1.0 CONTEXT SENSITIVE DESIGN, INCLUDING AESTHETICS AND VISUAL QUALITY

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CONTEXT SENSITIVE DESIGN

Work Group Participants

Panel Moderators:
Barbara Petrarca
Harlow Landphair

Committee Members:
David Fasser
Michelle Pourcaiu
Bruce Douglas
Douglas Mann
Robert Jake Jacobson
April Stefel
Barbara Petrarca
Jon Williams
Harlow Landphair
Elizabeth Fischer
Daniel Johnson

Author(s):
Harlow Landphair
Barbara Petrarca

Resource Paper

Introduction

Context sensitive design is a process for providing transportation solutions that simultaneously advance the objectives of safety, mobility, enhancement of the natural environment, and the preservation of community values. In short, design excellence. The current focus of "Context Sensitive Design" (CSD) in transportation has evolved from two distinct shifts in the engineering project design paradigm. First, the nation and most of all of the states have shifted administratively from a narrow highway focus to a broader view of transportation. This recognizes links between all modal transport types in the transportation network. Secondly, there is an increasing demand on the part of stakeholders and users for a system that is more attractive, sensitive to the cultural and natural environment, and considers the values of affected communities, while maintaining the safety and mobility needed to support a vibrant economy.

Recognizing the shift in focus at the national level, the American Association of State Highway and Transportation Officials (AASHTO) issued a policy statement significant to context sensitive design in the "*National Highway System (NHS) Design Standards."* This publication made clear AASHTO's better understanding of public involvement as a key element in the transportation delivery process. This policy resolved to:

> "…work through AASHTO's design standards committees with DOT and with interested parties on design criteria and a design process for NHS routes that integrate safety, environmental, scenic, historic, community and preservation concerns, and on standards which also foster access for bicycles and pedestrian traffic along with other transportation modes."

Many other important works have contributed to the present ideology influencing CSD, some of which include:

- Flexibility in Highway Design, Federal Highway Administration *(* FHWA-PD-97-062),
- Policy on Geometric Design of Highways and Streets, 2001, AASHTO
- "Thinking Beyond the Pavement: A National Workshop on Integrating Highway Development with Communities and the Environment While Maintaining Safety and

Performance", Conference, Maryland Department of Transportation, State Highway Administration.

From these beginnings several other national transportation venues have followed on the foundations of these beginnings including: ASCE- Virginia (1999), FHWA co-sponsored Western Region CSD Workshop- Montana and Northeastern Region CSD Workshop-Connecticut (both in 2001), and Formation of an AASHTO National Steering Committee and CSD Action Plan. At least 16 states have sponsored CSD conferences or training.

The issues of CSD are most closely associated with environment, safety and geometric design. However, CSD really transcends all aspects of transportation project planning, design, construction, operation and maintenance. Because the issues are so broad, this paper focuses only on setting the stage for establishing CSD research needs in the areas that impact natural and cultural environmental concerns.

Concepts, Principles, and Measures of Context Sensitive Design

Context sensitive design is a process based on concepts of excellence, principles for gauging performance, and tools that can be employed to achieve the goals of excellence. The intent of this section is to explore the concepts of CSD, the principles by which success may be measured, and the tools being employed to achieve design excellence in transportation.

Concepts of CSD

Two broad concepts are central to CSD:

- Each transportation project is unique. That is the site, circumstances, users and value systems of the stakeholders are different than any other project regardless of similarities.
- The design response must be crafted to meet the unique characteristics of the site and the stakeholders.

In general, practitioners accept these concepts as being "business as usual." However, in practice designers have a tendency to return to what worked before and solutions that appear to be "safe." Given the litigious nature of the practice environment, the motivation for using a "cookie cutter" approach of time-tested standards is easily understood. But widespread public resistance to standardized solutions gives ample evidence that this mentality is simply no longer acceptable.

Clearly there are many design considerations of the transportation network that do require uniformity to ensure safety and operational efficiency. Signals and markings need to be standardized to communicate clearly and avoid confusion; the geometric properties of the traveled way must be set to accommodate the speed and types of vehicles that use them; roadside features must be designed to minimize the potential for injury. However, beyond these basic parameters, there are almost unlimited degrees of freedom.

Principles of CSD

The Maryland workshop on "Thinking Beyond the Pavement" developed eight principles that clearly articulate the foundation of the CSD project delivery process. These principles were labeled as the "characteristics" of the process.

- Communication with all stakeholders is open, honest, early, and continuous.
- A multidisciplinary team is established early, with disciplines based on the needs of the specific project, and with the inclusion of the public.
- A full range of stakeholders is involved with transportation officials in the scoping phase. The purposes of the project are clearly defined, and consensus on the scope is forged before proceeding.
- The highway development process is tailored to meet the circumstances. This process should examine multiple alternatives that will result in a consensus of approach methods.
- A commitment to the process from top agency officials and local leaders is secured.
- The public involvement process, which includes informal meetings, is tailored to the project.
- The landscape, the community, and valued resources are understood before engineering design is started.
- A full range of tools for communication about project alternatives is used (e.g., visualization)

These principles require constant communication with the stakeholders and being responsive to their values and the unique conditions of the site. While it sounds simple, the actual practice is complex. In an article for Public Roads, Peaks and Hayes cited a post construction survey in which users were asked to rank the most important characteristics of the new freeway. In the survey, participants living adjacent to the freeway ranked noise, fumes, and appearance as the top three characteristics. This same group ranked congestion, design standards and travel times at the bottom of the list. Those responding to the survey that lived away from the freeway ranked the same characteristics in the opposite order.

Because perceptions of need and purpose for projects can be very diverse and often diametrically opposed it is critical that project managers be skilled in conflict resolution and have access to a multidisciplinary team with appropriate technical skill and knowledge to address the unique problems of each project.

CSD Measures of Design Excellence

The "Thinking Beyond the Pavement" workshop went on to describe seven measures of design excellence for transportation projects. These measures provide a fundamental yardstick for measuring the success of a project in meeting the CSD principles.

