Synthesis
**Technical Report Documentation Page**

CTS 07-12

2.  

3. Recipients Accession No.  

4. Title and Subtitle  
Synthesis

5. Report Date  
September 2007

6.  

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10. Project/Task/Work Unit No.  

11. Contract (C) or Grant (G) No.  

12. Sponsoring Organization Name and Address  
The American Institute of Architects  
1735 New York Avenue, NW  
Washington, DC 20006

13. Type of Report and Period Covered  
Final Report


15. Supplementary Notes  
Report #7 in the Series:  Moving Communities Forward

16. Abstract (Limit: 200 words)  
This project summarizes and synthesizes quantitative and qualitative measures and best practices relative to the integration of design in the planning and implementation of beneficial transportation projects. This project examines the composite benefits discovered in four research projects under the rubric of "The Role of Well-Design Transportation Projects Enhancing Communities." These four research studies are analytical case studies of transportation projects, predominantly of two types: transit-oriented development (TOD), and context sensitive design and solutions (CSD/CSS). The studies focus on community enhancements through good design in each of four specific areas: economic development; public health, safety, and the environment; visual improvement; and citizen participation. This project matches key synergies of community design and planning processes to the outcomes in these cases. Highlighting both critical similarities and differences across the cases, the findings set new standards of integrative design excellence as they also suggest design principles that both broaden and focus design practices in community transportation projects. A final report summary of the study will be prepared and published.

17. Document Analysis/Descriptors  
integrated design, measures, best practices, community, transportation design principles, TOD, CSD/CSS

18. Availability Statement  

19. Security Class (this report)  
Unclassified

20. Security Class (this page)  
Unclassified

21. No. of Pages  
48

22. Price  

Synthesis

Report #1 in the Series: Moving Communities Forward

Final Report

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September 2007

Published by:
Center for Transportation Studies
University of Minnesota
200 Transportation and Safety Building
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This report represents the results of research conducted by the authors and does not necessarily represent the views or policies of the Center for Transportation Studies and or the American Institute of Architects. This report does not contain a standard or specified technique.
Preface

Well-designed transportation projects demonstrate the potential to shape a community in ways that go far beyond the project’s original purposes. Anecdotal evidence and advocacy exist on behalf of the benefits of well-designed transportation projects on communities, yet there is little organized quantifiable or qualitative data, nor is there a comprehensive guide for communities to maximize or integrate the diverse benefits that well-designed transportation projects can bring.

Recognizing this lack of data about the role of design in transportation, Congress authorized a study in Section 1925 of the 2005 Safe, Accountable, Flexible, Efficient, Transportation Equity Act: A Legacy for Users (SAFETEA-LU) to achieve two goals: (1) begin to measure how well-designed transportation projects can bring multiple enhancements to communities in terms of economic development, health and the environment, visual identity and design, public participation, and public safety; and (2) provide communities, designers, transportation officials, and policymakers a set of principles and practices to adapt to their unique situations and needs.

The Moving Communities Forward research team employed a case study-based approach, analyzing nearly 30 transportation projects that represent a broad spectrum of regions, demographics, and project types. The research team identified key principles and practices that designers and others can use—in the context of their unique situation and environment—to realize multiple enhancements to their communities.

Funding for the study was derived from a grant to the American Institute of Architects (AIA) from the Federal Highway Administration (FHWA), authorized by Congress in SAFETEA-LU. In 2006, the AIA selected the Center for Transportation Studies (CTS) at the University of Minnesota to conduct the pioneering research study.

To address the interdisciplinary issues raised by the study, CTS assembled a research team drawn from multiple fields. Research was allocated to five research projects; a sixth project synthesized the study's key findings into a single document highlighting major themes and recommendations:

1. Promoting Economic Development
2. Improving Health and the Environment
3. Designing Great Places
4. Fostering Civic Participation
5. Making Communities Safer
6. Study Synthesis

Results of this research are available in a series of reports on the Moving Communities Forward Web site: www.movingcommunitiesforward.org. The site also includes a summary report submitted by the FHWA to Congress in September 2007. The Web site is part of a coordinated outreach effort designed to share the research findings and recommended practices with transportation and design professionals, policymakers, and the public.
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ABOUT THE AMERICAN INSTITUTE OF ARCHITECTS

The American Institute of Architects (www.aia.org) is the voice of the architectural profession and the resource for its members in service to society. As AIA members, more than 80,000 licensed architects in over 300 state and local chapters express their commitment to excellence in design and livability in our nation's buildings and communities. Members adhere to a code of ethics and professional conduct that assures the client, the public, and colleagues of an AIA-member architect's dedication to the highest standards in professional practice.

ABOUT THE CENTER FOR TRANSPORTATION STUDIES

The Center for Transportation Studies’ (www.cts.umn.edu) mission is to serve as a catalyst for transportation innovation through research, education, and outreach. CTS works with University of Minnesota faculty in over 25 disciplines to advance knowledge in a variety of transportation-related research areas. In 1997, CTS first became involved with transportation and urban design issues in its leadership of a major interdisciplinary effort, the Transportation and Regional Growth Study, which produced new understandings of the relationship between transportation and growth in the Twin Cities area. CTS has also worked closely with the Minnesota Department of Transportation and local governments in advancing Context Sensitive Design/Solutions practices through the development of training courses and web resources, which have helped Minnesota to be recognized by FHWA and AASHTO as a leading state in applying Context Sensitive Design/Solutions.
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Executive Summary

Integrated Design: The State of the Art

The transportation network of the United States—a public good—is the largest designed connective system of public and publicly used space in the country. This systemic connectivity underpins transportation's unique potential to enhance communities across a wide spectrum of values. The research synthesized and summarized here examined well-designed transportation projects that enhanced their communities through five categories of values: economic, environmental, visual, participatory, and safety. Research organized in case studies around these values analyzed the integrative role of design in enhancing ordinary places, and has yielded key findings that elucidate critical measures of enhancement and design practices.

These five aspects of the study have, in part, focused on the integration of public policy and planning with architectural and other design practices at all community and project scales. While important works of architecture and some single buildings and bridges are covered in this study, even these structures demonstrate broader, especially environmental and often economic and visual, public benefits.

The works studied in these cases concentrated on the potentially generalizable principles employed on repeatable types of projects, if not the specific design and planning practices that guided their realization. The projects studied demonstrate values that arise from integrated design, planning, and other public processes to give physical form to public vision. One of the common dimensions of these projects is that they add value over time. Transportation projects have an immediate impact, of course, arising out of their fundamental purposes to relieve congestion or enhance safety. However, while the design principles cited here might be applied to any public project, the unique reach of a transportation project goes beyond its literal scope of work or project. The well-designed transportation projects studied here demonstrate the potential
to shape the future of a community and to transform a whole order of composite values often well-beyond their original purposes.

