written for highway engineers and project managers who want to learn more about flexibility available to them when designing roads and illustrates successful approaches used in other highway projects. The guide aims also at provoking innovative thinking for fully considering the scenic, historic, aesthetic, and other cultural values of communities, along with safety and mobility needs.

This Guide illustrates the flexibility already available to designers within adopted State standards. These standards, often based on the AASHTO Green Book, allow designers to tailor their designs to the particular situations encountered in each highway project. Often, these standards alone provide enough flexibility to achieve a harmonious design that both meets the objectives of the project and is sensitive to the surrounding environment

Definitions, Vocabulary, Terminology, Practical Design Principles

An important concept in highway design is that every project is unique. The setting and character of the area, the values of the community, the needs of the highway users, and the challenges and opportunities are unique factors that designers must consider with each highway project. For each potential project, designers are faced with the task of balancing the need for the highway improvement with the need to safely integrate the design into the surrounding natural and human environments.

- Use the flexibility within the standards adopted for each State.
- Recognize that design exceptions may be optional where environmental consequences are great.
- Be prepared to reevaluate decisions made in the planning phase.
- Lower the design speed when appropriate.
- Maintain the road's existing horizontal and vertical geometry and cross section and undertake only resurfacing, restoration, and rehabilitation (3R) improvements.
- Consider developing alternative standards for each State, especially for scenic roads.
- Recognize the safety and operational impact of various design features and modifications.

Implementation Issues, Challenges, Hurdles, Impediments

Tort liability

- The best defense for a design engineer is to present persuasive evidence that the guidelines were not applicable to the circumstances of the project or that the guidelines could not be reasonably met. (It should be noted that an economic defense is not the most effective.) It is highly recommended that designers document their rationales for decisions. If the justification documented by a designer completely describes the physical and environmental factors that make the exception or any design necessary, it is likely that this will be legally persuasive that the correct procedures were followed and ultimately the appropriate decision was made. In addition, it is helpful to have statements by other design experts who concur with the decision in the documentation.
- As a result of concerns about litigation, designers may be tempted to be very conservative in their approaches to highway design and avoid innovative and creative approaches to design problems. While it is important for design engineers to do their jobs as thoroughly and carefully as possible,

avoiding unique solutions is not the answer. This may undermine design practice and limit growth in the engineering profession. Designers need to remember that their skills, experience, and judgment are still valuable tools that should be applied to solving design problems and that, with reliance on complete and sound documentation, tort liability concerns need not be an impediment to achieving good road design.

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

The information contained in the above section is applicable here: providing best practice information for designers in order to document decisions, etc.

Having a process that is open, includes public involvement, and fosters creative thinking is an essential part of achieving good design.

Additional Information, Comments

This is a great reference for use in this project.

Additional information can be found at: http://contextsensitivesolutions.org/content/reading/flexibility/. It contains some easy-to-navigate sections/excerpts of this publication.

There was discussion on the Green Book and what it does not contain:

- AASHTO Green Book contains a general set of guidelines on road design, however, it is not meant to be a design manual. A great deal of flexibility is allowed, and designers are encouraged to tailor roads to particular situations
- In order for the design criteria in the Green Book to become a standard, they must be adopted by a particular State (or may be set by court decision). The FHWA has adopted applicable parts of the Green Book as the national standard for roads on the National Highway System (NHS). These roads comprise all the interstates and some other primary routes. The design of roads other than those on the NHS is subject to the standards of the particular State. The standards adopted by a State are usually based on the Green Book criteria.
- There are many aspects of design that are not directly addressed in the Green Book. A number of these items are as follows:
  - Problem definition
  - Project definition
  - Definition of the termini of the project
  - Development of a project concept
  - Aesthetic treatment of surfaces
  - Design within the appropriate context
  - Selection of the appropriate guardrail/bridge rail
  - Determination of functional classification
  - Determination of the appropriate functional requirements, capacity, and level of service
  - Structure design
  - Landscape development
  - Selection of light fixtures
  - Roadside development
  - Traffic operations

Synopsis #	13
Title	***Florida Department of Transportation Practical Design website***
Author(s)	Florida Department of Transportation (FDOT)
Year	n/a
URL	http://www.dot.state.fl.us/projectmanagementoffice/ProjectReview/PracticalDesign/default.shtm
Key words	practical design, efficient, budget, maintain, flexibility, scope of work, purpose and need, safety and operational performance, engineering judgment, critical thinking, design philosophy, needs and wants, alternatives, innovative, collaborate
Applicable Tasks	2, 4, 5, 6

Synopsis

FDOT has created a Practical Design Handbook. Like other DOTs, FDOT is increasingly expected to produce projects more efficiently with limited resources. FDOT must maintain its current infrastructure, while also meeting the demand for increased mobility of people and freight. The intent of the handbook is to provide basic guidance for implementation of a Practical Design approach.

Definitions, Vocabulary, Terminology, Practical Design Principles

Practical Design is a philosophy which maximizes improvements to the transportation system by focusing resources on project needs that deliver the highest return on investment.

This objective is accomplished in two parts:

- Developing the scope of work to meet the project's Purpose and Needs.
- Utilizing design flexibility based on safety and operational performance.

Practical Design is a design philosophy that encourages flexibility based on purpose and needs. Practical Design demands that the engineer make use of empirical evidence, science, and engineering judgment. This differs from traditional design, which is based on experience, standards, and manuals.

Under Practical Design, the overall context of the corridor should be considered.

Every project should either make the facility safer, or maintain the existing safety performance for that facility. Under no circumstances should an individual project be allowed to degrade the overall safety of the corridor or system.

Be innovative. The engineer is encouraged to explore the potential for adding value outside of FDOT's published criteria and standards.

Practical Design encourages engineers to maximize the use of Design Exceptions and Variations while also ensuring that those modifications are based on safety, cost feasibility, and operational performance. These factors help determine the best criteria for a project's site specific conditions.

Implementation Issues, Challenges, Hurdles, Impediments

None

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

None

Additional Information, Comments

None

Synopsis #	14
Title	***Idaho Transportation Department Practical Solutions for Highway Design***
Author(s)	Idaho Transportation Department
Year	n/a
URL	http://itd.idaho.gov/manuals/Manual%20Production/DesignSolutions/DesignSolutionsPrintable.htm
Key words	practical design, challenge traditional standards, cost-effective, efficient, safe, project needs, innovation, creativity, flexibility, context sensitive solution, purpose and need, planning, best value
Applicable Tasks	2, 4, 5, 6

Synopsis

Idaho Transportation Department (ITD) developed their *Practical Solutions for Highway Design* guide. It was not intended to supersede or replace the agency's Design Manual, section manuals or administrative policy. Also, it need not change the need for documentation of design decisions or to properly document design exceptions. It is intended to be a companion document during the planning and design process. The document describes how to consider practical design in the planning stage and when designing various roadway elements.

Definitions, Vocabulary, Terminology, Practical Design Principles

ITD's design philosophy is to build cost-effective projects and to achieve a safe and efficient transportation system. They point out that their Practical Design initiatives are parallel to and mutually support Context Sensitive Solutions.

Agencies must properly define the project scope by focusing on achieving the project purpose and need. It is important to be sensitive to project location and implement solutions that are appropriate to the context of the surroundings. The goal is to get the best value for the least cost. Life cycle costs must be considered so that additional responsibilities or costs are not shifted to maintenance.

They will not compromise safety. They state that the facility must be safer after project completion.

Practical Design is most efficient if it is considered during the planning stage.

Practical Design does not replace Value Engineering which should be considered on all complex projects with a high potential for savings.

Implementation Issues, Challenges, Hurdles, Impediments

None

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

None

Additional Information, Comments

None.

Synopsis #	15 & 16
Title	***INDOT Open Roads (Practical Design) / INDOT Open Roads Program Guide***
Author(s)	Indiana Department of Transportation
Year	May 28, 2014
URL	http://in.gov/indot/3261.htm and http://in.gov/indot/files/OpenRoads_ProgramGuide.pdf
Key words	practical design, limited resources, results, reduced costs, purpose and need, engineering judgment, evaluate, process, product, innovation, flexibility, solution, function, common sense, context awareness and sensitivity, design up, safer, system focus, alternative, communication, creative, performance measure
Applicable Tasks	2, 4, 5, 6

Synopsis

The Indiana Department of Transportation (INDOT) website (first link) gives an overview/introduction. The Program Guide (second link) provides an outline and recommendations for implementation of the INDOT Open Roads program utilizing Practical Design methodology as a foundation.

INDOT's Open Roads program addresses the challenge of delivering projects with limited financial resources. They also reference changes in consumer demand and mobility patterns.

Open Roads utilizes a practical design philosophy to maximize system-wide improvements. Their approach focuses on investments that benefit the roadway system as a whole rather than perfection for a single project. Their goal is construct project that deliver specific results.

Definitions, Vocabulary, Terminology, Practical Design Principles

Practical Design starts with a solid purpose-and-need project statement and a clear process for documenting design decisions. It requires good engineering judgment.

Open Roads encourages innovation and flexibility and places emphasis upon solutions that contribute to the overall condition and function of the corridor.

INDOT's Open Roads program identifies key principles that include: sound engineering judgment, a "design up" philosophy, getting the scope right and a safer, system focus.

Open Roads relies heavily on early and consistent stakeholder involvement.

Implementation Issues, Challenges, Hurdles, Impediments

The agency must adopt and adapt to a new way of thinking.

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

Performance measures include:

- Total cost savings attributable to Practical Design, expressed in dollars and as a percentage of construction estimates.
- Number, type, location, and cost (dollars and percentage) of projects implemented w/Practical Design.
- Number, type, and cost savings associated with Design Exceptions.
- Number, type, and cost savings associated with specific design alternatives and changes.
- Number, type, location, and cost of individual projects that were developed and/or accelerated due to Practical Design

Additional Information, Comments

None.

Synopsis #	17
Title	***KDOT - Practical Improvements Guide***
Author(s)	Kansas Department of Transportation
Year	2009
URL	http://kart.ksdot.org/Download/DownloadDetail.aspx?FileID=330
Key words	Alternative, balancing, common sense, criteria, design exceptions, efficient, practical improvement, safe, scope, service life, solutions, tailor
Applicable Tasks	2,3,4,5

Synopsis

In order to maximize the use of available funds, and in keeping with its ongoing commitment to safety and efficiency, the Kansas Department of Transportation (KDOT) introduced the philosophy of practical solutions. Under this model, a project scope within the STIP (while legitimate in and of itself) is little more than a placeholder. From that baseline, a multidisciplinary team analyzes the project parameters and data to identify any alternative scopes that will more efficiently satisfy the purpose and need. Any concept that is advanced, whether original or alternative is subject to further flexibility in design criteria as it is developed.

Definitions, Vocabulary, Terminology, Practical Design Principles

- **Practical Improvement** – Philosophy which guides decisions that affect project cost and scope in order to stretch transportation improvement dollars further while still maintaining a safe and efficient highway system.
- **Principle 1** – Design choices that lie outside of current design criteria must be evaluated.
- **Principle 2** – Most practicality lies within the alternative scoping phase.

Implementation Issues, Challenges, Hurdles, Impediments

None

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

None

Additional Information, Comments

None

Synopsis #	18
Title	***KYTC - Guidance for the Use of "Practical Solutions" to Project Delivery***
Author(s)	O. Gilbert Newman
Year	2008
URL	http://transportation.ky.gov/Organizational-Resources/Policy%20Manuals%20Library/SHEPolicyDoc.pdf#Page=20
Key words	adequately, appropriate, betterment, context-sensitive design, cost, design criteria, limited resources, operational efficiency, parameters, practical solutions, purpose and need, realistic, right sizing, safety, scope
Applicable Tasks	2,4,5

Synopsis

The Kentucky Transportation Cabinet (KYTC) was faced with the reality of having to do more with less. In response, senior officials introduced an initiative known as "Practical Solutions" to ensure that every project was appropriately scoped according to purpose and need but remained within realistic fiscal parameters. In so doing, the KYTC hopes to be able to address more needs across its entire system. The Kentucky model is based upon the selection of an appropriate design speed and design life. Once established, those parameters are used to determine design values from tables revised for increased flexibility.

Definitions, Vocabulary, Terminology, Practical Design Principles

- **Practical Solutions** – The appropriate use of limited resources to meet the transportation needs of the state.
- **Principle 1** – Through fiscal constraint on one project, funding becomes available to spread improvements more widely across the system.
- **Principle 2** – It is essential to find the balance among operational efficiency, safety, and cost in order to design a suitable roadway to meet the needs of the state.