- The project satisfies the purpose and needs as agreed to by a full range of stakeholders. This agreement is forged in the earliest phase of the project and amended as warranted as the project develops.
- The project is a safe facility for both the user and the community.
- The project is in harmony with the community, and it preserves environmental, scenic, aesthetic, historic, and natural resource values of the area, i.e., exhibits context sensitive design.
- The project exceeds the expectations of both designers and stakeholders and achieves a level of excellence in people's minds.
- The project involves efficient and effective use of the resources (time, budget, community) of all involved parties.
- The project is designed and built with minimal disruption to the community.

- The project is seen as having added lasting value to the community.

The workshop established a very clear vision of what CSD is about. The subsequent pilot project for implementation will provide further guidance in institutionalizing the CSD process. Unfortunately the results of the TRB Project 15-19, FY 2000: *Application of Context Sensitive Design Principles*, were not available for review and discussion.

This notwithstanding, the benefits and the roadblocks to implementing the CSD process are reasonably clear. What appears to be lacking is documentation of actual experiences in implementation, along with the development of frameworks and tools for implementation. These broad topics represent the most likely areas for future research.

Frame Works for Institutionalizing CSD

Context sensitive design is actually the reformation of the entire transportation delivery process. In many cases the project delivery process is seen as linear (Figure 1). In its simplest form it involves programming, planning, design, construction, operation and maintenance. One only has to look at the organizational make up of a state transportation agency to see that this is still a ubiquitous model. This organizational format is for the most part logical. However, with respect to the project delivery process, it can be very unresponsive if it is viewed as a sequence in time. That is, the planners plan, and then turn the plan over to the designers who design, designers then pass the project on to the contractors who build a product, which is then turned over to operations and maintenance personnel. This model is not responsive if communication is not maintained throughout the process both internally and externally.

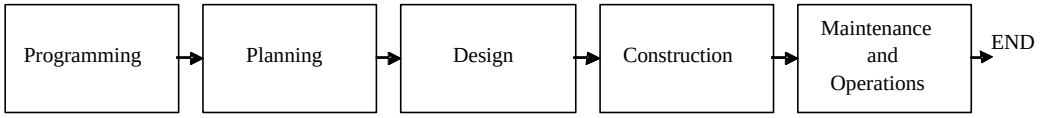

Figure 1: Traditional Transportation Project Delivery Process

The CSD process recognizes that the project delivery process is iterative and that communication must be maintained between all stakeholders (Figure 2). To accomplish this there must be a framework established that maintains communication with stakeholders throughout the project delivery process.

Efforts to institutionalize CSD within state transportation agencies are generally structured around programs of education and training in CSD. In addition to education many include careful review of existing enabling statutes, directives, and in-place project delivery processes to identify and remove roadblocks to CSD implementation.

These efforts demonstrate that the transportation industry is recognizing the need for a critical paradigm shift away from the old model of "Design ... Defend ... Redesign ... and, often, … Defend, and Redesign again. Whereas the new CSD paradigm is "Listen and completely understand the context ... then Design … and …Build without going back to the drawing board. This is the time and money saving benefit that accrues from CSD. While these benefits are intuitively understood little has been done to quantify these potential or actual savings.

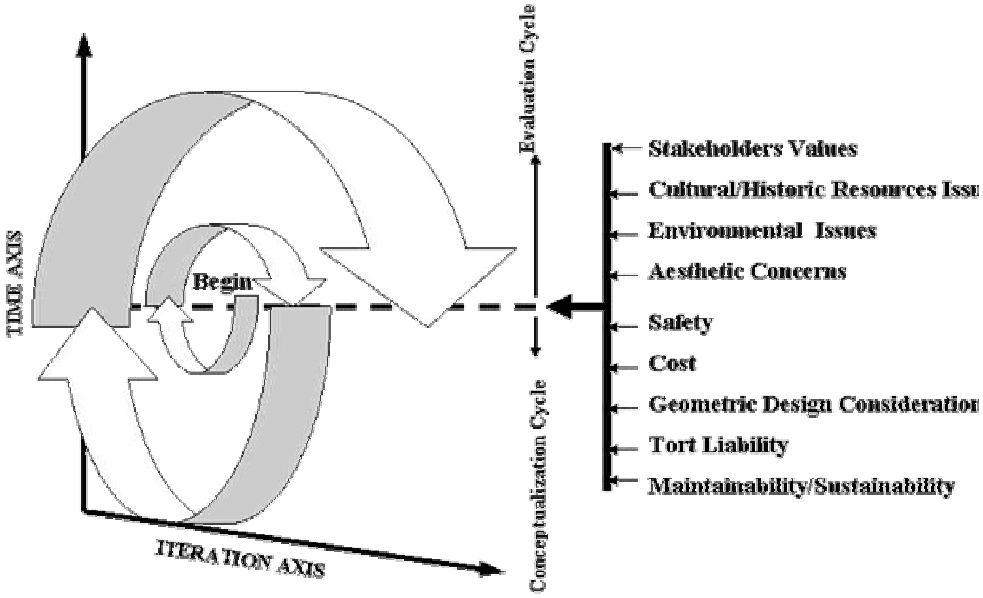

Figure 2: CSD Project Delivery Process

Education and Training

Each state has adopted different approach to CSD training programs. The elements of most programs include:

- Project Development and Management
- Public Involvement and Facilitated Communication
- Environmental Management
- Geometric Design and Design Guidelines
- Tort Liability
- Aesthetics/Visual Resource Management

This content must be tailored to the operational and organizational styles of the individual agency.