Designers of these projects facilitated the physical realizations of community visions. Often these projects demonstrate the measurable, if not always monetized, values of enlightened public policy on behalf of increased access and safety, community planning partnerships, and collaborative and engaged design efforts. No one discounts the impact of a great single work of new transportation architecture or the adaptive reuse of a well-positioned historic icon of American architecture, such as a grand early 20th century train station, to transform a community. However, this study does not focus on the so-called ‘Bilbao effect,’ named for the phenomenon associated with civic investments in iconic architecture to create destinations. The projects showcased here show instead the measurable improvements to communities in well-designed transportation projects for, and by, residents.

Composite Design Performance: New Processes

Design is both a transformative product and a transforming process. Design as process is itself being transformed, as the cases demonstrate. Among the aspects of this transformation is the need to solve ever-bigger and more complex problems. There are new tools; understanding how to use which ones will be a matter of producing better-validated measures of enhanced outcomes across a broad array of related societal imperatives. At the same time, transparency of application of design tools has become another increasing imperative. New design processes examined in the cases and elsewhere in emerging public practices show evidence of success with a basic two-part integrated design concept: composite performance measures that frame place-specific combinations of traditional and emerging tools in a transparent, mediated, and connected political context. In simpler terms, we need whole solutions, not just projects.

Each of the five studies here—economic, environmental, visual, participatory, and safety—proceeds from a different academic perspective, but all see the emergence of the success of integrated design. On the measurement side of that premise, each of the studies finds slightly different means and tools of evaluating enhancement. In the texts of the summaries (later in this report), different terminologies show how the cases recommend whole, composite measures, even within the specific scopes of the five research study reports. The composite measures of enhancement evidenced in the cases are prelude to larger orders of integrated design that will be needed in the immediate future. For design research, the message from these cases is that better-validated measures of enhanced outcomes across a broad array of social, cultural, economic, and environmental parameters are required now. For architects and other design practitioners, this situation means new kinds of investments in design investigation, possibly even new kinds of requests for proposals and public contracts; in short, new design processes.

New global conditions, not the least of which are the adaptive social, cultural, and economic parameters of climate change, have placed a new order of integrative demands on the processes of design. At this moment, the challenge is sharpened by enlarged expectations of the energy and emissions performance of buildings and by concern over the fate of materials and hydrological impacts of construction. Perhaps there is no clearer pairing of imperatives for new levels of design integration in the human environment than building and transportation, which together are implicated in the production of the majority of the world’s greenhouse gases. Only clean water supplies and food production, not unrelated issues, are as pressing at a global, national, and local
scale. In communities, particularly those in which economic disparities or resource depletion produce stresses on the systemic provision of public goods such as transportation, the role of architecture and all design can be a powerful positive force across these fields of change. Public constituencies need architecture and other design and planning efforts to provide the synergies that will help to sustain communities.

SAFETEA-LU (Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users) is only the most comprehensive of several public policy measures (see Appendix) which provide funding and design performance guidelines for enhancements to transportation projects. Its language and other federal, state, and local policies anticipate and give a platform to some, if not all, of the kinds of increasingly integrated designs which, as studied here, have been classified broadly from their current classifications.

- **Transit-oriented developments (TOD)** that use transit operations not only to reduce vehicle miles traveled (VMT) and congestion but to contribute to sustainability of community resources beyond the immediate area and time of the project’s initial enhancements.
- **Context-sensitive designs and solutions (CSD/CSS)** that protect the contextual resources for which they were intended but also create new opportunities for enhanced resource conservation through citizen engagement processes, including visualization.

Emerging from this research are project outcomes and, more important, processes that begin to speak of the promise of integrated design in transportation-focused projects. Two ideas that seem, then, to boil to the top are:

- **Composite performance-measured architecture** and other site-scaled design that not only increase network and transportation system connectivity and access but could also create economic benefits with equity, have a smaller environmental footprint, add visual and cultural values, and invoke citizen engagement.
- **Multi-functioning community infrastructures** including new building elements such as green roofs, streets, bridges, and open spaces that are integrated into well-designed transportation systems. This new multi-functioning infrastructure promises to create broad systemic public enhancements—including protection of of place and ecological and cultural resources—while also addressing core transportation issues of access, equity, efficiency, cost, health, and safety.
Chapter 1:
Connectivity and Access

Transportation projects by their very nature provide greater mobility and safety of movement, but they also connect people and places. In the United States and in a global society, transportation constitutes therefore not only the functional network of mobility, but also the most directly connective and resource-concentrated network of the public realm, a system of our shared values and human needs. Design as a public process celebrates this wholeness as it provides a process to integrate the diverse issues that arise when transportation shapes the main purpose and need of a project. The cases examined here and elsewhere demonstrate specific aspects of this wholeness and suggest the necessity of policy and planning contexts. The hypothesis of this study has been, therefore, that integrating good architecture and other design across a transportation-focused project creates values that reflect not only improved access and connectivity but at least five types of enhancement in broader community values: economic, environmental, visual, participatory, and safety.

What the measures of advancement of these places actually are and how the design toolkit is deployed to achieve them are the questions addressed in this study. An architecture of community calls for, even demands, designing and framing practices that together broaden both access and connectivity in transportation-focused design projects. As demonstrated in the research, the pattern access and the reach of connectivity may also extend beyond the literal architectural scope of a project. In some ways, this enhancement of multiple and integrated public functions is another emerging measure of success of a well-designed transportation-focused project.
Project Frameworks

Several contemporary, though relatively well-seasoned, frameworks to transportation-focused projects can be identified. The project frameworks studied here largely can be classified under the headings Transit-Oriented Design (TOD) and Context-Sensitive Design/Solutions (CSD/CSS).

Transit-Oriented Development (TOD) is urban intensification around the immediate vicinity of a transit station, along with related services. It has become more commonly assumed that projects which reduce congestion and vehicle-miles of travel (VMT) or increase transit ridership also create direct ecological and social cost benefits and are more attractive as designed places from broader economic, environmental, aesthetic, political, and safety perspectives. TOD requires an architecture of residential developments at medium (7-16 d.u./acre) gross density to high density (16 d.u. and up). Most TOD projects mix these densities with commercial uses. Building code, acoustics, privacy, and urban design and siting issues must be considered to mix commercial uses in the same buildings. Several of the cases studied here used TOD as the planning framework to set up designs that match land uses to reduction of VMT and traffic congestion and consequent emissions. The Orange Line cases—Rosslyn, Clarendon and Ballston—demonstrate how policy and planning can powerfully underpin design success. Emerson Park, in East St. Louis, Illinois, and Fruitvale Village in Oakland demonstrate that TOD has been used in a wide range of socio-economic settings with various modes of transit from buses to light rail (LRT) to commuter rail operating on normal heavy rail routes.