Implementation Issues, Challenges, Hurdles, Impediments

None

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

None

Additional Information, Comments

None

Synopsis #	19
Title	***Practical Solution Concepts for Planning and Designing Roadways in Kentucky***
Author(s)	Nikiforos Stamatiadis, et al.
Year	2008
URL	http://wwwcf.fhwa.dot.gov/exit.cfm?link=http://www.ktc.uky.edu/files/2012/06/KTC_08_30_SPR_369_08.pdf
Key words	cross-section, design speed, diminishing return, geometric, Green Book, Highway Capacity Manual, LOS, purpose and need, quality, severity, system-wide, targeted approach
Applicable Tasks	2,4,5

Synopsis

Practical design is about more than simply saving money. In its most effective form, it identifies multiple solutions to the purpose and need that meet the required capacity and do not lower the level of safety. The solutions are then developed further to see which provides the maximum value before returns begin to diminish. This method demonstrates that gravitating toward the upper level of a standard does not necessarily increase safety or function.

Definitions, Vocabulary, Terminology, Practical Design Principles

- **Principle 1** – in order to achieve a practical design, design element guidelines cannot be viewed as minimum thresholds. Nor does increasing them result in a better project.
- **Principle 2** – Spending an inordinate sum at one location provides a safer solution on a project basis, but it also results in addressing fewer miles, thus limiting the potential for greater safety gains.
- **Principle 3** – A successful practical design must:
  1. Target the goals/objectives of the purpose and need statement.
  2. Meet anticipated capacity needs.
  3. Evaluate safety compared to existing conditions.
  4. Develop and evaluate design options and alternatives.
  5. Maximize design to the point of diminishing return.
- **Principle 4** – The development of a new set of guidelines for design element values is not advisable if practical solutions are to be successful in reaching their potential benefit.
- **Principle 5** – It is essential to have a balance among operational efficiency, safety, project constraints, and costs.
- **Principle 6** – Focusing on "what" is to be built allows for greater savings than a design focused on "how" a project is to be built.

Implementation Issues, Challenges, Hurdles, Impediments

None

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

None

Additional Information, Comments

None

Synopsis #	20
Title	***MoDOT Practical Design Website***
Author(s)	Missouri Department of Transportation
Year	2005
URL	http://www.modot.mo.gov/business/PracticalDesign.htm
Key words	creativity, efficient, implementation, innovation, Project Development Manual, safer, value
Applicable Tasks	2,3

Synopsis

Practical Design uses innovation and creativity to efficiently meet transportation needs. With this in mind, Missouri Department of Transportation (MoDOT) restructured the standards governing the items upon which the greatest amount of money was being spent. These revisions were published in an interim guidance document that superseded the *Project Development Manual* (PDM).

Definitions, Vocabulary, Terminology, Practical Design Principles

None

Implementation Issues, Challenges, Hurdles, Impediments

None

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

None

Additional Information, Comments

This review was conducted on the website itself, not the *Practical Design Implementation Manual*. That work is reviewed in Synopsis 21.

Synopsis #	21
Title	***MoDOT Practical Design Implementation Manual***
Author(s)	Missouri Department of Transportation
Year	2005
URL	http://www.modot.org/business/documents/PracticalDesignImplementation.pdf
Key words	alignment, challenges, context, cost drivers, creativity' design criteria, efficient, flexibility, hydraulics, implementation, Incidental, interstate, life-cycle costs, maintenance, major, minor, pavements, policies, practical design, Project Development Manual, purpose and need, roadside safety, scope, section, solutions, standards, structures, surroundings, taxpayers, traditional
Applicable Tasks	2,4

Synopsis

After a year of practically designing projects, largely unfettered, Missouri Department of Transportation (MoDOT) leadership examined and restructured the design policies that governed their largest expenditure. Specifically, guidance was published for typical section elements, horizontal and vertical alignment, pavements, structures/hydraulics, roadside safety, and incidental construction. This document was an interim measure while the *Engineering Policy Guide* was being constructed.

Definitions, Vocabulary, Terminology, Practical Design Principles

- **Cost Drivers** – These are defined as items of work that most greatly control the cost of the project.
- **Principle 1 –** Innovation and creativity are necessary to accomplish Practical Design.
- **Principle 2** – To accomplish Practical Design, the scope must be properly defined by focusing on achieving the project purpose and need while considering the surroundings of each project.
- **Ground Rules** –Missouri accomplished Practical Design by applying the following rules:
  - Every project gets safer.
  - There is collaboration on every project.
  - Projects must still have quality.
  - Problems cannot be passed along to maintenance.

Implementation Issues, Challenges, Hurdles, Impediments

None

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

MoDOT allowed engineers, with very little guidance, to use their innovation and creativity to deliver the scope of their projects at a reduced cost.

From that experience, the agency determined best practices and used them to rewrite the design standards that drove the most cost.

Additional Information, Comments

None

Synopsis #	22
Title	***Oregon - Practical Design Website***
Author(s)	Oregon Department of Transportation
Year	Unknown
URL	http://www.oregon.gov/ODOT/HWY/TECHSERV/Pages/practical_design.aspx
Key words	analysis, appropriate, corridor context, efficient, guidance, lower cost, optimize, oversight, practical Design, performance, Public Support, resources, results, standards, system, tangible
Applicable Tasks	2,3,4

Synopsis

Over the years, the Oregon Department of Transportation (ODOT) has been refining its business practices and finding ways to streamline many of its functions in order to maximize service in the face of limited funding and resources. Practical design is their next logical step towards this goal. This concept allows engineers to engineer, focusing on the purpose and need and meeting it through more flexible design standards. Projects are designed with their contribution to the entire system in mind; collaboration across the Department's disciplines makes this possible. Some in Oregon feared that practical design would cut corners, resulting in questionable designs, but under their system, everything is done by focusing on a very specific set of values, or SCOPE. This acrostic stands for "Safety, Corridor context, Optimize the system, Public support, Efficient cost."

Definitions, Vocabulary, Terminology, Practical Design Principles

- **SCOPE** – An acrostic to state ODOT's values of: Safety, Corridor context, Optimize the system, Public Support, Efficient cost.
- **Principle 1** – Results must be tangible to the traveling public.
- **Principle 2** – The system's context shapes the design
- **Principle 3** – Good engineering judgment assesses the severity of adverse consequences, evaluates design tradeoffs, and to mitigate risks to the extent practical.
- **Principle 4** – Practical design must take a systematic approach to deliver the broadest benefit to the transportation system.

Implementation Issues, Challenges, Hurdles, Impediments

Some in Oregon feared that practical design would cut corners resulting in questionable designs, but it actually resulted in better designs as engineers more deeply analyzed project data.

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

- Strive to make results tangible to the public.
- Work hand-in-hand with FHWA.
- Provide better data to design personnel so that projects are aligned with the system's needs.

Additional Information, Comments

This review was conducted on the website itself, not the *Practical Design Strategy Guidebook*. That work is reviewed in Synopsis 23.

Synopsis #	23
Title	***Oregon - Practical Design Strategy Guidebook***
Author(s)	Doug Tindall et al.
Year	2010
URL	http://www.oregon.gov/ODOT/HWY/TECHSERV/docs/practical_design_guideline.pdf
Key words	boundaries, commitment, consistency, constraints, constraints, context, continuous, improvement, decision matrix, economic development, expectations, flexibility, functionality, goals, integration, life-cycle, objectives, outcomes, project charter, safety, SCOPE, silver bullet, stewardship, strategy, success indicators, sustainable
Applicable Tasks	2,4,5

Synopsis

Over the years, the Oregon Department of Transportation (ODOT) has been refining its business practices and finding ways to streamline many of its functions in order to maximize service in the face of limited funding and resources. Practical design is their next logical step towards this goal. It is a way to provide solutions that are sufficient to improve the transportation system, without being excessive. There is a focus on the project's purpose and need, and engineering judgement is critical. Projects are scoped in light of their contribution to the entire system and designed to fit their context. ODOT insists on collaboration among its many disciplines in arriving at a solution. The values that guide practical design are summarized by the acrostic SCOPE: Safety, Corridor context, Optimize the system, Public support, Efficient cost.

Definitions, Vocabulary, Terminology, Practical Design Principles

- **SCOPE –** An acrostic to state ODOT's values of: Safety, Corridor context, Optimize the system, Public Support, Efficient cost.
- **Principle 1** – Projects have to deliver some benefits within the money available.
- **Principle 2** – Projects are put in a system context.
- **Principle 3** – Results must be visible to the traveling public.
- **Principle 4** – Collaboration contributes to a broader evaluation of data and measures of success, and ensures that community interests are considered.
- **Goal 1** – Direct available dollars toward activities and projects that optimize the highway system as a whole.
- **Goal 2** – Develop solutions to address the purpose and need identified for each project.
- **Goal 3** – Design projects that make the system better, address changing needs, and maintain current functionality by meeting, but not necessarily exceeding, the defined project purpose and need and project goals.

Implementation Issues, Challenges, Hurdles, Impediments

None

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

- Strive to make results tangible to the public.
- Direct available dollars toward activities and projects that optimize the highway system as a whole.
- Develop solutions to address the purpose and need identified for each project.
- Design projects that make the system better.
- Keep stakeholders engaged in the process.

Additional Information, Comments

None

Synopsis #	24
Title	***Utah Department of Transportation Practical Design Website***
Author(s)	Utah Department of Transportation
Year	Unknown
URL	http://www.udot.utah.gov/main/f?p=100:pg:0:::1:T,V:3195,
Key words	cost savings, innovation, limited resources, needs, practical design, right sized
Applicable Tasks	4,5

Synopsis

The goal of Practical Design in Utah is to build only right sized projects that meet focused needs. This allows the agency to spread limited resources more effectively throughout the transportation system.

Definitions, Vocabulary, Terminology, Practical Design Principles

None

Implementation Issues, Challenges, Hurdles, Impediments

None

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

None

Additional Information, Comments

This review was conducted on the website itself, not the *Practical Design Guide: Planning and Designing Practical Transportation Solutions for Utah*. That work is reviewed in Synopsis 25.

Synopsis #	25
Title	***Practical Design Guide: Planning and Designing Practical Transportation Solutions for Utah***
Author(s)	Unknown
Year	2011
URL	http://www.udot.utah.gov/main/uconowner.gf?n=3142031557718121
Key words	collaborate, deviations, diminishing returns, exceptions, flexibility, good enough, limited resources, maximize, multi-disciplinary, needs, objectives, over designing, performance, practical design, priorities, relationships, solutions, waivers
Applicable Tasks	4,5

Synopsis

Drawing on the successes other states, the Utah Department of Transportation (UDOT) instituted Practical Design to enable the agency to do more with less. The UDOT approach focuses on the benefit a project provides to the entire system and works toward the following four goals: take care of what we have, make the system work better, improve safety, and increase capacity. At the heart of the Practical Design program is flexibility and engineering judgement, but those factors are not used to strip down projects, rather, they are used to provide the best possible value. The practical design process also makes use of multi-disciplinary collaboration and has a clearly defined set of metrics.

Definitions, Vocabulary, Terminology, Practical Design Principles

- **Objective Statement** – The foundation for system improvements and project development.
- **Project Sponsor** – The entity that initially identifies the project and funding.
- **Principle 1** – Building a series of good, not great, projects will result in a great system.
- **Principle 2** – Practical Design is a “design up” approach, not a “strip down” process.
- **Principle 3** – Value engineering is project-focused, practical design is system-focused.
- **Principle 4** – Design standards should be considered the ideal level of design, not the minimum level.
- **Goal 1** – Take care of what we have
- **Goal 2** – Make the system work better
- **Goal 3** – Improve safety
- **Goal 4** – Increase capacity

Implementation Issues, Challenges, Hurdles, Impediments

None

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

None

Additional Information, Comments

None

Synopsis #	26
Title	***Practical Planning and Design Leads to Low Cost Transportation Solutions – A Report to the Governor and Legislature***
Author(s)	Washington State Department of Transportation
Year	June 30, 2015
URL	http://www.wsdot.wa.gov/publications/fulltext/LegReports/PracticalDesignReport.pdf
Key words	Practical design, practical solutions (WSDOT), collaboration, context sensitive, performance-based decision making, lowest cost, options, least cost planning, standards, context, flexibility in design, sustainable, integrated,
Applicable Tasks	3,4,5

Synopsis

Washington State Department of Transportation (WSDOT) developed a program delivery method known as Practical Solutions that includes least-cost planning and Practical Design Stakeholder engagement, and a total system focus are essential.

Definitions, Vocabulary, Terminology, Practical Design Principles

- **Planning Process Principle** – WSDOT uses least cost planning to plan transportation solutions that address a specified need for the least cost and also that consider social, environmental, and economic impacts.
- **Project Development Principles** – Develop and design transportation projects targeted to address the essential needs of a project, not every need. Designs are developed with criteria that achieve stated performance for the least cost. If there are competing needs they will optimize tradeoffs. Solutions will consider mitigation strategies that address tradeoffs for the least cost.
- **Sustainable Safety** – Use quantitative data and scientific engineering methods to assess the safety performance of highway segments and intersections.
- **Least Cost Planning** – Decision making process that achieves an efficient, sustainable, innovative, and generally, low cost and high benefit solution.