Identification of Institutional Roadblocks

Within each state there are institutionalized mandates that direct how an agency does business. In many cases these mandates effectively prevent the application of CSD principles. For example, some statutes have prescriptive language that governs highway configuration and design. These situations must be identified and appropriate strategies developed to mitigate antiquated regulations. When discussing current practice and changing long-standing standards and statutory mandates there are sometimes misconceptions about what CSD does. It is very important to note that CSD does not:

- Compromise standards or safety
- Create Us vs. Them and Winners vs. Losers situations
- Listen only to the Loudest Voices

- Do what each stakeholder wants
- Spend much more time and money

Tools

Tools as used here, refers to specific activities or design principles that can be used to understand the design context and help define and satisfy client and stakeholder transportation needs. Because CSD is really a broad based approach to the transportation delivery process and because that process involves every aspect of programming, financing, planning, design and engineering, construction, operations and maintenance, research associated with CSD is probably best defined when related to more specific tools used in implementation. This section discusses some of the most prevalent CSD tools that may lend themselves to meaningful research.

Traffic calming

Traffic calming has become popular as a tool for increasing safety and reducing traffic noise and speed in established neighborhoods and historic commercial districts. There is a great deal of information available on actions that can be taken to reduce traffic volume and speeds that range from constriction of driving lanes at intersections to traffic circles and limiting access. While the concept of traffic calming is highly touted as a means to create more desirable "user friendly" spaces within neighborhoods and communities, the only substantive post construction evaluation of these tools has been conducted in Western Europe. These results do not necessarily translate to US culture. Likewise, little is known about the economic impact and safety performance of many traffic-calming strategies. For example, placing small circular islands to create roundabouts are not well understood and often become a driving hazard rather than a traffic control. The FHWA has two studies underway in the area of traffic calming that have not been released. These may answer some of the questions and may point to other areas needing further research. When taken in the context of an aging population, and the need to integrate better pedestrian facilities into many neighborhoods, traffic calming will likely remain an area needing additional research for sometime.

Figure 3: Traffic Island,

Source Madison Wisconsin Web Site

Aesthetic design treatment

The aesthetic quality, or lack thereof, of public works and the transportation system in general has resulted in considerable resistance from stakeholders and users of the system. In a vast majority of cases were public resistance to transportation projects is encountered; much of that resistance is based on the perceived aesthetic quality of the product being proposed. In this regard it is important to understand that aesthetic quality tends to be a shared cultural value that may be related to local or neighborhood

perceptions or user expectations. These values are often difficult to capture and successfully integrate into projects.

Some states have tried to approach the aesthetic issues of transportation projects with a cookbook mentality. But the cultural differences in visual preference are not likely to be effectively addressed by an "aesthetics cookbook." The tool that seems to offer the greatest success in cost effectively addressing aesthetic issues is the public participation process. Post project satisfaction studies and developing better tools for the public participation process, to deal with aesthetic issues, will likely be fruitful grounds for further research.

Cultural Resource Management

Cultural and historic resources are frequent obstacles to transportation projects. These types of resources are not always obvious or easily understood with out the help of the local community. Once identified the relative cost of conserving these resources can be prohibitive for a variety of reasons including: building codes, material availability, utility, location, etc.

Figure 4: Mortise-and-Tenon Barn

Source FHWA

A variety of tools are have been developed, but there is often a gap between the transportation community and the cultural resource interests in a community. Two areas that appear to offer the greatest potential to successfully address the cultural resource issues in transportation are the public participation process and information technology. A public participation process can be used effectively to identify public and stakeholder concerns for cultural resources, as well as to negotiate means to preserve or conserve the resources of concern. Information technology offers the best means for providing data that will help transportation programmers and planners to identify and avoid cultural resource conflicts early in the project delivery process.

The use of information technology, particularly web-based applications, appear to offer economic means to gather and disseminate cultural resource information and appears to be an area for meaningful investigation.

Figure 5: Glenwood Canyon

Visual Resource Management

Visual resources are often lumped together with "aesthetics," while in fact it is quite a different part of the CSD puzzle. Visual resources refer to the greater landscape. That is, the landscape that extends far

beyond the right-of-way line. Most frequently the issues related to the visual resource are the view to the road as opposed to the view of or along the road. Most of the dramatic examples of visual resource management are seen in projects like Glenwood Canyon where the spectacular scenery is easily damaged or permanently changed by corridor construction. Figure 5 shows a good example of the best and the worst as far as visual change. In the fore ground and middle ground, both corridors hug or fly over the existing landscape, while in the background the alignment runs through a massive rock cut. This in no way is intended to diminish the Glenwood Canyon project, which has been recognized for its attention to the visual and environmental resources, it is only an example of the scale of the visual resource as opposed to other issues of aesthetics.

The research needed in the area of visual resource management is most strongly related to issues of design flexibility, which will be discussed more in a later section.

Public Participation

Involving stakeholders in the project development and delivery process lies at the heart of providing "Context sensitive Solutions." Final success and product quality are inexorably linked to how it is received by the clients and users. In a planning and design environment where there is no clearly defined end user and where responsibility resides in a political entity rather than an individual, it is usually very difficult to clearly scope a project and identify all the constituencies that will be impacted, without a well designed program of public participation.

The validity and need for public participation in the project development and delivery process has become more widely accepted by transportation officials, the means for implementing the process and using the findings are poorly developed and not well understood.

There is a substantial literature in the area of public participation and conflict resolution. However, this information is rarely being translated and transferred into transportation practice. This fact is clearly at the root of the CSD movement in transportation.

It is probably fair to say that effective public participation and communication is potentially the weakest link in every aspect of the process. Successfully delivering a quality product in a controversial environment is dependent on systematically developing and maintaining "informed consent" For this reason research in public participation is needed to extend and refine research that has been done in other venues and translate the public participation tools into transportation practice. One important part of this research would be the translation of a largely social science research base into a design and engineering compatible language.

Flexibility in design

Flexibility in design is often cited as another term for CSD. However, in the framework of transportation practice as defined by AASHTO, flexibility in design has come to have a somewhat narrower definition than CSD, in that it tends to focus on specific physical areas of concern. These are:

- Safety
- Geometry
- Aesthetics

- Tort liability.