Context-Sensitive Design and Solutions (CSD/CSS) is the category for design and planning approaches that broadly include transportation projects in which sensitive resources, natural and cultural, have been conserved (or impacts mitigated). Bridgeport Way, in University Place, Washington, is a strong multimodal and pedestrian-friendly design that also reconfigures the street to give a streetfront presence to architecture. The Marjorie Harris Carr Cross Florida Greenway Wildlife Crossings is a 52.5-foot-wide (16-meter-wide) land bridge over I-75 just north of County Road 484 in Marion County. It rejoined the two halves of the greenway, a 110-mile conservation and recreation corridor split by the interstate years ago.

A concept related to TOD, Traditional Neighborhood Development (TND), has also come to prominence, embodying many of the same attributes as TOD but not necessarily in relation to transit stations. TND has been established in two decades of new and, more recently, redeveloped areas that look and sometimes even behave more like traditional towns and urban neighborhoods. Although the Highland Gardens Village in Denver, Colorado, may not strictly be a TND, the broader design principles embodied in the ‘skinny street’ designs of this and many TNDs have had an impact on the design of this infill project and multimodal aspects of other designs in several cases. Highland Gardens Village was redeveloped on an amusement park site in Denver. Such infill projects with a mix of land uses are a critical planning and design opportunity for communities with large industrial or other single-use (usually commercial or institutional sites) often not served well by transit. Brownfield redevelopments are infill efforts on contaminated sites within existing transportation and other regional infrastructure. Such developments often require incentives and other seed money and have specialized design constraints relative to contamination remediation. Fruitvale Village Station is an infill TOD on a former industrial site and parking lot.
Chapter 2: Design Principles

Integrated design works. Context matters.

Architecture and other processes and forms of design simulate, represent, and integrate ideas across a multiplicity of issues. They frame the construction of the spaces we inhabit. Design is both discovery and decision making. Transportation design problems are complex and specific to communities and even project types, and they involve multiple jurisdictions, funding sources, publics, and clients. They take time and they require coalescent leadership.

The research cases clearly suggest a crucial overarching principle: an integrative spatial approach to transportation-focused design requires integrating design with health (including ecological health), safety, and all other known social, economic, and cultural resources.

The rich toolkit of creative practices employed in the case studies have been guided by design principles. Here are five that stand out:

1. Transparency
The complex public nature of a transportation-focused community project necessitates transparent design decisions (Schively, et al.). Not only must there be frequent, clear communication (reduced jargon, acronym-speak) in multiple media and meetings, the design leadership must also commit itself to complete openness through media that are well-tailored to the project and the clients if it is to discover the best design solutions.

2. Consensus
There is genius in the multiple visions that make a community. Still, not every project will make everyone happy. The project leadership that consistently explores all alternatives and works
toward participant partnership and consensus has the best odds of successful implementation and post-construction evaluation (Forsyth, et al.) These kinds of projects have the best chance to inflect institutional design and planning protocols when combined with rigorous audits of results (Schively, et al.; Forsyth, et al.; Davis).

3. **Stewardship**
Care for shared resources builds community by creating greater sustainability (Carmody, Singh). The best transportation-focused design project identifies all values of key resources—even if at first glance they seem to be outside the scope of architecture or even broader definitions of design and planning—and keeps them at the heart of the design process.

4. **Resilience**
Resilience is a critical measure of the sustainability of any organism—especially communities—and even of artificial constructions, especially highly connective transportation infrastructure and projects that increase infrastructure capacity and efficiency (Carmody, Singh). When a roadway or a transit facility is built, for example, it increases not only connectivity but capacity. When capacity for a dedicated transportation facility enhances other connected capacities such as economic capacity, the net resilience of the system can be increased (Adams, VanDrasek).

5. **Transformation/Fit**
Architects and other designers transform and shape change. This study suggests clearly that well-conceived and executed design integrates changes in function, economy, ecological balance, appearance, safety, and even political environment. Designed spaces are often an intervention in existing communities. Transportation projects can be as intrusive as enhancing if they are not well-programmed for existing and projected uses (Forsyth, et al.) or miss the economic capacity of the community to maintain them (Adams, VanDrasek). They can constitute a net addition of capacity or not; either a fragmentation or a connection of ecological systems (Carmody, Singh).
Design that develops a great place takes time, and each place is different and will be enhanced, therefore, by different kinds of designs (Forsyth, et al.). Transformation and fit are a balance, each having and making its place. A subtle integration that pays attention to contexts can be as transformative as the addition of a new destination or the work of a widely-known architect, the so-called ‘Bilbao effect.’ Such name-brand transportation-focused architecture, more common in airports, rail transit stations, and intermodal hubs in Europe than in the United States, may become more common in the future here as cities vie for pre-eminence as destinations. However, even this signature/destination transportation architecture will change in fundamental ways. Composite patterns of resources will be physically apparent as well as accounted for in sustainable solutions that not only transform, but also fit.
Chapter 3: 
Composite Measures of Enhancement

Several of the cases were analyzed in multiple parts of the study and provide a composite picture of multiple measures related by linked practices. Most of these cases document the role of comprehensive and sustained participatory, political, and planning activities in the establishment of an integrated design framework. In fewer cases, such as Highland Gardens Village, integrated design has played a leading role independent of any transportation project.

Measures
- Some measures of the values of design observed in these cases can be monetized (economic).
- Others can be assigned economic value indirectly (environment, safety).
- Still other values can be measured by survey or expert opinion (visual) or the types of measures that are common to all of these research studies (e.g., citizen participation) and explicitly part of the composite values of design. These measures, for example, are derived from statistical abstracts or analyses of data relevant to performance of designs.

The studies of these cases revealed that enhancement of values is generally based in adherence to design principles and the deployment of multiple types of integrated design practices. This pattern has produced composite measurable enhancements in both transit-oriented development (TOD) and context-sensitive design/solutions (CSD/CSS) cases that characterized most of the research here. The Fruitvale case, for example, evidenced enhanced visual values across an area (Forsyth, et al.). Related increased economic development had occurred both in the infill projects most closely served by transit at the Fruitvale station and along the existing commercial
boulevard two blocks away (Adams, VanDrasek). The economic reach of the best design extended beyond the project-scale according to the balance-sheet evaluations employed here. Other measures added to composite values in some cases. The design of Fruitvale (and other cases) was also carefully tailored to the site to provide intermodal transit; vehicular, pedestrian and bike access; and connectivity imagined (if not rigorously projected in quantitative terms) by planners to enhance integrated environmental conditions relative to the reduction of VMT and other outcomes (Carmody, Singh). These values were buttressed by evidence of enhanced civic engagement created through sustained participatory practices and civic organization (Schively, et al.). Context-sensitive design/solutions (CSD/CSS) cases studied from multiple perspectives of community enhancement such as Bridgeport Way and Barracks Row also suggest that sustained attention to visual (Forsyth, et. al.) context and participation (Schively, et al.) in project planning fosters good design while potentially increasing pedestrian safety (Davis).

