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Cooper River Bridge, U.S.A.

Case Study 12

Aspects of Sustainability

This project highlights the following:

Social Aspects

Human Resources

Corporate Community Involvement

Business Ethics

Health and Safety

Environmental Aspects

Energy and Climate

Materials

Ecosystems

Local Impacts

Economic Aspects

Project Selection

Supply Chain

Value Added

The Cooper River Bridge, South Carolina, U.S.A., was constructed to replace two obsolete bridges over the Cooper River and strived to benefit surrounding communities, the local economy, and protect and enhance wetland environments.

Project Introduction

The Arthur Ravenel Jr. Bridge, also known as the Cooper River Bridge, is a cable-stayed bridge over the Cooper River in South Carolina, U.S.A., connecting Charleston city with the town of Mount Pleasant. The bridge was opened to traffic in July 2005 and replaced two inadequate truss bridges that had deteriorated due to poor maintenance. The old bridges were too narrow for modern vehicles, had weight restrictions and were too low to accommodate large shipping vessels. The bridges were also considered unsafe with limited emergency access and central reservations, steep gradients and one of the bridges rated 4 out of 100 for safety and integrity in 1995.

The Palmetto Bridge Constructors consortium (PBC), which consisted of Tidewater Skanska and Flatiron Constructors, was awarded the design and construction contract by the South Carolina Department of Transport (SCDOT) in 2001. The US$540 million bridge project carries Highway 17 over the Cooper River and consists of a 4km eight-lane highway, bicycle and pedestrian path and two interchanges. The bridge is North America's longest cable-stay bridge with a span of 471m and was constructed using the design-build approach, meaning that construction progressed before the complete design had been finalised. PBC completed the bridge one year ahead of schedule and approximately US$150 million under budget.

Social and environmental considerations were fundamental to the project, which connects Charleston and Mount Pleasant with approximate populations of 100,000 and 50,000 respectively, and 75% of the span was constructed over or adjacent to sensitive wetland environments. In 2005 the American Road & Transportation

Builders Association awarded the project first place in both the PRIDE Award for community relations and the Globe Award for excellent standards of environmental protection and enhancement.

Contributing Toward Sustainable Development

The SCDOT and PBC worked closely with stakeholders in an innovative and proactive manner, through dialogue and partnerships, to quickly resolve social and environmental issues and maximise socio-economic benefit. The bridge has enhanced local communities by improving safety, accessibility, visual aesthetics, sustainable transport provision and reducing noise disturbance. The new bridge is also durable and is designed to meet the predicted future needs of the Charleston area. The regional economy has been enhanced by the prioritisation of local workers and suppliers during construction, enhancement of sea trade opportunities, reduction of transport times, and stimulation of real estate investment and tourism. The environment has been protected and enhanced by employing high environmental construction standards, restoring wetland environments, creating marine habitats and reducing air and light pollution.

Social Aspects

Stakeholder dialogue

SCDOT and PBC encouraged stakeholder dialogue throughout the build-design process by conducting interviews and meetings with impacted residents and stakeholders to understand their needs and concerns. Following stakeholder dialogue, more local employment was provided, the pedestrian and cycle lane was incorporated into the design, plans for light beacons on the towers were abolished and the diamond tower design was selected from other options.

Stakeholder communication

A Community Bridge Office was opened adjacent to the project's right-of-way to act as a public information point, and the SCDOT and PBC delivered over 500 project presentations to local organisations, businesses, schools and community groups. To continuously update stakeholders, door-to-door project updates were delivered, media agencies were given regular updates and tours, and project information was posted on an official website (www.cooperriverbridge.org). Following completion of the project, information signage was placed at the entrances of the pedestrian walkway to inform the public about the bridge and the social and environmental considerations made.

Local authority partnerships

An interagency task force to guide specific activities and expedite the permit process was established by the SCDOT, which included the U.S. Coast Guard to approve the bridge's specifications and the U.S. Army Corps of Engineers to oversee the demolition of the old bridges. The U.S. Fish and Wildlife Service and the South Carolina Office of Ocean and Coastal Resource Management were involved in protecting and enhancing wetland habitats. The task force contributed toward improved cross agency communication and relationships, which may benefit future collaboration.