The AASHTO *A Policy on the Geometric Design of Highways and Streets*, the "Green Book," strongly influences the physical design of highways in this country. While the publication clearly states that it is a guide, it is often held out as a standard. This interpretation has led to a perceived level of inflexibility in design. To mitigate this perception and to deal with the legitimate concerns of safety, geometrics, aesthetics and liability, the AASHTO Standing Committee on Design is currently working on a supplemental publication or publications to address these concerns.

On the other hand, it is doubtful that a supplemental publication to the "Green Book" will really allay all of the concerns particularly in the area of tort liability. Concerns over the liability for design of any structure below optimum configuration are understandable in the current legal environment. For this reason, there may be a need for substantive research that demonstrates the safety and utility of facilities designed to the minimum rather than optimum standard. This is essential to encourage design exploration.

Popular Movements Related to CSD

These are movements that have gained popularity and have some common ground with CSD in transportation. In general, these movements focus on concepts and issues of urban living rather than values common to rural communities, or what might be termed scenic landscapes. Each of these movements represents an organized voice that can be an important source of information when defining the scope of a project. It is equally important to understand that each of these movements represents a single point of view and may not necessarily represent the broader community of stakeholders.

Livable Communities

This is a term popularized in the last national administration that focuses on developing those components of the urban environment that make a community more people friendly, and therefore more livable. It focuses on issues of neighborhood, and particularly stresses the use of alternative transport modes i.e. public transit and bicycle pedestrian.

Sustainable Transportation

Sustainability is becoming an extremely popular concept particularly as it relates to the environmental concerns. The emerging focus of this movement is at the macro-scale, which is often beyond the scope of traditional transportation practice. On the other hand, sustainability concepts stem from maintaining a standard of living without depleting the natural resource base. Clearly, the availability and use of natural resources impacts the environment and ultimately the transportation system. To this extent, a component of the research needs agenda in CSD may wish to address issues of sustainability related specifically to the long term utility of the transportation system.

Smart Growth and New Urbanism

These movements are focused on curbing urban sprawl. Advocates credit urban sprawl with many of the problems faced by major urban centers, blight, declining tax base, etc. Smart Growth proponents recommend concentrating growth and population by a variety of landuse controls and incentives.

Proponents hold that infill and increased densities reduces the cost of construction and maintenance of infrastructure and makes mass transportation more viable and cost effective.

These ideas and principles remain controversial but they have great influence on many decision-makers. Therefore the concepts espoused by these movements may be used a guide for developing transportation research that will document the relative validity and lead to strategies for adjusting transportation design criteria to meet a changing development philosophy.

Conclusion

The concept of CSD, as demonstrated in the literature while not new, is extremely broad in scope. It touches on all aspects of transportation development and therefore needs definition and further exploration. The scope of CSD is not just environmental and does not fall in the domain of any single discipline. CSD principles require a team approach to be implemented successfully.

The purpose of this presentation has been to develop the background and context of the CSD movement and has pointed out some broad areas that seem to warrant further investigation. The paper has deliberately avoided suggesting specific research needs. That is for the focus group in CSD to accomplish at he March meeting in Washington DC. It is hoped that those that wish to participate in developing research needs in CSD will find the resources listed in the reference section useful in framing ideas and concepts needed to develop statements of detailed research needs.

References and Other Readings

Brewer-J; German-J; Krammes-R; Movassaghi-K; Okamoto-J; Otto-S; Ruff-W; Sillan-S; Stamatiadis-N; Walters-R, Geometric Design Practices For European Roads, 2001, American Trade Initiatives, Federal Highway Administration, Office of International Programs, Washington, DC,

The objective of the scanning tour was to review and document European procedures and practices in roadway geometric design and context-sensitive design, in which a balance is sought between safety and mobility needs and community interests. The U.S. group visited sites in Sweden, Denmark, the Netherlands, England, and Germany, and met with numerous representatives from transportation and highway ministries, research organizations, and consultants. In the European countries, the general philosophy for highway design and project development is to develop a transportation program and system that enhances community values and integrates roadways into communities and the environment. This philosophy is supported by very high safety goals. The U.S. delegation found potentially transferable practices regarding public involvement in project planning; self-explaining, self-enforcing rural roads; design flexibility; area-wide traffic calming measures; intersection control through roundabouts; and integration of bicyclists and pedestrians.

American Association of State Highway & Transportation Officials, Environmental Successes In Transportation Project Development, 2001. pp56 (Phots.), Washington, DC, 20001, USA

This report contains 16 case studies of exemplary programs and projects now underway across the country that improve mobility and add to the quality of their surroundings. The projects are organized according to six successful practice categories: Process Management; Improved Scoping; Visualization Techniques; Technology Application; Context-Sensitive Design; and Conflict

Avoidance and Dispute Resolution. These project practices and strategies should be of interest to those responsible for planning, programming, development, and design of highway projects.

Mccormack, S. Agents Of Change, 2001, World Highways/Routes Du Monde. 2001/04. Pp32-4

Although in developed countries environmental considerations are commonly employed when considering road planning management processes, the situation is considered to be different in developing, and transition, countries where poverty alleviation and industrial development can take precedence over environmental concerns. Such countries have to set their own priorities and resent developed countries trying to influence infrastructure investment decisions. While transport infrastructure development is essential for market accessibility, and therefore employment, the World Bank considers that inappropriately designed transport strategies can harm the environment and aggravate the needs of the poor and public finance capacity. Environmental Impact Assessment (EIA) studies, carried out by funding agencies, can cause an increase in project costs, but can bring increased awareness of environmental considerations even where they are not a main priority. In the USA, many states have introduced 'context-sensitive-design' (CSD) when considering transport projects to include environmental aspects.

Kramer-J; Williams, K.M., Community Impact Assessment: A Handbook For Transportation Professionals, Institute of Transportation Engineers, Washington, DC, ITE 2000 Annual Meeting and Exhibit. Location: Nashville, Tennessee.

