Envision Emerges

A new way to track bridge sustainability available for owners, project teams

by Emily Lorenz

Envision,™ a rating system for sustainable infrastructure and developed by the Institute for Sustainable Infrastucture (ISI), was first released for public comment in July 2011. ISI is a non-profit organization founded jointly by the American Council of Engineering Companies (ACEC), the American Public Works Association (APWA), and the American Society of Civil Engineers (ASCE). Shortly after this first public-comment period, the Zofnass Program for Sustainable Infrastructure at Harvard University partnered with ISI to further develop the Envision rating system. Project certification under the Envision rating system began in September 2012.

The intent of the Envision rating system is to standardize evaluation of the sustainability of infrastructure projects. It is applicable to projects in sectors such as energy, water, waste, transportation, landscaping, and information. In the transportation sector, project types that can use Envision include airports, roads, highways, railways, public transit facilities, and bridges.

Infrastructure is critical to a functioning society. It enables humans to have clean drinking water, travel between our homes and work, and ensures a reliable energy supply. However the earth's resources are not infinite, and thus to maintain sustainable development, we must attempt to reduce negative environmental, economic, and social impacts in infrastructure design. The Intergovernmental Panel on Climate Change defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Similar to other green or sustainability rating systems, credits are grouped in categories related to environmental, social, and economic impacts. A total of 60 credits are distributed across five categories, each of which is explored further in the following sections. Within each credit, point levels are set based on meeting different levels of achievement, and points are weighted within Envision based on the importance of the credit related to overall infrastructure sustainability.

An assessor assigned to the project will determine the level of achievement that the project team has reached for each individual credit using a predetermined set of evaluation criteria. The level of achievement for the entire project is determined by the number of points achieved in the different credit categories. Envision levels of achievement include:

- Improved
- Enhanced
- Superior
- Conserving
- Restorative

In the following sections, all credits and their intents are listed. However due to space limitation, only some of the credits to which concrete bridges can contribute are discussed in more detail.

Table 1–Quality of Life Credits and Intents

Credit Category	Credits	Intent
Purpose	QL1.1 Improve community quality of life	Improve the net quality of life of all communities affected by the project and mitigate negative impacts to communities
	QL1.2 Stimulate sustainable growth and development	Support and stimulate sustainable growth and development, including improvements in job growth, capacity building, productivity, business attractiveness, and livability
	QL1.3 Develop local skills and capabilities	Expand the knowledge, skills, and capacity of the community workforce to improve their ability to grow and develop
Well Being	QL2.1 Enhance public health and safety	Take into account the health and safety implications of using new materials, technologies, or methodologies above and beyond meeting regulatory requirements
	QL2.2 Minimize noise and vibration	Minimize noise and vibration generated during construction and in the operation of the constructed works to maintain and improve community livability
	QL2.3 Minimize light pollution	Prevent excessive glare, light at night, and light directed skyward to conserve energy and reduce obtrusive lighting and excessive glare
	QL2.4 Improve community mobility and access	Locate, design, and construct the project in a way that eases traffic congestion, improves mobility and access, does not promote urban sprawl, and otherwise improves community livability
	QL2.5 Encourage alternative modes of transportation	Improve accessibility to non-motorized transportation and public transit. Promote alternative transportation and reduce congestion
	QL2.6 Improve site accessibility, safety, and wayfinding	Improve user accessibility, safety, and wayfinding of the site and surrounding areas
Community	QL3.1 Preserve historic and cultural resources	Preserve or restore significant historical and cultural sites and related resources to preserve and enhance community cultural resources
	QL3.2 Preserve views and local character	Design the project in a way that maintains the local character of the community and does not have negative impacts on community views
	QL3.3 Enhance public space	Improve existing public space including parks, plazas, recreational facilities, or wildlife refuges to enhance community livability

Quality of Life (QL)

Strategies in this category relate to a project's impact on the community. Broad credit categories include purpose, well being, and community. Table 1 lists the credits in this category and their intents. Two strategies in the Quality of Life category that relate to concrete bridges are explained in more detail in the following sections.