Implementation Issues, Challenges, Hurdles, Impediments

Federal transportation policy drove the criteria for roadway design. That, combined with WSDOT's policies requiring the state to bring some highway locations "up to standards," resulted in the scope of the project expanding to meet high levels of safety standards when there was little need for safety investments in that location.

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

Executive orders were used to provide direction to WSDOT staff.

WSDOT reviewed and reformed a number of planning and design policies and practices. Numerous briefings were conducted with regional WSDOT staff, local agencies, and organizations interested in the new approach.

Engaging with Washington's communities and public is a key to this approach. One of the first steps in the process is to set visions and goals for transportation projects that reflect a community's values and support. A problem statement is collaboratively developed that clearly defines the purpose and need for a transportation project.

Additional Information, Comments

Performance measures, or indicators, for how the multimodal transportation system is supposed to perform are also developed so that the range of options can be considered. Examples are provided.

Synopsis #	27
Title	***Moving Washington Forward: Practical Solutions (Website and Supporting Documents)***
Author(s)	Washington State Department of Transportation
Year	2015
URL	http://www.wsdot.wa.gov/Projects/PracticalDesign/
Key words	alternatives, collaboration, context sensitive, engagement, flexible, investment, practical design, practical solutions, stakeholders, strategy, sustainable
Applicable Tasks	4,5

Synopsis

Washington State Department of Transportation (WSDOT) developed a program delivery method known as Practical Solutions that includes least-cost planning and Practical Design Stakeholder engagement, and a total system focus are essential.

Supporting Documents

- Practical Solutions – A Checklist for Practitioners
- Flyer – Moving Washington Forward: Practical Solutions
- Practical Design – Selected Project Examples
- WSDOT Secretary's Practical Solutions Committee – Information and Q/A – August 4, 2015

Definitions, Vocabulary, Terminology, Practical Design Principles

- **Practical Design** – an approach to making project decisions that focuses on the need for the project and looks for the lowest cost solutions. It engages local stakeholders at the earliest stages of defining scope to ensure their input is included at the right stage of project design.
- **Practical Design Principles**
  - Innovation and solutions are encouraged.
  - Safety is not to be compromised.
  - Community engagement is important to making decisions.
  - Collaboration ensures a wide array of perspectives.
- **What is different about practical design?** – With practical design, decision making focuses on maximum benefit to the system rather than maximum benefit to the project. Focusing on the specific project need minimizes the scope of work for each project. The goal is to allow more needs to be addressed system wide by reducing spending on lesser priority items on each project.
- **Least Cost Planning** – an approach to making planning decisions that considers a variety of conceptual solutions to achieve the desired system performance targets.

Implementation Issues, Challenges, Hurdles, Impediments

Standards-based decision making drove project decisions.

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

- **Practical Solutions** – WSDOT developed a checklist for practitioners to give guidance on elements of projects that may need to be considered.
- **Practical Solutions Committee** – This group provides ongoing oversight for project implementation, practical solutions policy development, and practical solutions training at key milestones.

Additional Information, Comments

Implementation Steps:

- Focus on a clearly defined need and outcome for each project.
- Move from standards-based to performance-based designs.
- Empower designers and supporting their engineering judgment.
- Provide tools, technical assistance, and training promoting innovation.

Why use practical design? - Practical design encourages efficient, effective, and sustainable transportation decisions that can achieve:

- Maximum results within limited funding,
- Tailored solutions for the project's purpose and need,
- Phased solutions that address more critical and current needs,
- Design guidance that transitions from a rigid structure to a more flexible framework, and
- Freedom to innovate.

Synopsis #	28
Title	***Practical Design (article)***
Author(s)	Joseph Jones
Year	2010
URL	http://www.fhwa.dot.gov/publications/publicroads/10janfeb/06.cfm
Key words	commitment, communication, flexible, grassroots, ground rules, innovation, legal, liability, MoDOT, philosophy, practical design, quality , results, safety, standards, Top-down
Applicable Tasks	2,3,4,5

Synopsis

When faced with a higher cost of doing business and decreased funding, The Missouri Department of Transportation (MoDOT) developed a unique strategy to keep their commitments. Under this practical design philosophy, projects were to be designed to a level that just met their purpose and need. Designers were instructed to rely upon their engineering expertise and not simply accept (often inflated) published standards. If their decisions fell within the established boundaries of safety, communication and quality, then they'd be able to apply them to their projects. In so doing, good projects could be built everywhere instead of perfect projects being built somewhere. The results of this endeavor were outstanding; millions of dollars were saved, the safety of the system increased, and MoDOT's public image soared to unprecedented heights.

Definitions, Vocabulary, Terminology, Practical Design Principles

- **Principle 1** – The amount of money received cannot be controlled, the way the money (however limited) is spent, can be.
- **Principle 2** – Building good projects everywhere--rather than perfect projects somewhere--will yield a great transportation system in the end.
- **Principle 3** – Only a very few items of work drive the vast majority of spending. In Missouri, 5 items accounted for 80 percent.
- **Principle 4** – Practical Design must be implemented from the very top levels of leadership within the organization.
- **Principle 6** – Practical design must be implemented in plain sight and hand-in-hand with consultants and the FHWA.
- **Practical Design Ground Rules** – 1) Every project must get safer. 2) Quality must remain high. 3) Communication must be frequent, open, and honest.
- **Cookbook Engineering** – Defined as following a highway standard verbatim without thought or consideration as to how the individual circumstances of the project affect the design.

Implementation Issues, Challenges, Hurdles, Impediments

- **Skepticism** – Designers and consultants were nervous and uncomfortable with the notion of shelving their manuals and relying on their engineering judgement.
- **Legal liability** – Designers questioned whether or not they'd be liable if MoDOT were sued on a project that did not exactly comply with published standards.
- **Failures** – Some of the practical design ideas did not work well. For instance, the elimination of bridge approach slabs on minor routes turned out to be a mistake and MoDOT quickly changed the policy.
- **FHWA disagreement** – On some occasions, FHWA did not agree with a particular direction of MoDOT. In these cases, communication was necessary to arrive at a mutually agreeable solution.

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

- District engineers were allowed to keep any savings realized within their districts to reinvest in their district's program.
- Design exceptions began to be thought of as less of a last resort and more like an opportunity.
- Once the positive results began to be realized, support for Practical Design grew both within the DOT and throughout the stakeholder community.
- The acceptance of Practical Design by the rank and file as well as the consultant community was never optional. Rather, it was mandated from the top down by MoDOT's senior leadership.

Additional Information, Comments

None

Synopsis #	29
Title	***Smart Transportation Guidebook – Planning and Designing Highways and Streets that Support Sustainable and Livable Communities***
Author(s)	Pennsylvania DOT and New Jersey DOT
Year	2008
URL	http://www.state.nj.us/transportation/community/mobility/pdf/smarttransportationguidebook2008.pdf
Key words	Smart Transportation, Smart Growth, Context Sensitive Solution, sustainable, livable community, financial constraints, community needs, land use, environmental constraints, guidebook, planning, design, alternatives
Applicable Tasks	2, 4, 5

Synopsis

The goal of the Guidebook is to integrate the planning and design of streets and highways in a manner that fosters development of sustainable and livable communities. The Guidebook is applicable to rural, suburban, and urban areas. Smart transportation means incorporating financial constraints, community needs and aspirations, land use, and environmental constraints during project development. The result will be an effective use of resources and a lasting community asset.

Definitions, Vocabulary, Terminology, Practical Design Principles

- Smart Transportation is informed by two important concepts that have taken root in transportation and land use planning: Context Sensitive Solutions (CSS) and Smart Growth.
- They reference the CSS definition from ContextSensitivesolutions.org.
- Smart Growth emphasizes environmental preservation, compact development patterns, alternative transportation, and social equity.
- Smart Transportation includes the following principles:
  - Tailor solutions to the context.
  - Tailor the approach.
  - Plan all projects in collaboration with the community.
  - Plan for alternative transportation modes.
  - Use sound professional judgment.
  - Scale the solution to the size of the problem.

Implementation Issues, Challenges, Hurdles, Impediments

Standards in most state design manuals adhere closely to AASHTO values and sometimes surpass them.

This guidebook outlines issues to consider when implementing context sensitive streets, including operations/maintenance and emergency response.

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

The design manuals for both New Jersey and Pennsylvania are heavily drawn from the AASHTO Green Book.

Both the FHWA (Flexibility in Highway Design, 1997) and AASHTO (A Guide for Achieving Flexibility in Highway Design, 2004) recommend flexibility in application of the Green Book design values, particularly when considering impacts on the community. Even greater flexibility is possible for non-NHS roadways; on these roads, states can set their own standards.

Additional Information, Comments

None

Synopsis #	30
Title	***MNDOT Performance-Based Design***
Author(s)	Minnesota Department of Transportation
Year	2012
URL	NA
Key words	Performance-based design, analytical tools, context sensitive solutions, purpose, need, safety, system-level performance, flexibly
Applicable Tasks	3,4,5

Synopsis

Minnesota Department of Transportation (MNDOT) recognized the gap between needs and available funding and began using performance-based design as its preferred approach to preserving and building through more skillfully allocating investments. This two page paper summarizes the agency's approach to implementing performance-based design.

Definitions, Vocabulary, Terminology, Practical Design Principles

- **Performance-based design** focuses on building what is needed, and not building what is not valuable while maintaining and improving safety. Performance-based design represents a natural evolution in design practice more than a departure from historical practice. It lies within and serves to further the overall design philosophy of Context Sensitive Solutions.
- **Key characteristics** of performance-based design:
  - Being aware of a project's purpose, needs and genuine problems.
  - Using risk analysis to inform scope and design decisions.
  - Using predictive analytical tools to calculate expected safety and operational performance.
  - Ensuring safety is maintained (and improved where needed).
  - Applying design standards flexibly and focusing on the specific needs and safety of all users.
  - Respecting the resource (public funds).
  - Focusing on the objective of overall system betterment as opposed to isolated "perfect" projects.
  - Exploiting experience and knowledge to advance future practices.

Implementation Issues, Challenges, Hurdles, Impediments

None

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

What is needed to implement performance-based design?

- Change internal practices, cultures, habits and attitudes.
- Reassess every element of engineering from the standpoint of performance and value.
- Improve design policies, criteria, methods and practices continuously.
- Scrutinize project scopes and designs for opportunities for more cost-effective approaches.
- Monitor major projects for consistent statewide adherence to funding directives.
- Educate employees and consultants on the tools of performance-based design.
- Communicate honestly and effectively with the public and partners (external expectations can be a strong driver of how funds are used).
- Analyze projects as investments with measurable targeted goals.
- Design projects to achieve – and not exceed – targeted goals.
- Identify the optimal balance between projects, corridors and geographical regions.

Additional Information, Comments

None

Synopsis #	31
Title	***MNDOT Technical Memoranda***
Author(s)	Minnesota Department of Transportation
Year	2011-Present
URL	http://techmemos.dot.state.mn.us/techmemo.aspx
Key words	Flexible design, safety, system-wide basis, leeway, decision documentation, context-sensitive solutions
Applicable Tasks	4,5

Synopsis

Minnesota Department of Transportation (MNDOT) has developed technical memoranda that provide designers additional guidance in selecting solutions. They were published to help support the statewide effort to implement flexible design.

Definitions, Vocabulary, Terminology, Practical Design Principles

The benefits of flexible design allow for a greater sensitivity to the design needs of multiple travel modes, the local community, and the surrounding environment. This design approach also provides an opportunity to increase safety on a system-wide basis by stretching available funding to improve safety over a larger exposure area.

Thorough documentation of decisions is required.

Implementation Issues, Challenges, Hurdles, Impediments

None

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

None

Additional Information, Comments

None

Synopsis #	32
Title	***ITE – Integration of Safety in the Project Development Process and Beyond: A Context Sensitive Approach***
Author(s)	Richard C. Coakley, CH2M Hill; Institute of Transportation Engineers
Year	2015
URL	http://library.ite.org/pub/e4edb88b-bafd-b6c9-6a19-22e98fedc8a9
Key words	Design exceptions, tort liability, substantive safety, nominal safety, context sensitivity, practical design, documentation, best value, alternatives, flexibility in design
Applicable Tasks	3, 4, 5

Synopsis

This is a guide for applying quantitative safety performance for projects and for a range of highway and street types and contexts. Gives an approach on how substantive safety, or performance-based safety, should be integrated into project development and throughout the project life cycle.

Definitions, Vocabulary, Terminology, Practical Design Principles

Nominal safety – the evaluation of safety by determining whether a roadway, design alternative, or design element meets minimum design standards or warrants.

Substantive safety – the evaluation of safety in terms of actual (or expected) performance as measures by frequency and severity of crashes.

Implementation Issues, Challenges, Hurdles, Impediments

Balancing safety against other community, environmental, economic, or mobility values is a challenge.