The objective of this project is to provide practical, cost-effective and community driven methods for identifying, evaluating, and addressing community impacts that are oriented toward the practitioner. Transportation projects can have major social and economic effects-both positive and negative. Assessment of community impact provides insight into ways projects can be improved or redefined to reduce adverse impacts and increase overall project benefits, both for the affected communities and the traveling public. Community impact assessment also support the intent of the National Environmental Policy Act (NEPA), the federal law governing the environmental decision-making process for federally funded transportation projects. Although NEPA places equal emphasis on both the natural and human environment, much of the attention in environmental impact assessment has been placed on the natural environment. In an effort to address that inequity, the Florida Department of Transportation (FDOT) is developing a community impact assessment program to provide equal attention to how transportation projects affect people and communities. The program is to be carried out primarily during the environmental assessment process, but has implications for planning through construction. This effort coincides with the national movement toward context-sensitive design in the engineering arena and the sustainable development in the planning arena. In support of the statewide community impact assessment program, the FDOT asked the Urban Transportation Research (CUTR) at the University of South Florida to develop a handbook and training on community impact assessment.

Ewing, Reid, From Highway To My Way, 2001, Planning. 2001/01. 67(1) pp22-27

This article describes the relatively new concept of context-sensitive highway design and how transportation planners are focusing on the links between transportation systems and surrounding land uses. New standards, policies, and scenic/historic laws applicable to main streets in several U.S. states

and communities, within the context of planning and design that attempts to make roadways more community friendly, are provided and discussed.

Gavin,J, A Road Runs Through It, 2000American City and County. 2000/12. 115(17) pp5

This article discusses the growing trend by cities and counties to redesign roads to make them more community and pedestrian friendly through incorporation of public places into road and transportation planning. The practice has been termed "Context-Sensitive Design" and is concerned with the manner in which streets and highways are routed through living spaces. Several tips for building context-sensitive roadways are listed, and examples of successful efforts across the U.S. are provided.

Gavin, Jennifer, Building Livable Highways: Case Studies Show That There Is More To Road Design Than Just Getting From Point A To Point B. 2000, AASHTO Quarterly Magazine. 2000. Fall 78(3) pp22-25

Americans are beginning to realize the people need public places to be together in order to maintain some sense of belonging to a community. The way streets and highways are routed through living areas, or redesigned to lessen any negative effects they may have on the livability of an area is the significant part of the mission of a movement called Context-Sensitive Design. There are many success stories in the field of context-sensitive design: from Springdale, Utah, where the relationship between Zion National Park and the town nearest it was made positive by a redesign of the traffic flow through the town and the park; in Somerville, Massachusetts, where redesign of the traffic and pedestrian flow in Davis Square has turned Cambridge's ugly-duckling neighbor into a commercially viable swan; and Calabasas, California, where design steps that slowed down the raceway through town have sped up the commercial and pedestrian viability of the town. Other states that have taken the concept to new places include Florida, Oregon, Kentucky, Connecticut, Maryland, and New Jersey.

Reducing The Impact, World Highways/Routes Du Monde. 2000/09. 9(6) pp44-6

As population increases and more infrastructure is built to support it, the impact of human development on the environment increases. Today, engineers and contractors must ensure that a project is in as much harmony as possible with its neighbouring communities and environment. Increasingly often, an environmental impact study must be made before a road project can begin. In the USA, the Federal Highway Administration (FHWA) and some states promote 'context-sensitive design' principles. Effects of road projects and operations on the environment include the destruction of wildlife habitats, erosion, sedimentation, soil compaction, chemical pollution from de-icing, contaminated run-off, vehicle emissions, and the generation of a variety of waste materials. This article discusses: (1) a pilot program where ten transport projects in seven US states were selected to find ways of streamlining and accelerating transport improvements, while protecting the environment better; (2) the TERP environmental agency, which will add to the understanding of transport and environmental issues through research, and help to formulate new environmental policies; and (3) examples of ecological projects in the UK, the USA, and Canada to reduce the impact of road schemes on wildlife.

Myerson, D.L., Getting It Right In The Right-Of-Way: Citizen Participation In Context-Sensitive Highway Design, 2000, pp24, Scenic America, , Washington, DC, 20003

This Action Guide includes information on community involvement in transportation planning, advises citizens on planning strategies for working with state highway engineers, provides basic road design vocabulary and information on federal laws that support context-sensitive design, and gives helpful case studies. Also included is a bibliography prepared by Sally Oldham.

Kassoff, H., Making Design Context Sensitive, 2000, Roads and Bridges. 2000/02. 38(2) pp20

The highway design process has traditionally emphasized achieving required functionality at the lowest possible cost. While this goal remains important, it has become increasingly clear that other factors contribute to gaining acceptance for highway improvements. Paying close attention to environmental impacts; committing to avoid, minimize, or mitigate these impacts to the maximum extent possible; and even finding ways to provide environmental improvements over existing conditions have become prerequisites for winning local community and environmental resource agency support. Also, the visual impact of a highway project has come to have a major bearing on its acceptance or rejection. Highway planners and design professionals are increasingly aware that the basic process by which highway improvements are planned and engineered is changing. They are embracing the notion that environmental and aesthetic issues must be dealt with as an integral part of the process from the outset. This article outlines why context-sensitive design is the preferred way of developing a project.

Lewis D., How To Merge Yesterday's Roads With Today's Designs, 1999 Traffic Safety. 1999/01. 99(1) pp14-15

When engineers proposed a plan to make Main Street in Westminster, Maryland, a 40-ft (12-m) roadway, removing 42 mature trees and leaving sidewalks at 5 ft (1.5 m), it sparked an atmosphere of combativeness in the community. Eventually, the project was redesigned to everyone's satisfaction. The road's cross section was reduced to 36 ft (11 m), which allowed for ample sidewalks, the preservation of 34 trees (plus 106 new ones), and an overall harmonious ambiance. The Westminster project has become something of a poster child for the context-sensitive design movement. The public wants more from engineers than just the straightest, flattest, widest road possible. The widespread literal adherence to the American Association of State Highway and Transportation Officials' Green Book, which contains the basic geometric design criteria for roadways and is a product of the "speed and mobility first" school of thought, seems to be at the heart of the issue. The public perceives engineers as rigid bureaucrats, while many engineers view the public as overly emotional "tree huggers." A sidebar discusses the next steps for context-sensitive design.