Community mitigation plan

A mitigation plan was developed with the local authorities to enhance affected local communities during construction. The plan focused on providing local employment and education opportunities, drainage and lighting improvements, the enhancement of parks and green spaces and the provision of affordable housing, which included the donation and relocation of 9 affected buildings of historic significance to the authorities. Local authorities have continued this work with a project to redevelop the low-income communities around the bridge intersections, which aims to reconnect communities that were divided by the old bridges, provide safer public spaces and affordable housing, construct connecting bicycle infrastructure and create economic opportunities.

Improved highway safety

The new bridge is safer for motorists than the old bridges, with more gentle gradients, wider lanes, central reservations, emergency access lanes, traffic monitoring cameras and emergency phones. Since 2006 there have been an average of 1.2 injuries on the new bridge compared to a 1.6 monthly injury average on the old bridges since 1990, and as of April 2007 there have been no fatalities on the new bridge.

Improved accessibility and traffic flow

The bridge has improved accessibility between Charleston and Mount Pleasant for commuters and businesses by increasing vehicle capacity and enhancing driving conditions. Average daily commuting time during rush hour has been

reduced by approximately 5 to 10 minutes as traffic now flows more smoothly. Motorists can also better predict travel times due to reduced congestion and disruption caused by traffic incidents, which often gridlocked the old bridges. A US$16 million traffic monitoring system, with sensors, cameras and radar, has been installed to inform motorists of bridge traffic and weather conditions on boards at bridge access points.

Visual aesthetics

The old bridges had extensive metal deterioration caused by a lack of maintenance and were considered unsightly by many local people. In comparison the new bridge is modern, has a design life of 100 years and the signature diamond-shaped towers have become a striking regional landmark. The bridge's white and grey colours also match regional historic buildings and the designs were refined by local architects, and in a series of public meetings to reflect local aesthetics.

Reduced noise disturbance

Quality of life has been improved for local residents by less noise disturbance caused by the new bridge. One of the old bridges disturbed neighbouring communities with loud noises made when cars ran over the joints between two sections of the bridge.

Promoting sustainable transport

The new bridge has significantly improved cycle and walking access across the Cooper River and the pedestrian walkway and cycle lane are popular recreational and commuter routes.

Occupational safety

Safety was a fundamental consideration of the project and all site workers were provided with specialised training, safety equipment and regular on-site safety meetings. Regrettably though, one construction worker died when he accidentally fell after prematurely unclipping his safety harness in preparation for his lunch break.

Community charitable contributions

SCDOT and PBC helped to contribute approximately US$210,000 to local communities by fundraising for various causes. Other donations included a new basketball court laid for a local school and Christmas gifts to local families.

Bridge durability

The Cooper River Bridge is intended to last a century and has been designed to withstand the shipping accidents and natural disasters that have occurred in Charleston's history. The towers are flanked by rock islands to prevent ship collisions and the span is designed to endure wind in excess of 480 km per hour, which is far stronger than the worst storm in Charleston's history, Hurricane Hugo in 1989. The Bridge is also designed to withstand an earthquake to approximately 7.4 on the Richter scale without total failure.

Future need

The Cooper River Bridge has been designed to meet the predicted future need of 100,000 vehicle trips per day by 2030, as estimated by a government study.

Economic Aspects

Project finance

The State Infrastructure Bank, the Federal Highway Administration and the State Ports Authority Board contributed US$325 million, US$96.6 million and US$45 million to the project respectively. SCDOT secured a US$215 million federal loan and Charleston County has committed US$3 million a year for 25 years to finance the project.

Local construction employment

At the peak of construction, PBC employed 600 workers and over 150 subcontractors. Local construction workers were prioritised through an initiative that specifically targeted disadvantaged people and provided vocational training and employment.

Vocational training

The Community Bridge Office acted as an employment office, which offered pre-employment, on-the-job training and school-to-work programmes. Over 80 disadvantaged local people underwent two-weeks pre-employment training before spending one year training as a welder, carpenter, surveyor or operator with an experienced mentor. SCDOT also established a transportation career programme for secondary school students that offered 20 technical college scholarships to local inner-city youngsters. Approximately US$1.2 million was spent on training programmes.