QL2.3 Minimize light pollution

The metric for this credit is that "lighting meets minimum standards for safety but does

Table 2–Resource Allocation Credits and Intents

Credit Category	Credits	Intent
Materials	RA1.1 Reduce net embodied energy	Conserve energy by reducing the net embodied energy of project materials over the project life
	RA1.2 Support sustainable procurement practices	Obtain materials and equipment from manufacturers and suppliers who implement sustainable practices
	RA1.3 Use recycled materials	Reduce the use of virgin materials and avoid sending useful materials to landfills by specifying reused materials, including structures and material with recycled content
	RA1.4 Use regional materials	Minimize transportation costs and impacts and retain regional benefits through specifying local sources
	RA1.5 Divert waste from landfills	Reduce waste, and divert waste streams away from disposal to recycling and reuse
	RA1.6 Reduce excavated materials taken off site	Minimize the movement of soils and other excavated materials off site to reduce transportation and environmental impacts
	RA1.7 Provide for deconstruction and recycling	Encourage future recycling, up-cycling, and reuse by designing for ease and efficiency in project disassembly or deconstruction at the end of its useful life
Energy	RA2.1 Reduce energy consumption	Conserve energy by reducing overall operation and maintenance energy consumption throughout the project life cycle
	RA2.2 Use renewable energy	Meet energy needs through renewable energy sources
	RA2.3 Commission and monitor energy systems	Ensure efficient functioning and extend useful life by specifying the commissioning and monitoring of the performance of energy systems
Water	RA3.1 Protect fresh water availability	Reduce the negative net impact on fresh water availability, quantity, and quality
	RA3.2 Reduce potable water consumption	Reduce overall potable water consumption and encourage the use of gray water, recycled water, and storm water to meet water needs
	RA3.3 Monitor water systems	Implement programs to monitor water systems performance during operations and their impacts on receiving waters

not spill over into areas beyond site boundaries, nor does it create obstrusive [*sic*] and disruptive glare." Concrete bridges can contribute to this credit because light-colored concrete requires fewer lights for the same amount of visibility. This reflectability also reduces energy costs associated with outdoor lighting because more reflective surfaces reduce the amount of fixtures and lighting required. Concrete bridges can reduce outdoor lighting requirements and can contribute to lessening the associated light pollution.

QL2.4 Improve community mobility and access

For this credit, the metric is "extent to which the project improves access and walkability, reductions in commute times, traverse times to existing facilities and transportation." This all must be considered while improving user safety and considering all modes of transportation, such as personal vehicle, commercial vehicle, transit and bike/pedestrian. There are synergies between reducing environmental impacts and reducing construction-related user delays. During initial construction, various concrete bridge types can minimize on-site construction activities, thereby lessening the amount of time that drivers are inconvenienced. Likewise, by choosing a concrete bridge that has greater durability and fewer maintenance requirements, user delays during the service life of the bridge can also be reduced. This in turn reduces energy consumption of user vehicles and the resultant emissions to air.

Leadership (LD)

Strategies in this category relate to incentivizing more-credible management and leadership related to a project's sustainability. Broad credit categories include collaboration, management, and planning. Most of the strategies in the Leadership category relate to the project team, thus aren't as related to the structural system chosen for a bridge. There are bridges where stakeholder input (LD1.4) has guided the selection of the structural system. However, no strategies in the Leadership category are explained in more detail in this article.

Resource Allocation (RA)

Strategies in this category relate to reducing a project's embodied energy and use of virgin, non-renewable resources. Broad credit categories include materials, energy, and water. Table 2 lists the credits in this category and their intents. Four strategies in the Resource Allocation category that relate to concrete bridges are explained in more detail in the following sections.

RA1.3 Use recycled materials

To achieve this credit, projects must use a "percentage of project materials that are reused or recycled." Concrete bridges can contribute to this credit by using industrial wastes such as fly ash, slag cement, and silica fume as part of the cementitious materials—with certain aesthetic (color) and early compressive strength considerations. This strategy reduces the environmental impact of the concrete and also uses by-product materials that may otherwise be disposed of in a landfill.

RA1.4 Use regional materials

The metric for this credit is "percentage of project materials by type and weight or volume sourced within the required distance." For concrete, the distance requirement is 100 miles. Using local materials reduces the environmental impact (energy and emissions) related to transporting heavy building materials. Most concrete plants (ready-mixed and precast) are close to project sites, and likewise the cement, aggregates, and reinforcing steel used to make the concrete, and the raw materials to manufacture cement, are usually obtained or extracted from local sources.

RA1.5 Divert waste from landfills

For this credit, the metric is "percentage of total waste diverted from disposal." Precast concrete girders can be reused when bridges are expanded, and concrete can be recycled as road base, fill, or aggregate in new concrete at the end of its useful life. Concrete pieces from demolished structures can be reused to protect shorelines. Most concrete from demolition in urban areas is recycled and not placed in landfills. Also important is that concrete generates a small amount of waste with a low toxicity.