AASHTO, Thinking Beyond The Pavement, 1998, AASHTO Quarterly Magazine. 1998. 77(3) pp27-34

This conference was held at the University of Maryland Conference Center, College Park, Maryland in May 1998. It provided an opportunity for 325 invited participants from 39 states and the District of Columbia to develop a vision of excellence in highway design for the 21st Century. Conference planners sought to: (1) Find and publicize the best ways of integrating highways with their communities and the environment while maintaining safety and performance; (2) Encourage continuous improvement in design of transportation projects across the nation, balancing all of the public's concerns, whether transportation related or not; and, (3) Achieve flexible, context-sensitive

design in all projects. Conference developments included: (1) A consensus on the qualities of projects and the characteristics of the highway development process which could integrate transportation facilities with communities and the environment; and (2) Implementation actions to overcome barriers to context-sensitive design, to educate transportation professionals and stakeholders on this approach to design, and to encourage its application to all projects.

Maryland Department of Transportation, Thinking Beyond The Pavement: A National Workshop On Integrating Highway Development With Communities And The Environment, 1998, University Of Maryland, May 3-6, 1998. Conference Summary, pp24

The conference was designed to: develop a consensus on the qualities of projects and the characteristics of the highway development process which could integrate transportation facilities with communities and the environment; and develop implementation actions to overcome barriers to context sensitive design, to educate transportation professionals and stakeholders on this approach to design, and to encourage its application to all projects. 325 people from 39 states and the District of Columbia, including representatives from 29 state departments of transportation, attended the conference. Three-fourths of the participants were transportation professionals, while the remainder was transportation stakeholders representing public agencies, elected officials, private business and citizen perspectives. The conference participants examined Project Case Studies to identify and articulate the purpose of each project and to explore the desired results and the community impacts. This Conference Summary includes the conference agenda, an executive summary, and the conference summary report.

Useful and/or Informative Web Sites

These are web sites that have useful information about issues related to context sensitive design and livable communities. Many of these sites have links to other sites as well.

http://www.arrb.org.au/
http://goodneighbor.gsa.gov/goodnb/
http://www.cnu.org/
http://www.clfuture.org/
http://www.fhwa.dot.gov/csd/
http://www.pps.org/Transportation/csd_training.html
http://www.scenic.org/roads.htm
http://www.epa.gov/smartgrowth/
http://www.mainst.org
http://www.fta.dot.gov
http://www.lgc.org/center/index.html
http://www.sha.state.md.us/oce/thinking.htm
http://www.sonic.net/abcaia/narrow.htm
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http://www.smartgrowth.org/
http://www.epa.gov/livability/index/sgi-home.html
http://www.transact.org/main.htm
http://www.tlcnetwork.org/

http://www.arrb.org.au/arrbtr/enviro.htm
http://www.pps.org/Transportation/livable_transportation.htm
http://www.washingtonregion.net/
http://www.walkable.org/

1.1 Effect of Roadside Design on Driver Stress and Perception

Problem Statement:
Studies have documented that stress indicators, such as heart rate, rise when people drive. In addition, certain driving conditions prompt greater stress responses. Driving on highway off-ramps, roundabouts and on-ramps are associated with elevated heart rates, indicating elevated driver stress. What can be done to mitigate stress response? Numerous studies have documented the general stress reduction and restorative potential of passive nature experiences for urbanites. Can roadside vegetation be used to diminish driver stress response in difficult driving conditions?

These questions are significant for two reasons. First, off-ramps and roundabouts are often the first contact that drivers have with communities adjacent to the highway. A profusion of signage, lights, buildings and other attention-demand features are placed in the settings where driver stress may be greatest. What is the optimal balance of built elements and landscape materials, in terms of driver's awareness of local products and services and driving stress response? This study would evaluate the most effective use of both cultural and natural features in interchange environments to promote both driver safety and visual quality.

Proposed Research:
Highway interchanges in semi-urban to urban settings having varied arrangements of traffic signs, commercial features and landscape materials would be identified and delineated. The tests and measurements would evaluate both cognitive and physiological driver responses, seeking to answer:

1) Does the composition of the interchange visual character influence driver stress response?
2) How might interchanges be designed to serve multiple functions of commercial or community identity and optimal driver behavior?

Origin of the Statement:
Mark Maurer, Landscape Architect
Washington State Dept. of Transportation
360.705.7242
maurerm@wsdot.wa.gov

1.2 Effect of Roadsides on Perceptual Selection and Memory

Problem Statement:
The cognitive process of perceptual selection and memory is a little understood aspect of driving. Drivers must cope with complex, varied and rapidly presented information while driving. Cognitive psychologists have studied how people assimilate information and selectively retain or discard certain information content. We use both conscious and subconscious strategies to sift and process pertinent information from our surroundings.

The process of drivers' perceptual selection and its relationship to roadside settings is important for two reasons. First, multiple information sources provide crucial decision input and guidance resources for the driver. Roadside conditions influence the capacity of drivers to both sense and process information that is crucial to way-finding and safety. For instance, abundant business signage adjacent to the roadside may distract drivers' attention from directional signage.

Secondly, many communities are pursuing the goal of "imageability" in their strategic planning activities. They are working to express their "sense of place" to residents and visitors. These activities increasingly include collaborative work with transportation agencies to assure that highway and roadside design and management practices complement the image that a community intends to develop. In these instances, roadside design may be used to focus drivers' attention to intended sight lines and visual cues at the road edge.