The Rosslyn-Ballston Corridor projects, especially Clarendon, demonstrate the linked values of economic enhancement arising out of visual enhancement and out of comprehensive planning at a regional scale and civic participation at the local. Such larger developments, especially TODs, tend to evidence the best chance to create composite values over a long period of time and well beyond the project geographic scope. While Highland Gardens Village and Prairie Crossing, for example, seem positioned to yield a broad array of enhancements including measurably greater environmental sustainability (Carmody, Singh), though not studied here, economic values may also be stabilized or enhanced in a safety-enriched environment. However, these new projects have yet to realize their full composite potential as they transform place over time.

And time emerges as a tricky issue in the evaluations here. Economic values are particularly time-sensitive. As has been either explicitly stated or implied in all of the summaries, what can be chalked up as an enhancement for one community at one moment in time does not necessarily register enhancement across a whole community or transportation system for all time.

In the Emerson Park Metrolink and Fruitvale BART projects, painstaking planning and design and lots of political follow-through have produced affordable housing in the context of TOD. As indicated in the economic enhancement summary, a pattern of disparate gains can be particularly sharp when disadvantaged populations are affected by a project, even one that on paper provides greater access for all. One of the potential problems in a community that has a large plurality of renters such as Boyle Heights, a Latino community in East Los Angeles, is that renters have no immediate stake in the economic enhancement (Adams, VanDrasek). In this economic environment, a new or renovated building near a new transit stop on a new park may have the unintended ripple effect of perceived economic improvement by landlords, resulting in rising rents. When the Gold Line LRT project is extended to Boyle Heights, this situation could be exacerbated in spite of broad community support for the project. If local employment is in decline, as it is in East L.A., the results may initially constitute paper, not direct income, enhancements to community. Accepting the premised that immediate added values are unequally shared, such cases do seem to indicate that subject to these conditions, community enhancement can occur over time with careful and sustained integration of policy, planning, and design.
Chapter 4: Practices Toward Integrated Design

Some case studies summarized were specifically chosen to illustrate projects of specific types in particular communities. Others asked the question, ‘How are design practices aimed at the creation of one kind of value--for example, economic enhancement--augmented by those of another such as sustainability, aesthetics, citizen participation, or safety?’ With the caveat that a good practice in one place is just another tool in the kit in another (Adams, VanDrasek; Forsyth, et al.), this section particularly focuses on practices toward critical overarching goals such as the creation of safe and healthful systems and places that reduce vehicle miles of travel (VMT) and congestion.

From the cases studied here and elsewhere, a transportation-focused project conceived to enhance a broad range of community values can be said to be guided by integrative practices. Process and spatial practices increasingly are beginning to match as increasingly complex transportation-focused projects require greater integration of all aspects of the design work.

Here are seven general design practices for transportation-focused projects:

1. Integrative project scoping, programming, and design address the composite design problems to be solved, not just a general approach. The ‘Purpose and Need’ statement for a transportation project and the programming for an architectural or other design project can reduce VMT, protect cultural and natural resources, and sustain place-making contexts through historic preservation, context-sensitive design, traditional neighborhood design, and/or sustainable development. Some key transportation-focused issues include:
• Street and right-of-way design for dedicated lanes and grade separation (bridges), building and cultural site preservation, and stormwater filtration/infiltration.
• Multimodal engineering scoping, spatial capacity, and formal and spatial organization to increase capacity and congestion relief but also to broaden the public reach of transportation and related development and enhance its adaptability over time (Adams, VanDrasek; Carmody, Singh).
• Project programming to address the needs of diverse public clients (Forsyth, et al.).

2. **Participatory organization builds constituencies for design solutions.** Participatory organization requires the project architect and other design leaders to:
• Identify stakeholder issues in relation to key items of the scope and their budgetary and environmental constraints (Adams, VanDrasek).
• Pace the project in such a way as to inform the public about design alternatives including their implications to the best of their abilities (Schively, et al.). Maximize transparency. Create a project vision that meets both transportation and community needs will demand an equitable process that taps creative potential in participants without burning out the stakeholders (Forsyth, et. al.).

3. **Simulation and visualization provide critical interactive media of architectural and design communication that induce transparency into the citizen engagement process.** Three-dimensional visualization and simulation are advantages that architects and other designers can use to maximize creative citizen involvement, understanding, and buy-in--and ultimately, stewardship--for a project. The precision and scale of visualization must fit the issues to be resolved. The media have to fit the problem and the abilities of the stakeholders to synthesize the information that visualization supplies. Relatively low-tech processes were used in the cases shown here (Schively, et al.). However, visualization is part of a quickly-changing world of communications. The role of visualization in defining critical issues and choices for stakeholders has become both more sophisticated and accessible and interactive. The emerging best practices at the transportation project scale incorporate contextual visual and sometimes tabular presentations of information with simulations of travel movement, including the ability to simulate changes reflective of, for example, peak and off-peak conditions. Other broader approaches to planning scenario simulations using comprehensive data sets with GIS and oblique imagery have been used for larger transportation planning by design, engineering, and planning firms which have, in some cases, created their own proprietary software packages. Architectural projects, such as transit station designs, have conventionally been produced as fixed perspectival oblique views, but increasingly will be integrated with real-time simulations of transportation movement and with GIS-based data and other interactive data sets that provide clients and citizens with critical contextual information about proposals.

4. **Integrated design makes architectural and landscape spaces of intermodal wayfinding, connectivity, and legibility.** As energy prices rise, more people may need multiple modes to make a trip (Carmody, Singh). Intermodality will increasingly emphasize wayfinding legibility as a part of design programs. Clear, understandable links improve the predictability needed for users to change modes (Forsyth, et al.). Efficiency, health, and safety are other important benefits.

5. **Intense development at existing or new centers/cores/nodes requires orchestration of well-ordered, human-scaled structures and spaces.** Intensive development or redevelopment creates a concentration and, usually, compactness, measured by the number of opportunities (activities, jobs, places to live, or combinations) located within a given geographic space (Adams, VanDrasek). This intensity requires careful attention to hierarchy and cross-scale and use relationships in design. As much attention needs to be paid to the cross-section--and especially level-to-level connections and separations across mode---as to plans in designs of such spaces.
6. **Physical durability and flexibility are the foundations of sustainability.** Transportation projects in the 21st century embody one of the most demanding challenges to design: the structure must be durable while also providing the flexibility to adapt new power sources and other infrastructures that can meet changing needs (Carmody, Singh). Infrastructural flexibility underpins ecological resilience, and when combined with materials and forms for long-term aesthetic and cultural values and adaptable systems, such complex designs also provide budgetary challenges.

7. **Match vehicular performance requirements to human behavior.** Transportation projects require architects and other designers to anticipate and design for vehicular requirements and capacities, e.g., for speed, and, at the same time, to resolve these capacities with human behaviors including response times and other scale and time characteristics of the human mind and body (Forsyth, et al.). Safety requires incorporation of reliable measurements of enhancements based on audits (Davis).
Chapter 5:
Composite Enhancements as Integrated Designs

Focusing primarily on projects that were analyzed in multiple studies of this research, the following section examines the compositions, the outcomes of the applications of the basic planning and policy frameworks, and other conditions that framed and activated the design decisions. Using multiple photographs of the projects, an annotated graphic assessment explicates the physical outcomes of the applications of the design principles, measures, and practices.