Misconceptions about safety have driven the decision making process in the past:

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

Use substantive safety to:

- Assess the relative needs for a project.
- Communicate those needs to the public.
- Prioritize work to keep the project within budget.
- Support documentation for design exceptions.
- Monitor, evaluate, and report on safety performance.
- Consider the selection of design criteria and project components.

Substantive safety can:

- Quantify the relative safety of a facility.
- Demonstrate that the agency is addressing safety needs appropriately.

Tort liability – professional engineering analysis and design judgment must be used during the life cycle of a transportation facility for effective risk management regardless of whether one adheres strictly to standards. Documentation of decisions is needed throughout project development process.

Best practices for risk management fall into four broad categories that all take tort liability into consideration:

- Decision making – a process that considers alternative treatments can be more important than the selection of a particular treatment itself.

- Documentation – to protect the agency, the engineer, and the decisions, the decision-making process to consider alternative safety treatments must be fully documented to record the policy and engineering bases on which those decisions are made.
- Design exceptions – when a particular design feature does not fit neatly within existing policies, standards, warrants, or guidelines because of its context or some other engineering reason, then engineering judgment must be exercised. A properly drafted and approved design exception documents the decision-making process, thereby disclosing the discretionary nature of the decision and the engineering judgment exercised. The need for an exception must be documented as part of the design exception process.
- Continuing evaluation – having implemented the decisions made during the life cycle of a transportation facility, the agency will benefit by continuing to evaluate those decisions to determine if the expected outcomes were achieved.

Additional Information, Comments

This resource makes reference to AASHTO's *A Guide for Achieving Flexibility in Highway Design*, AASHTO's *Highway Safety Manual*, and FHWA's *Flexibility in Highway Design*.

Synopsis #	33
Title	***NCHRP Web Document 69 - Performance Measures for Context Sensitive Solutions – A Guidebook for State DOTs***
Author(s)	TransTech Management, Inc., Oldham Historical Properties, Inc., Parsons Brinckerhoff Quade & Douglas, Inc.
Year	October 2004
URL	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w69.pdf
Key words	Context sensitive solutions, performance measurement, collaborative, interdisciplinary, outcomes, project-level
Applicable Tasks	4,5

Synopsis

A Context Sensitive Solution (CSS) performance measurement framework had to find the right balance between: 1) measurement of project-level versus organization-wide factors, and 2) measurement of processes versus outcomes. This document provides suggestions for how to measure an agency's progress with CSS.

Definitions, Vocabulary, Terminology, Practical Design Principles

Process-related focus – measures milestone and processes such as use of multi-disciplinary teams, public engagement, alternative analysis, etc.

Outcome-related focus – measures the success of projects; however, the process must ultimately focus on stakeholder satisfaction with completed projects. This may be the most difficult part of measuring CSS performance. Outcome-related measures, by definition, should be applied after project completion.

Implementation Issues, Challenges, Hurdles, Impediments

Creating and implementing a CSS measurement program:

- Two key ingredients for creating a measurement program are strong leadership and syncing with agencies strategic planning efforts.
- An effective measurement program should be part of every project team's responsibilities.
- The timing of measures is a key. Organization-wide measures are measured on a regular basis (quarterly or annually for example). Project-level measures may be better suited for measurement at project milestones.

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

None

Additional Information, Comments

Suggestions for helping agencies to begin their CSS performance initiative:

- Identify a champion.
- Start with a small set of measures.
- Incorporate feedback from external sources.
- Focus on planning and preliminary design.
- Identifying measures for small projects is as important as doing so for large projects.
- Build CSS measures into project development process and strategic planning.
- Performance measures for CSS can start at the project or organization level.

Synopsis #	34
Title	***NCHRP Report 642 – Quantifying the Benefits of Context Sensitive Solutions***
Author(s)	Nikiforos Stamatiadis, Adam Kirk, Don Hartman, Theodore Hopwood, Jerry Pigman
Year	2009
URL	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_642.pdf
Key words	Context sensitive solutions, stakeholder, public satisfaction, project development, documentation, safety, risk management, quantitative, qualitative
Applicable Tasks	4,5

Synopsis

The objective of the project was to develop a guide with a comprehensive set of performance measures for Context Sensitive Solution (CSS) principles that quantifies the benefits through all phases of project development.

Definitions, Vocabulary, Terminology, Practical Design Principles

For clarity the report includes a dictionary of the terms to be used in the following metric indicators:

- **Satisfaction level –** The level of satisfaction for an element by a person.
- **Opinion –** The level of agreement to a concept by a person.
- **Expert opinion – T**he level of agreement to a concept by a project team member.
- **Primary Goal**: Transportation solution meets expectations of the transportation agency, stakeholders, and community.

Customer satisfaction was the goal for several of the processes that were examined in the literature review. Surveys or scorecards are commonly utilized.

CSS is principle-driven and benefit-justified. The report lists core strategies, action principals, fundamental benefits and example metrics.

Implementation Issues, Challenges, Hurdles, Impediments

None

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

None

Additional Information, Comments

Synopsis #	35
Title	***NCHRP Report 708 – A Guidebook for Sustainability Performance Measurement for Transportation Agencies***
Author(s)	Josias Zietsman, Tara Ramani, Joanne Potter, Virginia Reeder, Joshua DeFlorio
Year	2011
URL	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_708.pdf
Key words	Performance measures, data, goals, objectives
Applicable Tasks	4,5

Synopsis

The guidebook provides state departments of transportation (DOT) and other transportation agencies with a practical and easy-to-use approach to identify and apply sustainability-related performance measures. It contains good reference material on how and why to measure. Many measures are related to sustainability but may not be applicable to practical design measures.

Measures are developed from clear goals, focus areas, and objectives. For example:

- Goal: Safety.
- Focus Area: Planning.
- Measure: Change in the number and severity of crashes.

Definitions, Vocabulary, Terminology, Practical Design Principles

Performance measures are broadly defined as quantifiable criteria that can be used to track progress toward specific goals or objectives. Ideal performance measures are easily understood, provide a clear indication of what moving toward an established goal looks like, and can be tracked using accessible and available data.

Implementation Issues, Challenges, Hurdles, Impediments

None

Critical Elements for Acceptance and Use of Practical Design; Practices that made Practical Design Achievable

None

Additional Information, Comments

Performance measures can be used to:

- Describe the effect of a program or policy.
- Assess progress and diagnose what problems or barriers an agency is encountering that need to be addressed.
- Set targets for specific staff or programs and can measure how well these are doing in reaching the established goals.
- Help inform which approach would support the most sustainable outcomes.
- Explain to your partners or the public what your program or policy is achieving.

APPENDIX B. Practitioner Workshop

Attendees:

Nancy Boyd – Washington State DOT (WSDOT)

Kevin Marshia – Vermont Agency of Transportation

Kurt Lieblong – Florida DOT (FDOT)

Amy Rockers – Kansas DOT

Lisa Wilson – Utah DOT

Vernon Heishman – Virginia DOT

Nancy Yoo – Minnesota DOT

Jay Smith – Missouri DOT (teleconference)

Robert Mooney – FHWA

Patricia Bush – AASHTO

Don Hillis – Leidos

Joe Jones – Leidos

Monica Worth – Leidos

Dave Ekern – DS Ekern Consulting

Agenda:

August 19	ACTIVITY
8:00 – 8:30	Welcome and Introductions – Don Hillis Brief History of PD Philosophy Journey and Intent of NCHRP project– Don Hillis Brief Comments by AASHTO and FHWA representatives Meeting Goals, Objectives, and Outcomes – Monica Worth
8:30 – 10:00	What is Practical Design and how does it relate to Context Sensitive Solutions, Context Sensitive Design, Value Engineering, Design Exceptions, etc.? Identify and Define PD Principles, Concepts, and Vocabulary – Group Discussion – Don Hillis, Facilitator
10:00 – 10:15	Break
10:15 – 12:00	What is Practical Design? (continued)
12:00 – 12:30	Lunch
12:30 – 1:30	Overcoming PD Myths from Legal Counsel Perspective – Presentation (Jay Smith)
1:30 – 1:45	Break
1:45 – 3:15	Legal and Safety Issues, Constraints, Concerns with PD Implementation, How do we overcome those issues? – Group Discussion – Monica Worth, Facilitator
3:15 – 3:30	Break
3:30 – 5:00	What other issues are holding us back? How do we overcome those issues? – Group Discussion – Monica Worth, Facilitator
August 20	**ACTIVITY**
8:00 – 9:45	Identify Potential Revisions to AASHTO Guidance Publications to Incorporate PD. What other actions could AASHTO take to facilitate broad acceptance and use of practical design? – Group Discussion – Don Hillis, Facilitator
9:45 – 10:00	Break
10:00 – 11:15	Develop Discussion Topics and Key Issues to be Addressed During Leadership Forum – Group Discussion – Monica Worth, Facilitator
11:15 – 11:30	Next Steps and Adjourn – Don Hillis

August 19	ACTIVITY
8:00 – 8:30	Welcome and Introductions – Don Hillis Brief History of PD Philosophy Journey and Intent of NCHRP project– Don Hillis Brief Comments by AASHTO and FHWA representatives Meeting Goals, Objectives, and Outcomes – Monica Worth
8:30 – 10:00	What is Practical Design and how does it relate to Context Sensitive Solutions, Context Sensitive Design, Value Engineering, Design Exceptions, etc.? Identify and Define PD Principles, Concepts, and Vocabulary – Group Discussion – Don Hillis, Facilitator
10:00 – 10:15	Break
10:15 – 12:00	What is Practical Design? (continued)
12:00 – 12:30	Lunch
12:30 – 1:30	Overcoming PD Myths from Legal Counsel Perspective – Presentation (Jay Smith)
1:30 – 1:45	Break
1:45 – 3:15	Legal and Safety Issues, Constraints, Concerns with PD Implementation, How do we overcome those issues? – Group Discussion – Monica Worth, Facilitator
3:15 – 3:30	Break
3:30 – 5:00	What other issues are holding us back? How do we overcome those issues? – Group Discussion – Monica Worth, Facilitator
August 20	**ACTIVITY**
8:00 – 9:45	Identify Potential Revisions to AASHTO Guidance Publications to Incorporate PD. What other actions could AASHTO take to facilitate broad acceptance and use of practical design? – Group Discussion – Don Hillis, Facilitator
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11:15 – 11:30	Next Steps and Adjourn – Don Hillis

Outline and General Note Regarding Meeting Minutes:

The content of the discussion produced a high volume of worthwhile comments and ideas, which are presented here in their original, informal language. These meeting minutes are presented in the following structure:

- August 19 Morning Session
- August 19 Legal Counsel Perspective – Jay Smith Missouri DOT
- August 19 Afternoon Session
- August 20 Morning Session

AUGUST 19 MORNING SESSION

Brief History of the Practical Design Journey and the Intent of the NCHRP Project

After introductions, Don Hillis provided a brief history of Practical Design.

- Practical Design (PD) is not a new concept. It's been around for about 10 years now.
- Other related concepts, such as Context Sensitive Design (CSD) and Context Sensitive Solutions (CSS) have been used prior to and after Practical Design was started.
  - Initial implementation of CSS may have been skewed toward adding costs (bells and whistles) to projects rather than focusing on the project's purpose and need.
- A big misconception of PD in Missouri was that it was only to cheapen projects.
  - In reality the goals (for Missouri) were to make it safer, not pass on costs to future maintenance, and to make the best use of each limited dollar available.
  - The emphasis on savings was to promote the additional work that was being done elsewhere on the system.
  - There were problems as new concepts were tried in projects.
- Other states were curious and started their own practical design journey. Some are well on the way; others are in the early stages.
- States refer to PD by many different names:

  - Practical Solutions
  - Practical Improvements
  - Common Sense Engineering
- This has led to some confusion on what PD is and how it relates to other activities such as CSS, CSD and VE.
  - Our job is to clarify these issues.

Brief Comments by FHWA and AASHTO Representatives

Robert Mooney of FHWA provided an update on PBPD activities. The issue is that as agencies struggle with funding shortages it is important to ensure that highway designs meet the purpose and need of the project without over designing or sacrificing safety.

Patricia Bush of AASHTO indicated she would provide any support or input from their perspective. If changes are needed for any AASHTO publication it must be driven by the members (States).

What should be our goal with this project? – General Discussion

- The goal should not be to change the Green Book unless necessary because it is not always the problem. We need to fully utilize the Highway Safety Manual (HSM). If the Green Book needs updating, the change must come from the membership (States) by way of the committees.
- We do not want to bureaucratize PD to the point that it is unwieldy and unusable. Engineering judgment is still very valuable.
- We want to incorporate not only what we already know, but also the latest knowledge (HSM, etc.).
- We want to communicate/educate that PD is a comprehensive approach to planning and engineering rather than a technique or "gimmick." PD has always been inherent in true engineering.