Proposed Research:
Lengths of semi-urban to urban highway having varied arrangements of traffic signs, business signage and structures, and roadside features (including vegetation) would be identified. The tests and measurements would evaluate driver responses, seeking to answer:

1) Which traffic signs and signals are either responded to or remembered, to identify cognitive processes having important consequences for driver safety, and;
2) What images and character traits of a community are memorable thus evaluating the durable impressions that drivers retain of roadside places?

Origin of the Statement:
Mark Maurer, Landscape Architect
Washington State Dept. of Transportation
360.705.7242
maurerm@wsdot.wa.gov

1.3 Synthesis of Street Tree Research

Problem Statement:
The inclusion of street trees in urban roadway design has become an important component of jurisdictional implementation of "Livable Communities" type policies. Much of the decision-making appears to be based primarily on aesthetic issues. There is a need to synthesize relevant street tree research nationwide in order to gain a better understanding of the complex tradeoffs associated with street trees in urban roadway design.

Proposed Research:
A literature search to collect and review existing information regarding growth characteristics and life spans of street trees in urban roadway design would be conducted. Research regarding street trees planted in confined spaces will be specifically identified and compared to others of the same species grown in conditions that are more favorable. Then summarize the body of work to date.

Origin of the Statement:
Mark Maurer, Landscape Architect
Washington State Dept. of Transportation
360.705.7242
maurerm@wsdot.wa.gov

1.4 Street-trees as Visual Buffers for Urban Thoroughfares

Problem Statement:
Urban communities have suffered significant losses of street-trees along the major thoroughfares due to utility and transportation related activities.

Proposed Research:
Five-year study of street-trees along major thoroughfares with sidewalks and without sidewalks. Following factors: a) assessment of current street-tree quality and public opinion on traffic impacts, b) assessment of safety along routes, c) creation of an enhanced tree maintenance and development strategy, and d) follow up study on impacts on safety and public opinion.

Many transportation planners see street trees as safety hazards and there is a lack of integration of landscape into traffic management. This would serve to measure real impacts.

Submitted by:
Judy Shaw, Urban Coordinator
New Jersey Department of Environmental Protection
P. O. Box 402
Trenton, New Jersey 08625
609-633-1378 (phone)
609-633-2102 (fax)

1.5 Visual Impacts of Transportation Projects

Background:
Visual impact analysis is a component of social and economic impact analysis as required by NEPA. FHWA is making concerted efforts and significant transportation investments in Transportation Enhancements. In 1991, ISTEA stipulated that 10% of federal funds distributed to states through the Surface Transportation Program be dedicated to transportation enhancements. In 1998, TEA-21 provided an additional $3.8 billion in TE funds through the Surface Transportation Program. This includes areas such as: acquisition of scenic or historic easements and sites, acquisition of scenic land easements, vistas and landscapes, purchase of buildings in historic districts or historic properties: preservation of farmland, landscape and scenic beautification and historic preservation.

What is the Specific Problem or Issue?
Lack of good methods to evaluate visual impacts. Increase awareness of this issue among engineers and planners working at planning and project levels. Improved efforts to create highway systems that blend with urban and natural landforms.

List Research Objectives and Tasks:
Research and collect evaluation techniques for analyzing visual impacts of roadway projects. Use existing case studies and statistics to identify best practices/methods for identification and categorization of the visual effects of various types of roadway facilities and facility designs. Use existing case studies and statistics to identify the facility appearance as perceived by local communities. Collect cost data on these approaches. Identify and document funding mechanism for transportation enhancements.

What Would be the Product(s) of the Research?
A compendium of effective practices. Proposal guidelines MPOs can use to tap into federal TE money.

How Will You or Others Use the Product(s)?
As a reference to showcase innovative and effective roadway/project designs. To help in the creation of projects that are functional AND aesthetically appealing. To promote the use of natural and locally produced materials.

How Will the Product Benefit the Department?
(e.g., increased operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit). Increase public satisfaction of transportation projects and systems.

Submitted by:
Leigh Blackman Lane
Unit Head

1.6 Development of a Model Community- And Place-Based Project Development Process that Successfully Incorporates Visual Quality and Aesthetic Concerns

Problem Statement:
Traditional transportation system planning and design processes have often been single-purposed, environmentally myopic, and lacking in expertise of multiple disciplines and support of local communities. Community resistance to new and redeveloped facilities has increased. This resistance can be traced to several factors, including the lack of attention to visual quality and aesthetics.

While there are federal and state mandates that visual quality and aesthetics be addressed in planning and design of transportation facilities, a lack of criteria and guidelines for doing this means that visual quality and aesthetics have not been adequately addressed. Recent examples - particularly examples of developing management plans for scenic byways - are emerging which could provide insights or models. These examples have several common threads:

1. they integrate the local community into the process right from the beginning;
2. they are place-based, responding to the uniqueness and distinctiveness of each bioregional unit;
3. they are multidisciplinary;
4. issues, solutions, and guidelines developed in the planning phase of a project are carried through all phases of design and implementation; and 5. they address multiple objectives.

The community needs to be contacted early about a possible transportation project. Residents' understanding of the need will help them participate in the development of solutions and actions and advocate for a project's development within the community context. The community will put its signature on its own place.

Place-based planning begins with the larger context, the bioregion, and then identifies and characterizes smaller units. These units provide the framework for planning by making the connection between resource assets, community values, and implementation opportunities.

Professionals from many disciplines, particularly planners, landscape architects, cultural and natural resource specialists, and traffic and transportation planners and designers bring knowledge and expertise to a community. They facilitate the development of a community-initiated, place-based solution.

Solutions, activities, and guidelines that are developed by communities and supported by the multidisciplinary project team need to be carried through design, construction and operation and maintenance phases of a project, through all activities within these phases.

Single-purpose, single-objective solutions are becoming less and less popular and more and more difficult to fund. Solutions and actions that meet multiple objectives and have diverse stakeholders will enfold a larger constituency. Many more funding sources will be available for implementation.