Three TOD and two CSD/CSS cases studied from multiple perspectives demonstrate these composite enhancements:

- The DC Metro Orange Line TODs – Rosslyn, Clarendon, Ballston, Arlington, County, Virginia
- Fruitvale Village, BART TOD, Oakland, California
- Emerson Park Station Metrolink TOD, East St. Louis, Illinois
- Barracks Row, Main Street/CSD/CSS, Washington, DC
- Bridgeport Way, CSD/CSS, University Place, Washington
Additionally, three cases studied only from the perspective of environmental enhancement demonstrate variations on integration necessitated by emerging multi-functional performance imperatives:

- Highland Park Gardens, infill TND, Denver, Colorado
- The Marjorie Harris Carr Cross Florida Greenway Bridge, Florida
- Intermodal Hub, Salt Lake City, Utah
Orange Line, DC Metro: Rosslyn-Ballston Corridor, Clarendon Market Commons, Rosslyn Intermodal Station

Design Framework: Transit-Oriented Development
Enhancements: Economic, Aesthetic, and Participatory

Project Planning and Design
Key Institutional Structures: Arlington County-wide General Land Use Plan (GLUP), Metrorail Joint development

Key Planning and Policy Frameworks for Design Decisions:
- General Land Use Plan (GLUP), station area plans (including permissive and as-of-right zoning) shape development and design review standards for compact mixed-use development – easing private financing
- Grade-separated transit development on Wilson Boulevard highway (subway tunnel)
- Zoning: special Affordable Housing protection district
- Sub area plans, retail action plans, and design guidelines; site plan review
- Transportation demand management
- Transportation initiatives to increase transit ridership
- Green space preservation
- Multimodal design and planning

Design Consultants: multiple

Process: Urban design and pedestrian environment improvements; joint development through three public-private partnerships; receptive population: citizen participation

Outcomes
- Region-wide urban design and development improvements
- $10 billion assessed value, 32.8% of county’s tax base
- Five new stations and station-area, multiple infill TOD projects
- 40% transit share, 10% non-motorized transport to work
- 83,700 trips per day in corridor
- Employment - Two-way commute patterns
- Business development (office space more than doubled since 1980)
- 300+ apartment structures, 28 townhouses – 30,000 units (TRB, 2005)

Cost/Budget: Approx. $xxx million

Date begun: Planning: 1972; 1981 – development implementation

Date completed: 2001; ongoing development
Rosslyn

**Principle:** Transformation/Fit

**Measure:** Participatory

**Practice:** Integrative project scoping

Multimodal, transit-served streetscape including street trees and planted median is adaptation to pre-existing late-20th century large office development on arterial streets.

**Measures:** Economic, Visual

**Practice:** Integrative project scoping

Intermodal connectivity to regional and local bus routes at Metro station including angled bays, signage, street furniture, streetfront transparency in building design.
Clarendon Station Area and Market Common

**Principles:** Stewardship

**Transformation/Fit**

**Measures:** Economic, Visual, Participatory

**Practices:** Integrative project scoping; access for diverse users; physical durability; match vehicular performance to human behavior

Multimodal station and transit market plaza development utilizes combinations of traditional and new materials to create new connective fabric and program for commuters.

**Principle:**
Transformation/Fit

**Measures:** Economic, Visual

**Practice:** Intensity of development

Architectural forms and shopping center plaza layout adapt to pre-existing townscape. Multimodal streetscape is adaptation to scale of development.
Ballston

**Principles:** Resilience, Transformation/Fit  
**Measure:** Economic  
**Practice:** Intense development  
Reinvestment and infill development in neighborhoods adjacent to station at transit-served densities.

**Principle:**  
Transformation/Fit  
**Measures:** Economic, Visual  
**Practices:** Access for diverse users; intense development  
Urbane architecture in multimodal setting for office development, employment; streetscape is adaptation of pre-existing arterial that uses right-of-way capacity.
Emerson Park, East St. Louis, Illinois

*Design Framework: Transit-Oriented Development*
*Enhancements: Economic, Participatory*

**Project Planning and Design**

**Key Institutional Structures:** BiState Development Corporation (now St. Louis Metro)

**Key Planning and Policy Frameworks for Design Decisions:** City of East St. Louis tax increment financing (TIF) [http://www.slfp.com/CNews070501.htm](http://www.slfp.com/CNews070501.htm)

**Design Consultants:** McCormack Baron; East St. Louis Action Research Program (ESLARP)

**Process:** Mid-1980s, a small group of neighborhood women, led by Ceola Davis, started organization process in the neighborhood, culminating in Emerson Park Redevelopment Corporation in 1990; planning and design work with University of Illinois ESLARP, directed by Professor Ken Reardon, 1991-1997; in 1997 Metrolink station planning adopts neighborhood-supported preferred route; currently inner-city catalytic redevelopment help and government incentives to large design/development firms.

**Outcomes:** The Emerson Park Metrolink transit stop and park-and-ride lots are sited on the north side of Interstate 64. New low- and moderate-income housing developments, a community center, and charter school are served by the light rail, and a highway overpass was constructed to improve safety and auto and pedestrian access across the highway. The light-rail station links low-income and unemployed residents with job opportunities in the Greater St. Louis area; enhanced prospects for home ownership.

**Cost/Budget:** Parsons Place: approx. $24.6 million

**Date begun:** citizen organization, 1980s; planning, 1990s; Metrolink system begun, 1993; station and Parsons Place project, 1997

**Date completed:** 2003

**Principles:**
- Transparency
- Consensus
- Resilience
- Stewardship
- Transformation/Fit
Principles: Resilience, Transformation/Fit
Measure: Economic
Practice: Access for diverse users Park-and-ride parking lot for downtown E. St. Louis Metrolink station; tall building at rear is empty.

Principle: Stewardship
Measure: Participation
Practice: Participatory organization Emerson Park CDC offices and charter school with murals by local kids reflecting emerging self-image of students. This neighborhood-based activity contrasts with the continued deterioration of downtown.

Principle: Transformation/Fit
Measure: Economic
Practice: Intense development Reinvestment in retail and service facilities at Emerson Park Metrolink Station.
Measure: Economic Practice: Intense development Infill development at transit-served densities in neighborhood adjacent to station.
Principles: Transparency, Consensus, Transformation/Fit
Measure: Participation
Practice: Visualization
Designs by ESLARP program helps to shape expectations, decisions, and outcomes for residents and developers.