What is Practical Design? (Brainstorming)

- How we design highways, specifically involving: multimodality, safety, maintenance, context sensitivity and cost.
- This is all based on a true understanding of the circumstances of the project including the surroundings and the customers.
- It goes way beyond opening a manual and pulling a value off the charts.
- Simply talking to stakeholders—bringing up things you thought would never fly—can go a long way toward solutions.
  - Missouri's low-profile bridge rail and its importance to farmers is a great example of this. Farmers were not happy with a new bridge because the rail was too high for their equipment to go over. Missouri started utilizing a lower crash compliant rail that met the farmer's needs.
- Truly understanding and communicating with the stakeholders is critical to PD success.
- Embrace the fact that incremental change is okay. You don't have to build the 30-year project every time. Sometimes the 5-year will get you through.
- More is not necessarily "more." Why did we as States believe exceeding AASHTO standards was a good thing?
- Be willing to accept responsible solutions that are outside of "the way we've always done it."
- Beware of just expanding the "range" of existing guidance and calling it flexible. Once you do that, it just becomes the next cookbook.
- Do not be afraid of the design exception; embrace it. But that's a big cultural shift to pull off since most contemporary engineers have developed under a culture that strongly discouraged or forbade exceptions.

Practical Design Definition from Workshop: Building the right project for the surroundings using flexibility available in design guidance along with contextual clues.

- Highlighting the flexibility inherent in the Green Book can be an effective tool in promoting PD.

Practical Design Definition from Workshop: A philosophy that relies on real engineering solutions (rather than printed standards) to meet the purpose and need.

- Don't view PD as a tool, it has to be a philosophy—a way of life. We aren't just going to do it until it runs its course, then stop.
- There are tools (HSM, VE, Green Book, etc.) that aid PD, but PD itself is not the tool.
- PD can be the minimum needed to meet the purpose and need. Sometimes a 20-ft. wide sidewalk is what you need. If that's the case, then that's the minimum needed to meet the purpose and need and it is practical. This is a concept that rarely gets mentioned in PD circles.
- Maybe we should stop talking about a "philosophy" of PD, and just start calling it "planning and engineering" because in the purest form, that's exactly what it is.
- There can be an education gap in highway engineering. Many universities have stopped teaching highway engineering because there's no research money there. When it is taught, it's doubtful that practicality is part of the curriculum.
- Some State transportation agencies are embedding a design squad within the civil engineering department of local/state universities to give students a first-hand look at the real world and ensure the curriculum is sufficiently practical. This arrangement places an inconvenience on the State DOT, but it is outweighed by the potential for recruitment and for their future employees to be up to speed on day one.
- There may be something to be learned from landscape architects. Their training and service incorporate all the elements we've talked about as being critical to PD.
- Perhaps a national initiative (AASHTO, NAS, etc.) to incorporate more PD-type curriculum at the university level may be helpful.
- Engineers seem to see the world in black and white. Sometimes creativity gets lost. Inclusion of creativity (PD) may be critical in attracting and bringing up young engineers properly.
- DOTs aren't the only ones hiring young engineers. Consultants are too. Are consultants fully on board with PD? Reluctantly on board? Not on board at all? This is a concern because projections indicate that consultant design is the wave of the future for highway design. Some States are as much as 80 percent consultant design-dependent today. It's very difficult for inexperienced engineers to think out of the box, especially since they are often "trained" by emulating an existing set of plans. When hiring staff, try to discern whether or not they have the temperament, not necessarily the skills, to be innovative and practical.
- Coaching and mentoring is critical to forming practical engineers. Proper training is also necessary. Perhaps a "Design Academy" at the FHWA or AASHTO level is a good idea.
- The consultant is only an extension of the DOT staff and will do what the client wants. If the DOT PM is anti-PD, that attitude will be extended to the consultant as well.

Practical Design Definition from Workshop: A state of the practice that delivers highway improvements. A multimodal (multidisciplinary) approach to delivering transportation projects that improves safety and manages our assets in a cost-effective manner sensitive to context and customer needs.

- Other elements that could be added to definition:
  - Maybe "multidisciplinary" is a better word than "multimodal".
  - This could stand to shore up the purpose and need concept.
  - Flexibility.
  - Systemic.
  - Collaboration throughout.
  - Examine alternatives early in the process.
  - Document thinking and decision making.
  - Evaluate design alternatives in terms of addressing purpose and need.
  - Understand the problem and define the goals.
  - Look outside of traditional areas for solutions.

- Have the support of top management (top-down approach).
- Encourage risk and accept failure.
- Meeting competing and various needs.

Suggestions to Consider Adding to Definition:

- Systemic nature – Spread your money in small improvements around the system rather than one big project in a single area. This must remain needs-based, not just a publicity effort.
- Use appropriate tools to analyze solutions such as benefit/cost analysis or life cycle cost.
- Note: Be careful, some of items listed above are part of the definition, others are simply supporting tools.
- PD encourages us to consider other alternatives, not just jump to solutions. Doctors try therapy or medication before they jump straight to surgery.

Additional Brainstormed Thoughts / Ideas

- It seems like there is no difference in PD definitions. Agencies just call it by different titles.
- Sometimes tangible performance measures are what it takes to sell a revolutionary concept such as PD.
- One size does not fit all. What's considered good performance on one job may not be on all jobs. A freeway wants high speeds and high volumes; a collector might want slower speeds and the incorporation of bicyclists.
- Be careful with the term "performance-based." It's an integral part of PD but could be misleading if stated so overtly.
- Consider a balance of cost-quality-timeliness and scope-schedule-budget.
- Practical design should not focus on the solution but on the purpose and need. Don't tell me we need a bridge; tell me we need to cross a creek. Don't tell me we need a signal; tell me we need to conduct traffic more efficiently. You have to identify and truly understand the problem.

Legal Counsel Perspective – Jay Smith Missouri DOT

Mr. Smith presented his perspective as Assistant Chief Counsel during MoDOT's implementation of PD.

- Legal counsel wasn't consulted prior to PD implementation in Missouri. He was informed after the decision to implement was made.
- PD is a process that allows you to meet competing and varying needs that fosters a multi-disciplinary, flexible, well-documented approach to solutions.
- Practical Design is a tool of accountability that focuses solely on purpose and need, considering the surroundings of each project.
- In Missouri: Provide best value with 3 ground rules:
  - **Safety** – must be an improvement in safety.
  - **Communication** – must collaborate in the development of every practical solution.
  - **Quality** – project must function properly and cannot leave a legacy of maintenance challenges.
- Provide good solutions across entire system instead of perfect solutions in certain locations.
- Practical design tort law has not arrived yet because PD hasn't been tested in court. It will. Is it 20 years out still?

Questions and Answers with Mr. Smith

Q: From a legal perspective, what actions should national policy makers take to implement practical design?

A: There doesn't seem to be an impediment of any kind in implementing practical design. Both AASHTO and FHWA have been leaders. Actions include:

- Educate the AASHTO member States.
- Work concepts into the Green Book.

- Education is the key.

Q: What could AASHTO do to deal with the issues of tort liability?

A: AASHTO needs to get a lawyer in on this issue nationally. AASHTO should also promote and teach the HSM more comprehensively. The State DOTs need to be involved.

Q: Is there a legal recommendation or statute that States could rely upon to shelter them from tort liability when using practical design? Should we seek one?

A: It would be great to have a national law similar to the Vermont law that absolves the DOT from liability when using PD, but you don't *need* one to proceed. In fact, chances are it would never pass. State demographics, politics, and the background of politicians would make that very tough. However, we should not lose sight of it.

Q: If Missouri were starting PD over again today, what should it have done differently?

A: The leadership should have advised the legal counsel – but that doesn't mean "acquiesced to legal counsel," or you run the risk of dissenters seeking shelter from change through the counsel's office.

Q: How can making every individual project safer and spreading safety across the whole system coexist?

A: There are certain, proven technologies and methods that can be deployed system-wide to increase the general safety of the whole State. However, individual projects still exist and they still need to be made safer.

AUGUST 19 AFTERNOON SESSION

Besides liability concerns, what other things can hold you back? Why are they holding us back? How does a DOT overcome these constraints?

- Policy (following the standards is written into law in some States).
- Culture.
  - Risk aversion.
  - "No exceptions" (Exceptions = black mark).
  - Management / Leadership Position.
- False perception of increased risk.
- Lack of understanding as to what constitutes adequate documentation.
- Poor filing of documentation.
- Perception that practical design could be pushed to irresponsible limits.
- Resiliency against future unknowns (climate change, terrorism, etc.).
- Overcoming the fear of the unknown or "this-is-how-we've-always-done-it" mentality.
- Lack of supportive legal counsel.
- Revolving door of CEOs (average shelf life of 28 months). The incoming one might not be as supportive as the outgoing one. Institutionalization of the PD culture might be able to combat this.
- Common framework across the entire country. We can't have 50 States doing 50 different things.
- Trust of government competence in general (by the public) can be a roadblock.
- Is branding itself an impediment? Do we need to keep calling attention to this or should it just be our natural way of doing things?
- HSM integration with the design process has not happened yet. This is an important tool but it may not be critical to a functioning PD program.
- Resistance from offices whose mission is closely tied to standards (bridge, traffic, etc.). A good way to combat this is to have their own colleagues relate success stories with PD ("we did this and the sky didn't fall"). Research is another thing they listen to.
- Poor communication and education regarding parameters, key attributes, benefits, challenges.
- Formal education (university) does lend itself to practicality.

  - Academia is not teaching roadway design
    - No faculty in geometric design.
    - Reliance on standards does not foster the sort of thinking and judgment required for successful practical design.
- Communicate / Teach staff and the public.
- Get the right people
  - Staff
    - Geared to culture and expectations.
    - Continual teaching / mentoring.
    - Access to tools / training.
  - Leadership
    - Must champion.
    - Must creatively support "failure."
    - Must reward creativity.
- Get-in-get-out-stay-out mentality. If we don't fix it all right now, when are we going to come back and do it?
- Organizational silos. For instance, if planning isn't on board, then your projects may be impractical from day one.
- Long range planning that doesn't account for changes in use of roadways. Technology such as teleworking, internet shopping, and automated vehicles could all change usage patterns.
- Liability
  - May need to recommend review of tort liability statutes
    - But important to stress that States don't need a change to do PD
    - Also important to link documentation with project documentation so defense can be found when / if needed
  - Legal committee at national level (TRB) compiles best legal practices.

AUGUST 20 MORNING SESSION

What can AASHTO do to assist States in implementation?

- Contact all of the appropriate technical committees and ask if they have included the principles of practicality in their publications. If not, how could they?
- Do the manuals need to be changed, or do the ways States use them need to change? Maybe States need to realize that there is a great deal of flexibility inherent in AASHTO documents.
  - Talk about this in technical committee meetings, SCOD and SCOH.
- Consider addressing these questions:
  - What do the States need from AASHTO for comprehensive (from CEO to entry-level designer) implementation of PD?
  - How engaged are you today?
  - What impediments to becoming engaged do you have?
  - How much of the existing flexibility contained in AASHTO documents do you use today? What has been standing in your way of maximizing that? Would simple (not 4-day NHI) training be a good solution to this?
  - How do we liaison with higher education to properly form new engineers?
  - How can AASHTO help address the liability issue?
- It would be a good idea for AASHTO to send an official letter to the State's transportation governing body to add credence to PD that would transcend leadership turnover.
- Include more explicit support of PD principles in key publications such as:
  - Green Book
  - Roadside Design Guide
  - Highway Safety Manual

- Other guides and documents

What can States do if they wish to implement a practical design program of their own?

- Become aware of existing State of practice
  - Recognize flexibility in existing practice.
  - Recognize drivers of flexibility (can be triggers for Practical Design decisions):
    - Funding availability, more collaborative environment, technology advancement, societal changes, etc.
- Top leadership makes the call and gives the direction. Leadership must truly understand and believe in the philosophy and have the tenacity to make it stand. Staff will easily detect executive leadership's commitment (or non-commitment) to PD.
  - Coming from this level, the concept commands instant (even if sometimes reluctant) buy-in
- Develop the agency's guiding values and principles for the program.
  - Must be developed with executive, senior, and limited mid-level management.
  - Legal should also be kept informed.
- Rollout the program to the organization (by way of printed documents, meetings, or both).
- Develop the culture:
  - Leadership personally reviews designs as the philosophy is taking hold.
  - Mid-level managers need to have buy-in and "keep the fire burning."
  - Staff-level workers must learn to stick to purpose and need. This can be difficult; it's a real change from traditional methods.
  - Reach out to all units of the organization. Even though this is design, there are important construction, traffic, and maintenance considerations inherent in practical design project decisions.
  - Maintain awareness of key concepts (scope management, cradle-to-grave considerations, etc.).
- Create tools that support them (scoping document/framework; review characteristics document/ framework; decision framework/process).
- Promote results (collect and analyze data, communicate, reward best practices/results).
- Build long-term capacity (work with academia on skills development/workforce development; collaborate with industry on national resources).
- Don't wait until all the bugs are worked out before implementing. They won't ever be totally eliminated in a rapidly changing world, and a quick, strong start is critical.

