Challenges of Sustainable Infrastructure
AAEES-UCI

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Sustainable Infrastructure

- Defining Sustainable Infrastructure
- Sustainable Systems
- Sustainable Community Infrastructure
- Challenges
- Green Roads
- Sustainable Water Infrastructure
Sustainable Urban Infrastructure

Sustainable urban infrastructure is a term used to describe infrastructure that facilitates a place or regions progress towards the goal of sustainable living, and improvements that do not deplete natural resources. Emphasis is on localization and reducing the ecological footprint in areas with high population density.
Sustainable Infrastructure Engineering

The design of new infrastructure, and the re-design, rehabilitation, re-use or optimization of existing infrastructure, which is consistent with the principles of urban sustainability and global sustainable development.
Engineering

- Infrastructure renewal
- Long-term economic analysis of infrastructure, e.g. life-cycle analysis, ecological foot printing
- Material selection for sustainability - quality, durability and energy conservation
- Making better use of so-called "waste" water and materials
- The redesign of infrastructure in light of global climate change AB32
- The remediation of environmentally damaged soils and water
Sustainable Approach

- Reduce Operation and Maintenance
- Integrated Project Delivery and Design Charretts
- Longevity and durability
- Design Flexibility
- Risk Management
- Community Input
- GIS applications for Green Infrastructure
- Green procurement
Sustainable Site

Traditionally project owners, engineers, planners, architects, contractors and public agencies have worked in vertically divided silos of expertise. Sustainable site planning requires a new collaborative and horizontal integrated approach of best practices to solve today’s environmental challenges:

- Open space and healthy outdoor environment
- Project access, parking and circulation
- Site constraints and opportunities
- Site selection
- Analyze site topography
- Access to utility services
- Landscaping and irrigation
- Storm water quality and quantity
- Lighting system
Integrated Project Delivery (IPD) and Sustainability

**IPD** is a project delivery approach that integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to optimize project results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication, and construction.

Infrastructure Systems

Transportation

- **Road** and highway networks, including structures (bridges, tunnels, culverts, retaining walls),
- street lighting and traffic lights and edge treatments (curbs, sidewalks, landscaping)
- Railways, including structures, terminal facilities (rail yards, train stations),
- Canals and navigable waterways requiring continuous maintenance (dredging, etc.)
- Seaports and lighthouses
- Airports, including air navigational systems
- Mass transit systems (Commuter rail systems,)
- subways, tramways, trolleys and bus terminals
- Bicycle paths and pedestrian walkways
Infrastructure Systems

Water management

• **Drinking water supply**, including the system of pipes, pumps, valves and treatment

• **Sewage** collection, recycling and **disposal**

• **Drainage** systems (storm sewers, ditches, etc.)

• Major **irrigation** systems (reservoirs, irrigation **canals**)

• Major **flood control** systems (**dikes**, **levees**, major pumping stations and floodgates)
Other Sustainable Systems

- Communication Infrastructure
- Waste Management Facilities
- Emergency and Recovery System
- Energy Infrastructure
- Earth Monitoring and Measurement Network
Pre-Cast or Cast In Place RCB?
Infrastructure of sustainable Community

- **Sustainable communities** are communities planned, built, or modified to promote sustainable living. They tend to focus on environmental sustainability (including development and agriculture) and economic sustainability. Sustainable communities can focus on sustainable urban infrastructure and/or sustainable municipal infrastructure.
Sustainable Community Infrastructure Planning

- Smart Location
- Proximity to water and wastewater infrastructure
- Reduced automobile dependency
- Bicycle network
- Housing, jobs and school proximity
- Compact development
- Diversity of uses
- Walkable streets
- Transit facility
- Transportation demand management
- Access to public spaces
- Community outreach and development
Measuring Sustainable Communities
Green Roads

- Project requirements
- Environment and water
- Access and equity
- Construction activity
- Material and resources
- Pavement technology
Green Roads Project Requirements

- Environmental review process
- Lifecycle cost analysis
- Lifecycle inventory
- Noise mitigation plan
- Waste management plan
- Pollution prevention plan
- Pavement management system
- Site maintenance plan
- Educational outreach

Figure 4-44: EXAMPLE: This arterial street utilizes a vegetated swale to accept stormwater from the street. This green street also uses sidewalks made from pervious concrete.
Green Roads
Environment and Water

- Runoff flow control
- Runoff quality
- Stormwater cost analysis
- Site vegetation
- Habitat restoration
- Ecological connectivity
- Light pollution
Green Roads
Access And Equity

- Safety audit
- Intelligent transportation systems
- Traffic emission reduction
- Pedestrian access
- Bicycle access
- Transit and HOV access
- Scenic views
Green Roads
Construction Activities

- Site recycling plan
- Fossil fuel reduction
- Equipment emission reduction
- Pavement emission reduction
- Water use tracking
- Contractor warranty
Green Roads
Material and Resources

- Lifecycle assessment
- Pavement reuse
- Earthwork balance
- Tire Rubber Modified Surface Seal (TRMSS)
- Recycled materials
- Regional materials
- Energy efficiency
Green Roads Pavement Technologies

- Long-Life pavement
- Permeable pavement
- Cold In place pavement
- Quiet pavement
- Rubberized Emulsion Aggregate Slurry (REAS)
- Asphalt Rubber Hot Mix (ARHM) Overlay
Challenges

- Inadequate ROW
- First costs can be challenging when dealing with tight budgets.
- Risk aversion from both the public and private sectors to doing something new.
- Need to make business case that sustainable infrastructure make sense.
- Must have flexibility in design.
- Politics and Public Support
- Operation and Maintenance adaptation
Sustainable Water Infrastructure

A sustainable water infrastructure will require a cooperative strategy among all the key stakeholders and regulators, including water, wastewater and stormwater service providers, as well as local, state and federal agencies.
Sustainable Water Infrastructure

- Transparency
- Holistic approach
- Full cost pricing
- Security and emergency preparedness
- Stewardship
- Asset management
- Public outreach and stake holder involvement
- Conservation and water efficiency
- Climate change mitigation and adaptation
- Research and technological, managerial innovation
- Advanced procurement and project delivery methods
- Watershed and regional optimization
Ground Water Replenishment System

- three-step process that includes reverse osmosis, which is used by manufacturers of bottled water, as well as microfiltration and ultraviolet light and hydrogen peroxide advanced oxidation treatment.
More Sustainable Applications

- Triple piping system
- Local wastewater treatment plant
- Reusing old piping for fiber optic cables
- Diverting stormwater to sewer system during dry season
- Using water from cooling tower for irrigation
- Traffic calming design