Principle:
Transformation/Fit
Measure: Economic
Practice: Intense development
Reinvestment and infill development in neighborhood at transit-served densities.
Measures: Economic, Participation
Practices: Participatory organization
Reinvestment and new single- and multi-family infill development under auspices of Emerson Park CDC.
Highland Gardens Village, Denver, Colorado

*Design Framework: Traditional Neighborhood/Sustainable Development*

*Enhancements: Environmental Values*

**Project Planning**

**Key Institutional Structures**: HUD and City of Denver HOME

**Key Planning and Policy Frameworks for Design Decisions**: City of Denver coordination of planning and zoning with redevelopment agency and HUD and Denver HOME to create baseline financial feasibility for selected developer and design team.

**Design Consultants**: Urban design: Calthorpe Associates; residential: OZ Architects, Harry Teague Associates, Wolff Lyon; retail: KLIPP; park design: Lee Weintraub, Civitas; design guidelines: Civitas; theater site plan: Project for Public Spaces

**Process**: Elitch Gardens Amusement Park relocated in 1994. Perry Rose LLC, a development company, becomes successful respondent to request for proposal by City of Denver in 1996: in 1998 the city rezoned the site as a Planned Urban Development; Denver Urban Redevelopment Authority (DURA) declares site urban renewal district, tax incremental financing eligible, and community design workshops sponsored.

**Outcomes**: 306 housing units with 52 single-family units, 20 carriage homes, 38 town homes/condos, 63 senior housing units, 74 multifamily units, 33 cohousing units, and 26 live/work lofts. Other areas in the development include:

- Office and Retail: 75,000sf
- School: 43,000sf
- Theater and Carousel Building: 20,000sf
- Open Space: 140,000sf
- Denver Arts and Technology Academy (public charter school)

The flexible commercial space offers restaurants, studios, and shops, with live/work townhouses and offices above creating the opportunity for residents to work and shop all within a minute’s walk from their home. The project also provides safe and convenient walking paths and a network of gardens, plazas, and public open spaces.

2005 Environmental Protection Agency (EPA) Smart Growth Award of Excellence; five-star rating from the Denver Home Builders Association’s Built Green Program and an “e-Star” certification by Energy Rated Homes of Colorado.

**Cost/Budget**: Approx. $102 million

**Date begun**: site purchased, 1998.

**Date completed**: Housing completed, 2002; retail and institutional construction near completion, 2007.
Principles: Transparency, Consensus, Stewardship, Transformation/Fit

Measure: Environment
Practice: Participation
The design of this project was guided by the community design processes. This process allowed a modest scale change but a great increase in density.

Measure: Environment
Practice: Integrated design
Architecture is coordinated with site engineering and landscape architecture to produce an environmentally-strong approach to stormwater and in a contemporary visual package. Some LEED-certified buildings, care share program.

http://www.epa.gov/smartgrowth/case/highland_p5.htm
Principles: Transparency, Consensus, Stewardship, Resilience, Transformation/Fit

Measure: Environment

Practices: Integrated design; physical flexibility

The infill housing components of the project were funded in part by City of Denver.

Measure: Environment

Practices: Integrated design; physical flexibility

Stormwater gardens (basins for runoff storage and infiltration) become a visual amenity and create a green infrastructure for parking in higher density residential courtyards.

Measure: Environment

Practices: Integrated design; intensity of development; match vehicular performance to human behavior

The retail/live work structures both face the street and have parking at rear of buildings for residents and customers. Parking drains to stormwater storage and infiltration basins. Lighting and other street furniture is at pedestrian, not vehicular, scale.
Fruitvale Village, BART, Oakland

Design Frameworks: Transit-Oriented Development, Infill Development
Enhancements: Economic, Environmental, and Participatory Values

Fruitvale Village has become an important service center and TOD for an ethnic-American neighborhood of Oakland. The project focused on the space between an existing commercial Boulevard and the BART station. Its driving principles—Transparency, Consensus, Resilience, Stewardship, and Transformation—gave a framework to the designed enhancements measured here.

This project has been evaluated in this study on four measures: Economic, Environmental, Visual, and Participatory.

Project Planning and Design
Key Institutional Structures: Unity Council working with BART and City of Oakland and these participants:
- National Transit Access Center, University of California at Berkeley
- Metropolitan Transportation Commission (MPO for Bay Area)
- Federal Transit Administration
- U.S. Department of Housing & Urban Development
- U.S. Environmental Protection Agency

Key Planning and Policy Frameworks for Design Decisions: Unity Council gains an organizing leadership position, forms Fruitvale Development Corporation and negotiates flexibility with BART and city to gain overall responsibility for land development, design and project management; creative financing combined with effective citizen participation in planning and design.

Builder: James E. Roberts-Obayashi Corp., Danville, Calif.
Developer: Unity Council, Oakland, Calif.

Process: Unity Council formed, 1975; initial community site planning meetings in spring and summer, 1995, sponsored by Unity Council with partners frame general planning and design principles and alternatives leading to formation of Fruitvale Development Corporation and key acquisition of BART parking lot as the site for redevelopment. Business Improvement District formed 2000, Fruitvale Access Plan, 2002, BART.

Outcomes: A mixed-use development adjacent to the Fruitvale BART that adds economic values to the neighborhoods and the city, greater multi- and intermodal access across income groups, improved air quality and pedestrian environments between the station and International Boulevard including redesign on that street and on 12th Street.

Cost/Budget: Approx. $100 million
Date begun: 1991, September 1999, groundbreaking
Date completed: Phase I completed c. 2004; Phase II not yet commenced.
Principles: Transparency, Consensus, Resilience, Stewardship, Transformation/Fit

Measure: Participatory
Practice: Participation
The infill elements of this project were guided by the participatory processes organized by the Unity Council.

Measures: Economic, Environmental, Visual
Practices: Intensity of development; match vehicular performance to human behavior
The infill project was coordinated with pedestrian crossings and boulevard median street furniture and plantings. City of Oakland and FDC funded.
**Principles:** Stewardship, Resilience  
**Measures:** Economic, Participatory  
**Practices:** Intensity of development; participation  
Mixed-use residential and commercial service buildings line paseo and International Boulevard.  
**Measure:** Visual  
**Practice:** Physical durability  
Regional construction techniques and artist-built street elements.

**Principle:** Transformation/Fit  
**Measures:** Visual, Participatory  
**Practices:** Intensity of development; participation; match vehicular performance to human behavior  
Parking lot converted to pedestrian paseo space (Federal Transit Administration funded) with mixed-used commercial service, retail, and residential buildings and spaces.

**Principles:** Consensus, Stewardship, Transformation/Fit  
**Measure:** Participatory  
**Practice:** Participation; intensity of development; match vehicular performance to human behavior  
Tree planting lines station area and track paseo. Among the services in the station area are the Cesar Chavez branch library, a childcare center, and La Clinica de La Raza, a health clinic.
Principle: Resilience
Measures: Economic, Environmental
Practice: Participation; match vehicular performance to human behavior; multimodal access
Inter- and multimodal space of paseo connects transit plaza, including intermodal bus station as well as BART parking, and bike storage and repair with main commercial paseo. FTA and Fruitvale Village funded.