How will we measure success?

The best measures will likely be a trend over time, not a single snapshot.

- Measure safety through crash reduction.
- Consider asset condition at the network level.
- Consider baseline performance measures from MAP 21.
- Initially leverage the cost savings, but this will eventually go away.
- Consider the ability to do more projects than the budget originally indicated.
- Use pre- and post-PD cost comparisons of work types (major resurfacing, minor resurfacing, bridges, etc.).

How do we know if our progress with PD is slipping or going backwards?

- Funding cut (legislature is unhappy)
- Public dissatisfaction
- Scope creep comes back

CEOs forum in November

- At a minimum, we are going to go over our research to date including information gathered from this workshop.
- We'll also present a draft AASHTO proposed work program with performance measures.

APPENDIX C. Leadership Forum Minutes

Attendees:

Lynn Peterson – Washington State DOT
Nancy Boyd – Washington State DOT
Carlos Braceras – Utah DOT
Shailen Bhatt – Colorado DOT
John Terry – Nevada DOT
Gregg Fredrick – Wyoming DOT
Jason Ridgway – Maryland State Highway Administration
Kevin Marshia – Vermont Agency of Transportation
Michael Kennerly – Iowa DOT
Matt Delong – Michigan DOT
Paul Looney – Kentucky Transportation Cabinet
Joyce Taylor – Maine DOT
Amy Mood – Mississippi DOT
Michael Shepard – Florida DOT
Robert Mooney – FHWA
Jim McDonnell – AASHTO
Jim Tymon – AASHTO
Patricia Bush – AASHTO
Andrew Lemer – TRB
Don Hillis – Leidos
Jackie Clark – Leidos
Dave Ekern – DS Ekern Consulting

Agenda

Monday, November 9, 2015	
8:00 a.m. – 9:00 a.m.	**Welcome** **Introductions** – *Name, Agency, Title and Involvement with Practical Design* **Overview of the Project** **Meeting Goals and Objectives** – *Why Are We Here?* **Comments** – *AASHTO and FHWA representatives*
↪ *ANTICIPATED OUTCOMES*	• Understanding the Purpose and Goals of the Project • Shaping the Day's Work and Goals • Understanding the Perspectives of AASHTO/FHWA
9:00 a.m. – 9:45 a.m.	**What Have We Learned from the Research?** *Practical Design Definitions, Terminology and Principles* *Presentation and Discussion*
9:45 a.m. – 10:00 a.m.	**BREAK**
10:00 a.m. –	**What Have We Learned from the Research? (continued)**
↪ *ANTICIPATED OUTCOMES*	• Understanding of Definition Commonalities • Understanding and Consensus on the Key Principles of Practical Design • Group Input and Consensus on Need for Definition
10:30 a.m. – 12:00 p.m.	**What Have We Learned from the Research?** *Challenges– Presentation and Discussion*
↪ *ANTICIPATED OUTCOMES*	• Summary of the Challenges Identified to Date • Additional Perspectives on Challenges Shaping the Initiative • Perspectives on the Priority/Importance of the Challenges

12:00 p.m. – 1:00 p.m.	**LUNCH (NAS Building Cafeteria)**
1:00 p.m. – 2:45 p.m.	**Implementing Practical Design – Initiative Development and Prioritization** *Presentation and Discussion*
2:45 p.m. – 3:00 p.m.	**BREAK**
3:00 p.m. – 5:00	**Implementing Practical Design – Initiative Development and Prioritization (continued)**
↳ *ANTICIPATED OUTCOMES*	• Review and Understanding of Initiatives Identified • Additional Ideas for Initiatives • Priority Setting of Initiatives
Tuesday, November 10, 2015	
8:00 a.m. – 10:00 a.m.	**How Will We Measure Success?** *Performance Measures Report* *Presentation and Discussion*
↳ *ANTICIPATED OUTCOMES*	• Understanding Around What Is Available • Ideas for Performance Measures
10:00 a.m. – 10:30 a.m.	**BREAK**
10:30 a.m. –	**Moving Forward**
↳ *ANTICIPATED OUTCOMES*	• Input and Direction of Next Steps • Timing and Champion Identification
11:50 a.m. –	**Wrap Up and Adjourn**

Practical Design (Practical Design) Definition

Title/Name

- Now that Practical Design has been legislated in some states, it will be difficult to change its name, but not impossible. For example, Context Sensitive Design was changed to Context Sensitive Solutions.
- Participants confirmed consensus of practitioner workshop that they are not worried about the specifics of a title or having an absolute definition. In fact, many would prefer not to have either and use Practical Design as a set of high-level principles.
- Currently used Practical Design names:
  - Common sense engineering
  - Practical improvements
  - Practical engineering
  - Practical solutions
  - Practical transportation
  - Performance based practical design
  - Open roads
  - Flexible design
  - State of practice of highway design
  - Good Engineering
  - Doing your job

Definition

The participants made several targeted suggestions for improving the wording of the definition:

- Make the definition more general. Do not overstate it.
- Do not use the title "Practical Design"; only use the definition's words.
- Take out the first sentence, "The state of the practice of delivering highway improvements."
- Remove "improve safety and manages out assets in a cost effective manner" and replace it with "addresses project goals".
- A multi-modal approach is important to include in the Practical Design definition. Many States' senior executives spend the majority of their time on modes other than highways.

Principles

The participants confirmed that principles, not a rigid definition, should drive the concepts surrounding Practical Design. These principles should emphasize:

- Practical Design emphasizes adding value rather than reducing cost. By improving the quality of the project, the system and societal cost is reduced. Practical Design's goal is to maximize money in order to achieve the best system condition possible.
- Always define the project's purpose, needs, and goals before beginning the project and ensure all stakeholders are involved and considered during this time.
- Projects need to have multiple performance based outcomes as well as non-measurable outcomes (i.e., community benefit and approval).
- Start at the minimum standards and continue to expand and improve the project to the point where the cost outweighs the benefits.
- There is a need to connect Practical Design to related initiatives (e.g., Complete Streets, CSS, and Value Engineering) and define their similarities and differences.
- Practical Design examines the system as a whole:
  - Looks system wide when defining purpose and need.
  - Examines the corridor along with the parallel and perpendicular roads.
  - Do as much as possible across the network so that it yields the greatest benefit.

Additional Definition Discussion

- Participants discussed what Practical Design is NOT. Items mentioned included:
  - Agencies not implementing Practical Design are ***not*** doing "impractical design."
  - Practical Design is ***not*** an excuse to cut cost beyond what should be cut. It is about spending money wisely on solutions that have long lasting benefits. It should ***not*** compromise safety or community values in order to reduce costs.
- The definition that emerged from the workshop was not universally agreed to by participants at the forum.
- Participants conveyed the idea that this effort is more about the art of project management than it is about the practice of practical design. The Green Book considers itself a State of the Practice. It considers Practical Design as State of the Art.
- Participants raised the urban vs. rural perspective of the definition and the connection to local level planning.

Implementation Challenges

Numerous implementation challenges were discussed during the forum. For many of the challenges, participants proposed possible solutions or ideas. These are presented in the following table. Additional challenges that were left unresolved are listed afterwards.

Implementation Challenges and Proposed Solutions

Challenge: Practical Design requires agencies to take reasonable risks when it is necessary to deviate from standards. The process currently in place makes it difficult to o accept the possible failure associated with reasonable risks. This fear prohibits new innovations and creative solutions.

Proposed Solution: Change culture to encourage constructive acceptance of failure. Document decision making process and outcome. Learn from mistakes. Accept that enough reasonable risks will eventually result in a failure.

Challenge: Agency staffs do not have enough time to elicit public involvement, include stakeholders in the planning and design process, and have risk conversations with higher levels of management. Staffs want to make the decision further down without communicating that the risk has increased.

Proposed Solution: Consider forming a council where engineers can express their concerns. Need to have the ability to raise issues up to secretary level or chief engineer's level. Every project needs to come before the community for the next step. Bring a level of accountability to the high levels of the project. Let the risk become administrative. It will be the administrator's fault in the end anywhere so we need to know about it in the beginning.

Challenge: Integrating Practical Design at the CEO level. In the last year, 20 State CEOs have been replaced and more will cycle out after the next election. Many new CEOs do not have a background in Transportation.

Proposed Solution 1: Develop marketing and educational material for CEOs. Ideas include:

- A training video or presentation with a catchy title; something like, "How To Be Responsible with Taxpayers' Money."
- Summarize benefits of Practical Design in something that is quick and easy to read.
- A small document that captures the journey of project development and catches them up to speed.

Proposed Solution 2: Get the group below the CEO (senior executives) to buy into and embrace Practical Design. They are the consistent group that is there from CEO to CEO and can help educate the new CEO on the benefits of Practical Design. Without additional support, CEOs can find it hard to get resident engineers to buy into a new idea two to three levels down.

Implementation Challenges and Proposed Solutions

Challenge: Integrating Practical Design at the entry-level. Universities are not delivering engineers that have the skillsets DOTs need. They teach the students to engineer by standards instead of using critical or flexible thinking.

Proposed Solution 1: State departments can work more closely with universities. DOT employees should lecture at the university using real-world experience. DOTs can hire graduate research students to complete technical studies.

Proposed Solution 2: DOTs should rotate entry-level engineers within their organizations so that they are exposed to all areas of the business and learn to think holistically.

Proposed Solution 3: DOTs should link entry-level engineers with a mentor who is outside their immediate group. Such a relationship could help educate new engineers about Practical Design and provide them with an unbiased advisor to bounce innovative ideas off of.

Challenge: The engineering culture is too dependent on the Green Book. Engineers use it as a standard rather than guidance. It allows them to turn off their critical thinking and fit the same solution to every problem, whether it is a good solution or not. Also, bicycle and pedestrian documents are separated from the main guidance documents, sending a message they are less important.

Proposed Solution 1: Change the philosophy of using the Green Book as a manual. Reorganize the Green Book to present standards in order of flexibility and in the proper context. Each chapter should begin with the purpose and general guidance of the standard. Work bicycle and pedestrian guidance into the Green Book so that they are considered during project design.

Proposed Solution 2: FHWA should create a web-based toolkit that combines all guidebooks and interactively links information together to promote Practical Design thinking.

Proposed Solution 3: Create a new overview, bridge document, or guide on how to integrate and use the flexibility that exists in the existing guide manuals.

Proposed Solution 4: Subdivide manuals and guidebooks to reflect the project location or characteristic. For example, rural, small urban, large urban, metropolitan, etc.

Challenge: FHWA guidelines and policies can be too stringent. We have used FHWA guidelines as the reason for not doing the right thing.

Proposed Solution: FHWA is reducing criteria and setting a minimum for design exceptions. There is a need to have this uniformly applied by the FHWA Division Administrators.

Implementation Challenges and Proposed Solutions
Challenge: DOTs understand how to do their job but do not understand how to do their consultants' jobs. The consultant's goal is to please the customer (DOT), so they do not always push back when something is unnecessary or not quite right. **Proposed Solution**: DOTs need to consider and treat consultants as part of their staff and instill in them the same accountability the DOT feels towards the general public. They must also create an environment where the consultant feels they can push back if it is the right thing to do. One way to move forward is to bring organizations like ACEC, ASCE, ITE and other together on a regular basis to discuss these and other related issues.
Challenge: Perceived increased liability when standards are not followed. **Proposed Solution**: Practical Design related lawsuits are estimated to be 20 years away. This will not be a significant issue.

Additional Challenges

- All states need a closer relationship with FHWA. Those that attended FHWA conferences and peer exchanges already have a good relationship with FHWA and are using more flexible solutions. FHWA is a toolbox, and taking advantage of the agency's support is important.
- It is difficult to incorporate Practical Design into large design-build type procurements.
- States are afraid of having to go back to NEPA after going through design. Designers over design and over study so they don't have to go back.
- Travel demand prediction models are very inaccurate. This makes it difficult to make design decisions today that will be appropriate for the system 20 years from now.
- AASHTO committee ownership of the guidance documents makes changes difficult and slow to implement.
- There is confusion over the role of FHWA in getting exceptions to AASHTO and state guidelines
- What is the appropriate level of documentation of changes from standards?

Implementation Ideas

Multiple implementation ideas were generated as "solutions" to implementation challenges in the previous section. In addition to these, participants generated several more ideas during the forum:

- Develop a new, overarching guide on how to use the Green Book and other guides together. It should be bigger and have broader flexibility than the highway design guides that are currently available.
- Alternatively, simplify the Green Book and elevate its contents to a higher level so that it gives States more flexibility and so the Federal government could adopt it without a huge amount of upkeep effort. With this document, States should be able to choose the pieces that work for them to match the goals they have for practical design.
- Hire consultants to expedite rapid updates of the Green Book to incorporate the changes being requested. Create a schedule for updating and deployment of the new Green Book and HSM.