RA1.7 Provide for deconstruction and recycling

To contribute to this credit, the project must use a "percentage of components that can be easily separated for disassembly or deconstruction." Precast concrete bridge girders can be reused for pedestrian crossings or other applications. To reuse components effectively,

Table 3–Climate and Risk Credits and Intents

Credit Category	Credits	Intent
Emission	CR1.1 Reduce greenhouse gas emissions	Conduct a comprehensive life-cycle carbon analysis and use this assessment to reduce the anticipated amount of net greenhouse gas emissions during the life cycle of the project, reducing project contribution to climate change
	CR1.2 Reduce air pollutant emissions	Reduce the emission of six criteria pollutants: particulate matter (including dust), ground level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, lead, and noxious odors
Resilience	CR2.1 Assess climate threat	Develop a comprehensive Climate Impact Assessment and Adaptation Plan
	CR2.2 Avoid traps and vulnerabilities	Avoid traps and vulnerabilities that could create high, long-term costs and risks for the affected communities
	CR2.3 Prepare for long-term adaptability	Prepare infrastructure systems to be resilient to the consequences of long-term climate change, perform adequately under-altered climate conditions, or adapt to other long-term change scenarios
	CR2.4 Prepare for short-term hazards	Increase resilience and long-term recovery prospects of the project and site from natural and man-made short-term hazards
	CR2.5 Manage heat islands effects	Minimize surfaces with a high solar reflectance index (SRI) to reduce localized heat accumulation and manage microclimates

engineers need to be able to determine the residual service life of the components. Precast concrete construction provides the opportunity to disassemble the bridge should its use or function change, and the components can be reused in a different application. These characteristics of precast concrete make it sustainable in two ways: by diverting solid waste from landfills and by reducing the depletion of natural resources and production of air and water pollution caused by new construction.

Other ways that the concept of reuse is facilitated with concrete components are as follows:

- Concrete pieces from demolished structures can be reused to protect shorelines and create fisheries.
- Wood forms can generally be used 25 to 30 times without major maintenance while fiberglass and steel forms have significantly longer service lives.

Natural World (NW)

Strategies in this category relate to a project's impact on biodiversity. Broad credit categories include purpose, well being, and community. Most of the strategies in the Natural World category relate to where the project is located, thus aren't as related to the structural system chosen for a bridge. The use of longer spans, segmental construction, or top down construction can be used to minimize the impact at ground level, however, no strategies in the Natural World category are explained in more detail in this article.

Climate and Risk (CR)

Strategies in this category relate to minimizing emissions and ensuring a project is resilient. Broad credit categories include emissions and resilience. Table 3 lists the credits in this category and their intents. Four strategies in the Climate and Risk category that relate to concrete bridges are explained in more detail in the following sections.

Resilience

Credits CR2.1, CR2.3, and CR2.4 relate to the ability of a structure to withstand, and continue to function to some degree, after a natural or man-made disaster. The metric for each of these credits is as follows:

- CR2.1 Assess climate threat: prepare a plan that is a "summary of steps taken to prepare for climate variation and natural hazards."
- CR2.3 Prepare for long-term adaptability: "the degree to which the project has been designed for long-term resilience and adaptation."
- CR2.4 Prepare for short-term hazards: "steps taken to improve protection measures beyond existing regulations."

Concrete bridges can contribute to these three credits because concrete structures are resistant to tornados, hurricanes, wind, floods, and earthquakes. Concrete can be economically designed to resist tornadoes, hurricanes, and wind.

In general, concrete is not damaged by water; concrete that does not dry out continues to gain strength in the presence of moisture. Concrete submerged in water only absorbs very small amounts of water even over long periods of time, and typically this water does not damage the concrete.

Concrete structures can be designed to be resistant to earthquakes. Appropriately designed concrete systems have a proven capacity to withstand major earthquakes.

CR2.5 Manage heat islands effects

The metric for this credit is "[maximize] surfaces with a high solar reflectance index (SRI) to reduce localized heat accumulation and manage microclimates." Concrete without added pigment can meet the high SRI value (29) required in this credit. Concrete bridges provide reflective surfaces that minimize the urban heat island effect and contribute to this credit. Urban heat islands are primarily attributed to horizontal surfaces, such as roads, decks, and walkways, which absorb solar radiation. Two methods of mitigating heat islands are providing shade and increasing albedo. Using materials with higher albedos (solar reflectance values), such as concrete, will reduce the heat island effect, save energy, and improve air quality.

Application

Project teams use the assessment tools provided by the Envision system to evaluate the community, environmental, and economic benefits of projects. Currently two tools are available, with two new tools projected for release after 2012. The available tools include the following:

- Stage 1—Self-assessment checklist: this tool can be used for educational purposes or to track project progress related to sustainability.
- Stage 2—Third-party, objective rating verification: in this scenario, the project team's assessment is validated by an independent, third-party verifier. This allows for public recognition of the project. Using this tool, projects can earn points in 60 potential credits within the five credit categories. A

EDITOR'S NOTE

More information on this rating system can be found at www.sustainableinfrastructure.org.