Principle: Stewardship, Resilience
Measures: Visual, Participatory Practices: Participation; multimodal access
The Ascend School is a neighborhood school and community center just two blocks from the station at the edge of 2nd phase of Fruitvale.
Barracks Row, Washington, DC

*Design Framework: Context-sensitive Design/Solutions, Transit-Oriented Development*

*Enhancements: Economic, Visual, Participatory*

Barracks Row lies in the southeast corner of Capitol Hill. The project focused on 8th Street, its neighborhood main street. Commercial uses are sited across from the historic Marine Barracks and near the Eastern Market Metro station. Its driving principles—Transparency, Consensus, Resilience, Stewardship and Transformation—framed the historic preservation and citizen participatory design practices that created the enhancements measured here.

This project has been evaluated in this study on a three measures: Economic, Visual, and Participatory.

**Project Planning and Design**

**Key Institutional Structures:** Barracks Row Main Street (BRMS) with National Trust for Historic Preservation; District of Columbia DOT (DDOT); Cultural Tourism DC

**Key Planning and Policy Frameworks for Design Decisions:** Main Street Program

**Design Consultants:** Urban design and landscape architecture: Lee & Associates; traffic engineering: Frederick Harris, Inc.

**Process:** A non-profit organization formed by local activists; in 1999 began using model provided by the National Trust for Historic Preservation's Main Street program; in 2000, the group hired a full-time executive director; in 1999 approached District DOT about resources to redesign 6 blocks of 8th Street; in 2000 engineering and landscape architecture firms retained to do preliminary study; in 2002 applied for and won designation as an national Main Street program; three public meetings were held, approximately two hundred people were surveyed, and additional working sessions were convened during this early design period. Coordination continued during the construction phase of the project. The Executive Director of Barracks Row Main Street (BRMS) and his assistant hosted on-site, bi-weekly meetings for the construction team, with representatives from agencies. District of Columbia DOT had contracted with the FHWA to provide the day-to-day management of the construction project, with DDOT retaining oversight responsibilities. Public outreach was extensive. Every other month, "construction coffee updates" were held. During construction "Welcome to Barracks Row" signs were posted along the corridor, with renderings of the completed corridor. Façade design guidelines instituted.

http://www.contextsensitivesolutions.org/content/case_studies/DC_Barracks/

**Outcomes:** complete reconstruction of public space of 8th Street; 15 new businesses since construction completed

**Cost/Budget:** Approx. $9 million

**Date begun:** 1997

**Date completed:** 2004
Principles: Stewardship, Resilience, Transformation/Fit
Measure: Visual
Practices: Integrative scoping; participatory organization; match vehicular performance to human behavior
The traffic signals, traditional Washington globe street lighting with overhead cobra lighting for traffic, and specialty paver crossings were part of the project scoping in the street reconstruction. Practice: Physical durability and flexibility
The brick pavements in the sidewalks and pedestrian crossings complement the brick architecture of the historic Marine Barracks.
Principles: Consensus, Stewardship, Transformation/Fit
Measure: Participatory
Practice: Participation
The Barracks Row Main Street community organization with Cultural Tourism DC and the Capitol Hill Restoration Society created the city Heritage Trail, ‘Tour of Duty,’ a program of interpretive plaques on 8th Street and a printed guide available at most merchants’ shops.

Measure: Visual
Practices: Intensity of development; match vehicular performance to human behavior
Design guidelines and façade grant programs preserve patterns, scale of window size and placement, define the transparency, safety and publicness of the street wall. Angle parking slows traffic and increases on-street parking capacity.

Principles: Stewardship, Resilience
Measures: Visual, Participatory
Practices: Participation, match vehicular performance to human behavior
The planting of 92 American elm street trees donated by Casey Trees Endowment creates the protected space of pedestrian movement.

Measures: Visual, Economic
Practice: Physical durability
Form-, scale-, material- compatibility with historic architecture of Marine Barracks in the brick and bluestone sidewalk paving.
Bridgeport Way. University Place, WA

Enhancements: Participatory and Safety Values
Design Framework: Context-Sensitive Design and Solutions

Project Planning and Design

Key Institutional Structures: Washington State Transportation Improvement Board; WSDOT, FHWA, Puget Sound Regional Council, and Washington State Public Works Board.

Key Planning and Policy Frameworks for Design Decisions: At-grade redevelopment for greater pedestrian access, safety; no roundabouts but functional classification flexibility

Design Consultants: The city hired Dan Burden, director, Walkable Communities, to introduce initial street design concepts. Roundabouts in initial plan rejected as part of compromise final design by Cascade Design Collaborative with WSDOT.

Process: Participation efforts were led by the newly incorporated City of University Place. Receptive and committed population. A compromise design removed the roundabouts and adjusted the alignment of intersections to allow for U-turns for business access, but retained extensive use of landscaping, central medians, two mid-block crossings, and pedestrian and bicycle enhancements.

Outcomes: This 1.5-mile highway redesign project, an urban design adapted from strip commercial arterial, located in a suburban community in the Seattle-Tacoma region, involved a roadway improvement from a five-lane ‘rural section’ highway to a four-lane divided highway/Main Street. The roadway design evolved as a result of public and business concerns about the proposed roundabouts, business access, and right-of-way acquisition. Mobility for all users; improved safety for vehicles, pedestrians, bikes; capacity appropriate to context, new building sites for civic center

Cost/Budget: Approx. $9 million

Date begun: May 1998
Date Completed: June 2002

http://128.163.152.205/csd/HTM/CSD10BridgeportWA.htm
**Principles**: Transparency, Consensus, Transformation/Fit

**Measure**: Participatory

**Practice**: Participation

The creation of this design with clearly marked lanes and crosswalks to break long blocks arose out of citizen response to more elaborate traffic calming ideas.

**Measure**: Safety

**Practices**: Match vehicular performance to human behavior; access to diverse users.

The multimodal street design uses crosswalk signalization, lighting, median design including low planting, and a pavement change in combination with transit improvements, a striped bike lane and basic sidewalk spatial delineation and pavements to achieve safe legible spaces for all modes.