- Propose and develop a National Partnership Agreement with the significant leaders in engineering and innovative design. These would include AASHTO, ITE, ACEC, ASCE and FHWA. The new National Partnership could focus on:
  - Coordinated training and education programs.
  - Development of a website.
  - Development of National Center of Excellence in design or shared and expanded Center of Excellence in the environment.
  - Creating a clearinghouse for Practical Design questions.
- Creation of a National Academy for Practical Design (Project Management). This would be geared towards providing DOT and Private Sector engineers with an in depth academy to learn the skills not offered in college. It could focus at UTC system for development of many of the ideas.
- Define a research project proposal to develop a guide for new CEOs to understand and support practical design.
- Create an online Practical Design toolkit that helps engineers walk through Practical Design processes and asks appropriate questions that encourage flexible thinking. Ensure that the tool's assumptions and reasoning are not hidden. The tool should help engineers make their decision by educating them about the different options.
- Create a resource identifying how other States and agencies have implemented Practical Design. This makes it easier to share ideas and help beginner States.
- Use the Capability Maturity Model as a tool. It measures development from an *ad hoc* process to a mature business process. This may help to measure the readiness of an organization to engage in practical design and identify where they need to focus their efforts.

Rankings of Workshop Ideas

Participants also ranked a list of implementation ideas prior to the forum. Submitted rankings are presented in Appendix A. The top 6 Ideas that received a 2.3 out of 3 or greater are summarized below with the highest ranked listed first.

1. Develop training programs that could be offered to state and local agencies.
2. Develop on-line training courses that incorporate Practical Design principles in conjunction with AASHTO guidance documents.
3. Include Practical Design implementation in the strategic plans for all appropriate committees.
4. Create a schedule for updating and deploying the new Green Book, Roadside Design Guide, and HSM.
5. Develop common language regarding practical design and decision-making flexibility for use in all AASHTO guidance documents.
6. Develop a Practical Design implementation template or toolbox that can both provide States starting the Practical Design journey with a "How To" guide as well as serve as a resource for states already implementing Practical Design.

Ideas Generated around Performance Measures (PM)

- Some States use cost as a PM and base initial cost on a non-standard approach. But as Practical Design becomes standard, there will be no non-standard comparison. Cost can be an initial PM but cannot be a PM years from now.
- Develop different PMs for every stage of the project design process.
- Develop a PM for community involvement and feedback.
  - Ask the city Mayor his/her opinion of the project.
  - Poll stakeholders to determine the percentage that are happy with the project solution.
- Develop different PMs applicable to the job site, project level, and system level.
- Create a review team (audit) that is involved in each stage of the process.

- Develop different PMs for each level within agencies to make sure they are meeting their goals; for example:
  - State level: Percent of statewide bicycle/pedestrian plan implemented.
  - Agency level: Stakeholder satisfaction of an agency.
  - Project level: Meeting project level goals. Tracking stakeholder's satisfaction with project solution.
  - Asset solution level: Lower cost, better pavement, better bridges.
- PMs need to measure if the design is meeting the goals identified at the beginning of the project.
- Require iterative reviews throughout the life of the project to evaluate if the project is still meeting its original purpose and need and project goals.
- Need to think differently about how we measure transportation solutions. It should be standard to ask questions throughout the development process. Did you consider multi-model, safety, etc.? Start them thinking about things that they weren't thinking about before.
- Use the capability maturity model as a tool. It measures the development from an ad hoc process to mature business process. This may help to measure the readiness of an organization to engage in practical design and where they need to focus their efforts.
- Incorporate a context based PM.

Moving Forward

- FHWA should sponsor a project that gives a larger global view of Practical Design.
- Performance based review is the next step in evolution. It should incorporate system like thinking and useful tools.
- Practical Design is a board level initiative within AASHTO. It needs an overarching document that talks about goals, directions, and influence.
- Center of excellence for program delivery in AASHTO.
- Comprehensive training program.
- Change the Practical Design title to reflect the environment we live in.
- State DOTs want to have more input about what activities will be funded.
- Focus on training and education. This could be a growth area of AASHTO. Need a focal point within AASHTO to help Practical Design education grow.

Priority Rankings for Implementation Ideas

Rankings

1 = Low 2 = Medium 3 = High

PRIORITY	IMPLEMENTATION IDEA
INSTITUTIONAL	
2.4	Include Practical Design implementation in the strategic plans for all appropriate committees. Every committee that is responsible for generating or maintaining decision-making guidance for projects should have a strategic focus on Practical Design to ensure the discussion and journey continues. With a strategic focus, the emphasis will be maintained and the state of the practice will eventually become the normal way of doing business. • Identify which committees need support. • Identify and ensure Practical Design champions are involved in leadership of key committees. • Workshop with committee chairs at AASHTO annual meeting or spring meeting.
2.4	Create a schedule for updating and deploying the new Green Book, Roadside Design Guide, and HSM.
2.3	Develop a Practical Design implementation template and/or toolbox that is potentially titled: *Steps that a state could take to implement Practical Design*. A state that is starting the Practical Design journey or is struggling with implementation would benefit by having a simple "How To" guide to assist them.
2.1	Propose and develop a National Partnership Agreement with the significant leaders in engineering and innovative design. These would include AASHTO, ITE, ACEC, ASCE and FHWA. The new National Partnership could focus on: • A coordinated training and education program. • Development of a website. • Development of a new National Center of Excellence in DESIGN. • Creating a clearinghouse for Practical Design questions. • Creating a Design Certification Program.
2.0	Propose hiring consultants to expedite rapid updates of the GREEN BOOK and other guidance documents in order to incorporate the changes being requested.
1.8	Develop an AASHTO support letter to each state's governor / highway commissioner regarding benefits of Practical Design. • Determine States that would like this support. • Send letters of support.
1.7	Engage state legal counsels in the AASHTO committee structure by either creating a new committee or having them support in an advisory role on an existing committees. The liability associated with Practical Design has not been tested in court. It may take up to 20 years for Practical Design tort law to be determined. Engaging state legal counsels now will allow them to be part of the implementation effort at the national level.

PRIORITY	IMPLEMENTATION IDEA
POLICY	
2.3	Develop common language regarding practical design and decision-making flexibility for use in all AASHTO guidance documents. *A Policy on Geometric Design of Highways and Streets (Green Book)* mentions cost-effective design in the foreword. The Roadside Design Guide has a section titled "The Application of This Guide" and further references its purpose as a guide in the preface. Additional emphasis on Practical Design and its relationship with the design guides is needed. A "how to" section of all manuals would ensure users understand the intent and purpose of the guide and the designers role in making good design decisions.
1.8	Incorporate as a Strategic Initiative in the AASHTO Strategic Plan.

PRIORITY	IMPLEMENTATION IDEA
TOOLS AND TECHNOLOGY	
2.5	Develop on-line training courses that utilize Practical Design principles in conjunction with AASHTO guidance documents. The course could be customized to specific States policies and can include real examples for participants to work through.
2.1	Create Practical Design decision support tools that analyze multiple solutions. The Highway Safety Manual provides a tool that allows the user to evaluate multiple alternatives based on the safety impact. Having a tool that allows the evaluation of other goals such as environmental stewardship, cost-effectiveness, etc. could help in selection and decision documentation.
1.8	Develop standard criteria and language to assist with justifying design exceptions.

PRIORITY	IMPLEMENTATION IDEA
OUTREACH	
2.2	Peer-to-Peer Exchanges or Training Conferences. Making the topic a central theme of several related National Conferences
2.1	Develop and implement quarterly webinars on Practical Design for new and experienced designers. Webinars provide an opportunity for continuing education and have successfully been used to communicate information across the country. Quarterly webinars will allow new designers to participate in an introductory course and experienced designers to catch up on the state of the practice.
2.1	Promote Practical Design through success stories. Telling a positive story with great outcomes is a great way to increase support for a concept. Promote these Practical Design successes on websites or through Practical Design / Highway Engineering awards and recognition. • Develop a recognition program for Practical Design. • Promote on websites, in news articles and with national recognition.

PRIORITY	IMPLEMENTATION IDEA
OUTREACH	
1.9	Initiate an outreach program to other AASHTO Committees to explain, and engage them in a discussion of, how they can support Practical Design
1.8	Define a research project proposal (20-24) to develop a *Guide For New Ceos To Understand And Support Practical Design*.

PRIORITY	IMPLEMENTATION IDEA
	SUSTAINED INITIATIVES
2.6	Develop Training Programs that could be offered to state and local agencies.
1.9	Develop templates and/or guidance to assist states in reaching out to Higher Education and promoting practical design education at college level. It has been noted that many universities have moved away from teaching Highway Design. A partnership between the States and their engineering schools could reverse this trend and set the stage for a future work force that is already familiar with the principles of Practical Design as it is applied to Highway Design work. • Identify general user requirements. • Develop mechanism to evaluate alternatives.
1.8	Develop an initiative with the University Transportation Centers (CTS) similar to that being offered by the University of Minnesota CTS. These would be tailored to the states being served by that Center.
1.7	Creation of a National Academy for Practical Design. This would be geared to provide DOT and Private Sector engineers an in depth academy to learn the skills not offered in college.

APPENDIX D. Subcommittee on Design Survey

Introduction: Provided to States Prior to Meeting

Several Subcommittee on Design members are participating in NCHRP 20-24(102) – Executive Strategies to Deliver Practical Design. Eight states (FL, KS, MN, MO, UT, VT, VA, and WA) recently participated in a two day workshop to discuss the definition, practices and challenges associated with Practical Design concepts. Based on that workshop attendees drafted the following definition of Practical Design:

> *Practical Design is the current state of the practice for delivering highway improvements. It is a multidisciplinary approach for delivering transportation projects that focuses on the health of the entire system, improves highway safety, manages assets in a cost-effective manner and is sensitive to context and customer needs.*

The following are various definitions of Practical Design that already exist throughout our country:

- From NCHRP Synthesis 443:

Method to determine the most cost effective way to achieve the projects purpose and need. The consistent theme among states isn't a specific definition but rather policies that are written in terms of goals, principles and process.

  - There isn't one definition for Practical Design. Each State using the term has a somewhat different definition, and some States may use other terms for similar approaches. Agencies with a Practical Design or related policy "have a common goal—developing individual projects cost-effectively to meet only the project's purpose and need and applying cost savings for additional projects, thereby optimizing their budgets statewide"

- From Washington State DOT:

Practical design is an approach to making project decisions that focuses on the need for the project and looks for the cost-effective solutions. It engages local stakeholders at the earliest stages of defining scope to ensure their input is included at the right stage of project design.

- From Oregon DOT:

Practical Design is a strategy to deliver focused benefits for the State's transportation system while working with the realities of a fiscally constrained funding environment.

- From Utah DOT:

The goal of practical design is to appropriately allocate limited resources to maximize system wide improvements. This approach focuses on maximizing improvements to the roadway system as a whole, rather than maximizing improvements to a few locations.

As the work of the Subcommittee on Design and associated Technical Committees are responsible for many of the technical documents that encompass the concepts of Practical Design, the NCHRP 20-24(102) panel is interested in your responses to the following questions. If at all possible, the panel is

requesting your consideration of these questions during the Regional Breakout Sessions at the upcoming SCOD meeting in Seattle, WA.

State Responses to Questions:

1. Based on the above definitions, does your state employ the concepts of Practical Design?

- **Alaska** - Focus on original scope of project, keep them classed as low as possible based on need, no practical design process in state right now. Trying to help people understand there is a range of acceptable values and the lower end is still standard. Use design waivers, deviation for non-controlling criteria.
- **Arizona** - Similar to California.
- **California** - Basically been stated policy for years but not practice, identify need and start adding on to meet standards, trying to change culture, design manual foreword focuses on need for flexibility but has evolved to if you touch it you fix it to standards. Working on making design exception process easier
- **Colorado** - Safety assessment review prior to design (3R), look at accident history, traffic issues, areas that don't show concerns don't require elements to be brought up standard, allows more flexibility. Other projects—be able to show reasons for deviations from standards—not always easy. One issue is the level of comfort of people stamping the plans when not everything is up to standard.
- **Florida** - Yes. Florida has developed a Practical Design Handbook.
- Louisiana – Yes.
- Maine – Yes.
- **Montana** - Working on design manual, struggling with meshing standards with practical design, use design exceptions, trying to change from top down to need and build up
- **New Jersey** - Yes, the NJDOT definition is similar to Washington DOT. We focus on the problem that was identified in the "Problem Statement" that initiated the project. We do not improve all substandard conditions within the project limits, unless there is a safety and/or an operational problem. Having stated that, we do try to get as much out of a project as feasible – that is; we improve as much as we can before heavy impacts are triggered: Extensive environmental mitigation, Right of Way, Utilities. These are the impacts that significantly increase costs and delay projects.

  At NJDOT we have Management Systems: Bridges, Pavement, Congestion, Safety and Drainage.