Local construction suppliers and materials

Suppliers were selected through a location hierarchy that prioritised Charleston companies before, county, state and national suppliers. The largest local contract was for 250,000 cubic meters of concrete, which was provided by the Wando Concrete Company.

Increased sea trade

Charleston is the fourth largest container port in the US, however the low clearances of the old bridges limited access to three of Charleston's four shipping terminals. The new bridge has greater clearance and large container ships are now able to access all Charleston's shipping terminals, which has increased the port's competitiveness and benefited businesses throughout South Carolina. Between 2005 and 2008 the port authority is expected to invest more than US$150 million in terminal improvements to further improve capacity.

Stimulating real estate investment

The old bridges acted as a "psychological barrier" to investment in Mount Pleasant. The new bridge has increased real estate prices and stimulated extensive residential and commercial property development in the area. However, one of the long-term goals is to minimise residential gentrification by building affordable housing.

Tourism promotion

Improved accessibility across the river has boosted visitor numbers to attractions in Mount Pleasant, and has increased the time and money tourists spend in the Charleston area. The artificial reefs created from demolished bridge material have promoted scuba diving and recreational fishing. The Cooper River Bridge has also become a tourist attraction in itself, with pedestrian access and scenic views of Charleston and the harbour.

Environmental Aspects

Environmental considerations during construction

PBC and SCDOT environmental specialists conducted inspections throughout the project and environmental impacts during construction were minimised through a range of measures. Best Management Practices ensured that routines were followed for controlling site runoff, disposing of waste and in the event of accidental spillages or leaks. To minimise river impacts all hydraulic systems that operated near water used biodegradable oil, protective curtains confined water disturbance from excavations and temporary platforms were constructed to limit permanent impacts to less than 0.32 hectares of wetlands and temporary disturbance to 2 hectares. Noise minimisation methods were used to diffract, absorb and reflect noise from construction activities.

Environmental design

Models and simulations were used to assess how specific bridge design features would influence natural systems in the Charleston estuary, with the aim of minimising environmental disturbance.

Wetland restoration

Following the construction of the bridge, disturbed wetlands were restored to their natural condition and sections of the old bridges were excavated and rehabilitated to wetlands. If original areas could not be restored, SCDOT allocated mitigation banks to compensate.

Artificial reef creation

Over 80 percent of the material from the demolished bridges was used to create artificial reefs near Charleston and along the South Carolina coast.

Tree relocations

Around 20 mature trees affected by the project were relocated to Charleston and Mount Pleasant at the request of local people.

Minimising habitat disturbance

Bridge lighting was designed to minimise potential impacts on nesting loggerhead sea turtles and migratory birds, as animal experts feared that lighting could disturb animal habits. Bridge lights are turned off at night during the turtle-nesting season in order to reduce disturbance.

Minimising light pollution

Light pollution is minimised by using dimmed and specially designed lighting on the bridge and its interchanges following public concern over light pollution and reduced night sky visibility. An automated system is used to control and reduce light intensity by approximately 40%.

Reduced air pollution

Less air pollution is produced as the new bridge and interchanges promote free flowing traffic and are less prone to congestion during rush hours.

Erosion control programme

The erosion control programme was primarily carried out during the construction of the Upstream gas gathering pipelines to prevent soil erosion along the cleared tracks of forest, and to restore sections of disturbed rainforest. The programme involved constructing temporary barriers on slopes to prevent soil erosion due to rain or construction machinery. During excavation the natural soil grading was carefully maintained

by the classification and segregation of excavated material, orderly backfill and suitable compaction. Reforestation was conducted immediately after construction to minimise soil erosion and only native species were used in order to maintain natural biodiversity.

Learning From Good Practice

The SCDOT and PBC worked closely with local authorities and communities in an innovative and proactive manner to quickly resolve social and environmental issues encountered during the design-build process. Extensive stakeholder dialogue ensured that concerns were acknowledged at an early stage and prevented their escalation into serious issues. In response to stakeholder requests, more local employment was provided, the pedestrian and cycle lane was incorporated into the design, plans for light beacons on the towers were abolished and the diamond tower design was selected.