**Measure**: Safety

**Practices**: Integrated scoping, design

The street design makes it possible for the newly-incorporated city to have a civic center and a central park. The design provides for access from a less-traveled thoroughfare and preserves a large stand of trees.
Salt Lake City Intermodal Hub Facility, Utah

**Design Framework:** Sustainable Transportation Building  
**Enhancements:** Environmental

**Project Planning and Design**  
**Key Institutional Structures:** Salt Lake City Corporation, Utah Transit Authority (UTA)  
**Key Planning and Policy Frameworks for Design Decisions:** Salt Lake City Transit Master Plan, 1996, updated. The TRAX LRT system (19 miles, with two lines that meet in downtown Salt Lake) and a new commuter rail project under construction, a 44-mile route from Salt Lake City to Pleasant View in Weber County, and eventually to Utah County on the south, will be brought together with AMTRAK and UTA regional bus lines at the Intermodal Hub. At the same time as the TRAX and Commuter rail projects, Union Pacific is realigning its tracks as they come through the city and increasing the radiiuses on the curves.  
**Design Consultants:** ajc architects with IBI Group  
**Process:** master planning, business and mayoral leadership  
**Outcomes:** 23,500 square-foot terminal provides light-rail, commuter rail, transcontinental rail and bus, car pool, local bus, taxi, and bicycle connections. The project involved retrofitting and seismic upgrade of an existing warehouse facility. Leadership in Energy and Environmental Design (LEED) Certified level. Fifty percent of the construction waste was diverted on the project. Brick was reused from two demolished buildings on the site. Healthy/non-toxic building material selection was emphasized on the project. Permanent CO2 monitoring systems; water-saving landscaping and irrigation; low-emitting materials (adhesives, sealants, paints, and carpet systems); and daylighting systems and controls, high efficiency HVAC systems, and an efficient thermal envelope were used on the project. In 2005 a municipal executive order required that all new and renovated public buildings be certified at the LEED Silver level; applies to all public buildings that are owned and operated by Salt Lake City Corporation.  
http://www.slcgreen.com/pages/hpb.htm  
It is anticipated that with the coming juncture of two mass transit rail systems at the Salt Lake Intermodal Hub, the surrounding area is going to change dramatically. City officials believe that the 19-block transit-oriented neighborhood between North Temple and 400 South, from 400 West to Interstate 15, could house up to 20,000 people who would live in rowhouses, townhomes and apartments next to or over the neighborhood shops and offices.  
**Cost/Budget:** Intermodal Hub: Approx. $21 million  
**Date begun:** Construction began September 2006 with infrastructure improvements, including sewer improvements and utility relocation in late Fall, 2006  
**Date completed:** Expected completion for the project is early 2008
Principles: Transparency, Consensus, Resilience, Stewardship, Transformation/Fit

Measure: Environment
Practices: Integrative project scoping; programming and design; match vehicular performance with human behavior

An intermodal hub requires a legible spatial organization for wayfinding and an easily maintained facility that also integrates user’s needs and behaviors with vehicular performance.

Measure: Environment
Practices: Integrative project scoping and design
Scoping and design of the project anticipated the reuse of existing facility and materials and the exercise of LEED-certified design and construction practices.
Marjorie Harris Carr Cross Florida Greenway Bridge, Florida

Design Framework: Sustainable Infrastructure
Enhancements: Environmental

Project Planning and Design
Key Institutional Structures: Florida DOT; Florida Department of Environmental Protection
Key Planning and Policy Frameworks for Design Decisions: Transportation Enhancement Activity 11
Design: Bridge: U-Beams by FDOT; planting: Department of Environmental Protection
Process: Opposition to the cross Florida barge canal project was led by Marjorie Harris Carr, successful in 1971. A revised federal bill to deauthorize the canal was filed in the U. S. Senate by Senators Bob Graham and Connie Mack providing for a minimum 300-yard wide greenway corridor to be maintained along the former Barge Canal route. Passed and signed into law by President George H. W. Bush, 1990.
Outcomes: Marion County land bridge vegetative cover protects wildlife from traffic noise and vehicle headlight-glare when they cross at night. The bridge also includes a built-in irrigation system and a 16-foot-wide trail for bicyclists, pedestrians, and horseback riders. Uninterrupted passage for deer, foxes, coyotes, possums, and other small- to medium-sized mammals.
http://www.1000friendsofflorida.org/Transportation/process.asp The key unique structural elements of the bridge, which is the first precast U-beam superstructure to be constructed in the state, include use of open triangular-shaped median piers, integral abutments, and geosynthetic-reinforced, vegetated approach slopes. http://pubsindex.trb.org/document/view/default.asp?lbid=651239
Cost/Budget: Approx. $3.4 million
Date begun: 1991
Date completed: 2001

Principles:
- Transparency
- Consensus
- Resilience
- Stewardship
- Transformation/Fit

www.fl-interstate.com
Principles: Resilience, Stewardship, Transformation/Fit
Measure: Environment
Practice: Integrated project scoping

The Cross Florida Greenway followed the path of a planned but unexecuted barge canal, originally designed to connect the Atlantic Ocean and the Gulf. The bridge maintains the wildlife habitat connectivity and human continuity of the greenway in spite of the barrier of the interstate by the use of a carefully designed, planted, and drained grade-separated structure with appropriate natural and landscape-scaled materials for bridge-surface barriers.
Woodrow Wilson Bridge, Virginia, Maryland

*Design Framework: Sustainable Infrastructure
Enhancements: Environmental*

**Project Planning and Design**

**Key Institutional Structures:** FHWA: only federally owned bridge; TEA 21 funding over successive years; VDOT, MHWA

**Key Planning and Policy Frameworks for Design Decisions:** VDOT

**Design Consultants:** Parsons: Steinman and DeLeuw

**Process:**
Hundreds of thousands of gallons of concrete wash water necessary to clean the heavy-duty conveyor systems were effectively managed, minimizing impact on the Potomac River. Cofferdams, or steel boxes, were installed into the shallows of the river to provide a work area for foundation workers, thus providing protection for workers and the river. Innovative solutions and management practices protected and enhanced the natural environment and neighboring communities; project website by VDOT: mapping and visualization; management techniques were deployed that enabled detailed tracking of environmental permit compliance including four-person environmental management team in VDOT.

http://www.wilsonbridge.com/

**Outcomes:** Completed foundations of the Woodrow Wilson Bridge connecting Maryland and Virginia over the Potomac River. Foundations contract completed on-time and on-budget. The project used “Air Bubble Curtain System” to protect fish during water pile driving activities necessary to support the bridge foundations. The project also created a permanent 84-acre bald eagle sanctuary north of Rosalie Island in Prince George’s County, Maryland, and over six acres of wetlands created in Fairfax County; part of $65 million worth of environmental mitigation programs that are being implemented to compensate for unavoidable impacts to environmental resources. Other key environmental successes of the foundations contract include reducing expected impacts to surrounding waters and wetlands through sound “minimization” techniques and reduced dredging requirements through selective use of equipment. Project winner of the 2004 Globe Award sponsored by the American Road & Transportation Builders Association-Transportation Development Foundation (ARTBA-TDF) for conquering major environmental challenges while completing the first major phase of construction.

**Cost/Budget:** Approx. $125 million for foundations; completed bridge $600 million; entire project $1.3 billion

**Date begun:** 1999

**Date completed:** 2007
Principles: Transparency, Stewardship
Measure: Environment
Practices: Integrated scoping, programming, and design; visualization
The design and execution of the cofferdam and ‘air bubble’ approach to the foundations of the bridge involved a coordinated, cost-effective, and creative approach to solutions of multiple known project objectives.
Measure: Environment
Practice: Integrated design
Design was conceived in terms of construction practices that would minimize cost, time, and noise disturbance to nearby wetland habitats.
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http://www.teachamerica.com/VIZ/02d_Burbank/index.htm visualization

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