Proposed Research:
The proposed research is to identify case studies from the United States and other countries of project development processes that successfully incorporate visual quality and aesthetic concerns. These case

studies will provide a basis for guidelines for project development processes. Specific tasks are as follows:

1. Identify cases from the United States as well as other countries that have successfully incorporated visual quality and aesthetic concerns into a comprehensive, community- and place-based approach.
2. Develop in-depth case studies of these successful examples. Interview local community groups, agencies, and multidisciplinary team members involved in each project. Gather information on the processes for each project and on what worked and what didn't work.
3. Evaluate the case studies to identify the steps that should be included in a successful process. Recognize differences in the planning, design, construction, operations and maintenance phases as well as regional differences.
4. Document and disseminate results using traditional and electronic means. Emphasize graphic examples.

Cost: $700,000

Duration: 18 months

Origin of Statement:
Transportation Research Circular
Number 469
March 1997

1.7 Linking Research on Human Aesthetic Perception of the Landscape to Transportation Concerns and National Forum on Aesthetics In Transportation

Problem Statement:
There is little objective research on transportation corridors that can assist officials in making sound aesthetic judgments. However, there is a significant body of knowledge developed in the fields of environmental psychology, geography, landscape architecture and architecture, that has direct application to transportation and design. There is also an important library of methodologies developed by federal agencies such as the Bureau of Land Management, National Forest Service, National Park Service, and Environmental Protection Agency, to assist them in making aesthetic decisions. There is a need to summarize and relate this body of material to transportation practice and to disseminate findings to the transportation community.

Proposed Research:

1. Research is needed to assemble the research on visual quality and aesthetics to support transportation planning and design. The objectives of the proposed work are to:

    - Review and summarize existing research on human perception of aesthetics and the environment that relate to transportation issues; and
    - Identify specific techniques and methods that can be used to improve the aesthetic qualities of transportation corridors.

2. Evaluate selected research efforts relative to transportation issues.
3. Conduct National Conference on Aesthetics and Transportation. Select and invite researchers to prepare position papers that link their research to transportation issues. Conduct the conference. Publish the proceedings.

Cost: $400,000

Duration: 18 Months

Origin of Statement:
Transportation Research Circular
Number 469
March 1997

1.8 Quantification of Benefits of Aesthetic Considerations in Transportation Facilities

Problem Statement:
Evaluation of proposed transportation facilities has often been restricted to areas such as cost/benefit analysis, travel-time savings, emissions reductions, etc. In quantifying the externalities (i.e. spill-overs) - both positive and negative - of a given transportation facility, an abundance of data has been produced. These data usually speak to a particular mode (e.g. transit or highways) and to specific aspects that are easily quantified (e.g. ridership or arterial capacity); data on less-readily quantifiable concerns, including aesthetics and visual quality, is lacking. Consequently, the element of aesthetic and visual quality in this multi-modal/multidisciplinary environment is not allocated an equal or sufficient amount of consideration. Often, aesthetic and visual qualities are not considered until after a decision or plan for an area or region is implemented; the economic impacts of this practice, in terms of delays and unplanned costs, are not analyzed. A comprehensive analysis of the economic efficiency and other community benefits inherent in the consideration of visual and aesthetic qualities would be beneficial to all participating parties (community, elected officials, MPOs, state DOTs, transit operators, etc.) in the development of regional transportation plans.

Proposed Research:
The goal of this research is to quantify the benefits of aesthetic considerations in transportation facilities, including benefits that are easily quantifiable as well as those that are often considered non-quantifiable. This research will provide an economic justification for investments in aesthetics and visual quality and will provide guidelines and methods for communities to incorporate aesthetics and visual quality into cost-benefit analyses. The research includes the following tasks:

1. Review of research relevant to the quantification of benefits.
2. Evaluation of the benefits of investments in aesthetics and visual quality in selected projects. Potentially quantifiable benefits include:

    - increased property values;
    - reduction in stress for users of the facility;
    - increased sense of security for users of the facility;
    - increased and improved opportunities for joint-use of the facility (e.g. bikeways parallel to highways); and
    - increased tourism.

3. Evaluation of community willingness-to-pay for different types and degrees of investment in aesthetics and visual quality. Analysis of similarities and differences between regions.
4. Development of guidelines for incorporating aesthetic and visual concerns into cost-benefit (or "full-cost" or "least-cost") analyses.
5. Documentation and dissemination of results using traditional and electronic means.

Cost: $400,000

Duration: 18 months

Origin of Statement: Transportation Research Circular, Number 469, March 1997

1.9 Best Practices in the Aesthetics of Transportation Facility Design

Problem Statement:
State and local jurisdictions throughout the country have developed innovative approaches to the design of transportation facilities. These efforts can provide useful guidance to other jurisdictions struggling with similar issues. It is important to identify, document, and disseminate these efforts. Recognizing that the planning and design process can be bogged down by minutiae, it is important to review and evaluate a broader approach that crosses both modal and place boundaries.

To reach this goal, there is a need to research and evaluate the projects that work by evaluating and identifying the criteria under which the best projects were designed and developed. There is a need to identify what role multidisciplinary teams played throughout the process and what role the community played in the process. There is also a need to understand the regulatory process and how it has affected these projects, beneficially and negatively.

Proposed Research:

1. Identify and prioritize design and aesthetic issues through a survey of practitioners (e.g., community planners and transportation facility designers). Potential issues include but are not limited to: lighting, tree conservation, signage and communications systems, and transportation appurtenances.
2. Identify best practice examples of the top priority issues that include a range of transportation modes (roads, transit), contexts (urban, rural, suburban), and scales (regional, local). Identify and define the criteria under which these are considered the best practice.
3. Disseminate the resulting information through both traditional and non-traditional means of communication.

Cost: $150,000

Duration: 18 months

Origin of Statement:
Transportation Research Circular
Number 469
March 1997