  - Bridges and culverts are ranked based on their condition and need for improvements.
  - Roadway segments are ranked based on Pavement condition.
  - Roadway sections are ranked based on congestion severity.
  - Intersections and other roadway segments with known crash history are ranked.
  - And Roadway segments that experience flooding are ranked.

Approximately 5 years ago, the NJDOT developed a "Limited Scope" (LS) Delivery Process for resurfacing projects. Limited Scope Resurfacing projects are considered "Preventative Maintenance" and therefore, according to the FHWA project definitions and our own Design Exception Manual, do not require the Design Exception process. To qualify for Limited Scope, the pavement recommendation for the project must be Mill x"; Pave x" (Equal mill and fill.) We are allowed an additional 1 inch of thickness – as this helps to improve deficient cross slopes. However, we do reference our Safety Management List and crash records to make sure that there are no "hot spots" within the limits of the project. If a significant safety issue is identified, the section can be broken out as a separate project.

In addition to LS Resurfacing projects, NJDOT also developed a process for the LS Bridge Deck and Superstructure Replacements. Bridge deck projects are identified via the Bridge Management system.

Given the significant and long term investment as well as the disruption to traffic for these types of projects, Design Exceptions are required. If it is determined that the bridge is not contributing to crash or operational problems, then the project advances from Concept Development to Final Design.

- **North Dakota** - Standard FHWA design exception form also used for internal.
- Pennsylvania – Yes.
- Washington – Yes.
- **Wyoming**—Similar to Colorado.

2. If so, what does your state call this practice? (Practical Solutions, Context Sensitive Design, etc.)?

- **California** - Supposed to be the way we do business.
- **Florida** - Calls this "Practical Design" and it currently only applies only to RRR projects.
- **Louisiana** – Informally, practical design or context sensitive design.
- **Maine** – We use the term Practical Design.
- **New Jersey** - It's been referred to as: Smart Solutions, Right Sizing, Contact Sensitive Design, and Cost Effective Solutions. NJDOT has the Limited Scope delivery process (discussed above). We do not have an official name for the design approach for all other capital projects. We rely on engineering judgment and we focus on improving identified problems; not necessarily meeting all standards. Every project is different. Each problem that we are trying to improve has a different priority based on crash rates, delays, hierarchy of the facility, traffic volumes, speeds, potential growth, etc.
- **Pennsylvania** - These practices had been called "Context Sensitive Solutions", "Right-Sizing" and "Smart Transportation".
- **South Dakota** - Project scope.
- **Washington** – Practical Solutions.

3. If yes, what impediments did your state overcome in deploying these concepts?

- **AASHTO Region 4 General Response** - Culture, leadership support to say he needs them to be engineers not just those who use the book
- **Florida** - Overcoming the mindset that it is necessary to bring all features on the facility up to current criteria. "Practical Design" overcame this by streamlining the design variation process and through training and education. In addition, Central Office provided 60% design reviews on Interstate 3R projects to provide "practical design" feedback to Districts.
- **Louisiana** – The administration was convinced quite readily. The biggest impediment was convincing designers (and other plan reviewers) that deviating from "black and white" design standards is acceptable with the application of engineering judgment. Much of our decision making utilizes the HSM and CMFs. Convincing hydrologists to match existing bridge elevations was also a challenge.
- **Maine - W**e had very few impediments – the concept was embraced from the highest levels down through the Department.
- **New Jersey** - There are some whose main objective is to get projects out to construction as fast as possible and others that want to "fix" everything. As a result there can be disagreements regarding the "severity" of a problem and the "feasibility" of an improvement. Both *severity* and feasibility are left to interpretation. Therefore, if the one in charge is inclined to keep a project small and get it out the door, it has become easier to say that an improvement is not feasible. Consequently, there is more potential to get less of an improvement built. In addition, by focusing on the current problem at-hand, there is the potential of not fully considering future growth and future infrastructure needs.

Making improvements on a case-by-case basis also makes it difficult for decision makers to maintain consistency – when dealing with so many different people with different agendas. This is not only a problem with our own in-house people on Capital projects, but it becomes even more difficult when dealing with developers – who tend to take a minimalist approach to mitigating their highway impacts. The more "*flexible*" we are on our own projects, the more difficult it is to hold a developer accountable. They will find and then emphatically point out a location where we did not build according to the book, but we are now requiring them, in a similar condition, to build according to the book. (It is unreasonable to suggest that although the design element may be the same, the conditions are actually different, and too, they are adding a high volume of traffic and a conflict point – essentially overnight.)

Along the same lines, practical design can be a double edged sword when dealing with local officials as well.

- **Oregon**—Upper management seals design exceptions. Designer is authorized to work within the standards need approval to do different.
- **Pennsylvania** – No impediments, but PA emphasizes that the project development teams make an individual evaluation of each project's context (and future context) site in order to yield a project that fits the context of the site and/or region.
- **Washington** - Consensus on performance measures to use in the determination and analysis of design elements. Standards-based design policy that relies on limited project information such as funding program and functional class, and design exceptions for decisions made outside of that policy. Design policy that did not support a more thorough examination of project need in advance of alternative formulation.

4. If not, what impediments exist to becoming engaged in Practical Design concepts?

- AASHTO Region 4 General Responses -
  - What is the point of having design standard? How do you reconcile that?
  - Continuity of national system—is there risk of losing consistency
  - Old school designers—can't get to 10 or 11 foot lanes, department leaders are an impediment.
  - On the other hand, experience is the key to understand the whys of the standards.
  - FHWA—often won't agree to do less than standards, many times there is no flexible

- **Florida** - One initial impediment is providing engineers with the resources (time, $$) to develop alternative designs during the initial engineering process. We typically try to narrow scopes to fast-track projects because we are trying to get jobs built quicker.

  Another impediment is creating consistency on our roadways. Engineers typically try to create consistency in alignment and cross sections of roadways to meet the expectancy of the traveling public. There is research that too much inconsistency in design approach leads to increases in crashes.

  Competing interests can also be an impediment. As we approach a roadway project, stakeholders compete for needs and amenities on projects. These stakeholders sometimes do not consider the impacts to other users of the transportation facility. Engineers are faced with trying to fit what they can to meet these political and social forces and it quickly expands the scope and limits the implementation of "practical design' concepts. DOTs and Engineers throw out quickly the option of buying more right of way due to costs and time, but sometime obtaining right of way would provide the best alternative.

- New Jersey – N/A.
- **Pennsylvania** - The concepts of the aforementioned practices have been engrained in our policies and procedures, and are expected to be utilized by our project teams.
- Washington – N/A.

5. Is there anything that AASHTO could do to benefit your state (from CEO to entry-level designer) in a comprehensive implementation of Practical Design concepts?

- AASHTO Region 4 General Responses –
  - Flexibility in design guide should be updated.
  - Green Book Chapter 1 update—should help with culture change; make sure people understand it is guidelines, not standards.
  - Training—hands on examples, not theoretical and high level but real world examples.
  - As an industry—we should make this a requirement in college (maybe a research topic on how to do this and what is needed).
  - Training to understand the trade-offs they are making with practical design.
  - Maintain as much flexibility in documentation as possible.
  - Compile best practices.
- **Florida** - Promote the concept, but not as a single stand-alone program. Tie the concepts to other programs that are trying to achieve similar goals, i.e. value engineering, complete streets, context sensitive solutions etc.
- **Louisiana** - Flexibility and engineering judgment should be made more obvious in AASHTO documents. It can be challenging to defend engineering judgment against the Green Book in front of a plaintiff's attorney and a jury.
- **Maine** - Continue to extol the virtues of Practical Design.
- **New Jersey** - Currently, the FHWA definition of "Pavement Reconstruction" means that if we mill and resurface a road and raise the profile by more than 1", it is considered Reconstruction. Pavement reconstruction requires the Design Exception process. A resurfacing project can be 3 – 20 miles long. Analyzing crash records for such long lengths of roadway for the Design Exception Report can be a quite an effort (considering our limited resources).

It would be very advantageous if we had an approved procedure that allowed us to add a couple extra inches of asphalt and improve cross slopes (and maybe do some minor widening) within a Resurfacing project - without the full blown Design Exception process kicking in. Please do not misunderstand; the intent here is not to dismiss safety issues. A safety review of the project limits certainly should be completed. However we do want to be able to get the most out of our pavements and make minor improvements as needed. We have come a long way in efficiently tracking and projecting pavement condition, but we need to be able to get resurfacing projects out in a timely and cost effective manner. We have other avenues to address safety, congestion, flooding, and bridge projects.

- Perhaps the definitions of "Preventative Maintenance and Pavement Reconstruction" can be changed to allow additional asphalt thickness within Preventative Maintenance.
- Perhaps the intent (or the origination) of the project should also be considered when determining whether or not to require Design Exceptions.
- Perhaps there should be a different Design Exception process tailored to resurfacing projects.
- Perhaps, if the Department performs a safety overview (according to guidelines to be determined), for each resurfacing project, the project can be exempt from Design Exceptions.
- Pennsylvania – Provide examples of Practical Design via AASHTO website.
- Washington - A review of and endorsement of innovations in procedures made from various perspectives that provide for flexibility beyond the use of standards in scoping and designing projects. Updated content for the Green Book that accounts for these innovations.

6. How much of the existing flexibility contained in AASHTO documents do you use today? What has been standing in your way of maximizing that? Which documents do you feel have the most flexibility? Which documents do you feel could benefit from a review that might identify areas to address additional flexibility that align with the state of the practice?

- **Arizona** - Use the flexibility when they really need it (between a rock and hard place) but otherwise not really, they have their RDG—use flexibility when they want to.
- **California** - Doesn't use the range the Green Book provides. They have standards based on type of roadway, could do more to employ the flexibility.
- **Florida** - FDOT uses all of the flexibility of the AASHTO manuals. The Roadway Design Office encourages the Use of Design Exceptions and Variations to ensure the right fit for both a safe and context sensitive design.

Nothing is truly standing in our way (see response to #7). We have streamlined our variations and exceptions approval process as described in our Practical Design Handbook to further encourage a "practical design" approach. The AASHTO Green Book is very flexible in its approach to criteria as evidenced by some of the safety research present in the HSM, reinforcing the ranges provided.

The HSM needs more work in the rural and urban area chapters. The information out there is limited and is usually derived from just a few states. There is a lot of criteria in the AASHTO Green Book without any SPFs/CMFs to do the comparisons of nominal and substantive safety. The remainder of the library of AASHTO Manuals is very flexible. What's missing is an educational component of the flexibilities that exist. Many engineers are not taking the time to read the manuals thoroughly to gain a higher level of comfort when evaluating possible solutions.

- **Louisiana** - We utilize as much flexibility as allowed. More emphasis on flexibility is needed in the Green Book and in the Roadside Design Guide. The HSM has been a great asset that can be used to demonstrate that spending more money or meeting certain design criteria does not necessarily translate to improved safety performance.
- **Maine** - We use the maximum amount of flexibility and employ a Design Exception process when additional flexibility is warranted.
- **Pennsylvania** - We find that there is a great deal of flexibility in the AASHTO Publications; however, Practical Design Concepts incorporated in the Green Book would be very helpful. For example something along the lines of the current section for superelevation values for low speed streets.
- **Washington** - Our state currently makes ample use of dimension ranges in our guidance and design exceptions in our practice. The Green Book is the pre-eminent document that many of our local jurisdictions rely on, and that we refer to in the ongoing development of our policy. New developments in the area of design context and more detailed functional classifications should be part of any updates there. Our new policies rely on advancements provided in the Highway Safety Manual, and continued and ongoing development of that product and supporting data is important to us. Ideas in development about evolving the roadside design guide to a more risk-based approach would fill an important need in our policy development that is becoming more dependent on HSM and the risk-based approaches provided there.

7. If there are liability issues that exist in your state that impede the implementation of Practical Design concepts, how could AASHTO help address those issues?

- AASHTO Region 4 General Responses -
  - Every state is different. AASHTO can't help individual states.
  - Risk—always focusing on cost savings can result in doing the wrong thing.

- **Florida** - Not aware of any liability issues, just perception that there may be liability issues associated with implementing “practical design”.
- **Louisiana** - State law requires the development of design guidelines/standards based on the AASHTO Green Book. Again, more obvious emphasis on flexibility and judgment would be helpful.
- **New Jersey** - NJDOT has a living document throughout the design process called the Design Communication Report (DCR). At the conclusion of major discussions, the design decisions are documented. We do not believe that liability is an issue – provided that we follow our approved policy and procedures, maintain the DCR and prepare Design Exception Reports.
- **Maine** – We feel that because of our documentation of design decisions and design exceptions we have little to no lower liability issues.
- **Pennsylvania** – As stated above, AASHTO could assist states by incorporating more Practical Design concepts in the AASHTO Green Book.
- **Washington** - Because of the approach we’re taking to documentation and analysis, our management and staff is confident that our implementation of practical design will provide adequate and perhaps even better position with respect to design liability.