Asia-Pacific Projects Reduce Ecological Footprint While Improving Highway Infrastructure

- Case Studies

Highway improvement programs on two continents often share one objective: to minimize their transportation systems' ecological footprint by reducing carbon emissions, recycling materials, preserving forests, and protecting communities. This is the new hallmark of sustainable infrastructure projects that meet the needs of society today without compromising the ability of future generations to meet their own needs.

Although infrastructure is fundamental to maintaining and improving the quality of life, there is still a critical need for basic infrastructure on a global scale. The World Health Organization reports, for instance, that more than 1 billion of the world's nearly 6.5 billion people live in extreme poverty without access to clean drinking water. Roughly half the world's population now lives in urban areas, where services such as water, sanitation, power, transportation, communication, health, and education are inadequate to support the standard of living developed countries have come to expect.

Sustaining society through infrastructure means increasing the earth's capacity to support life while decreasing the demands placed on the earth's ecosystems and natural resources. Infrastructure professionals are challenged to meet these often conflicting goals on large-scale, high-profile projects in both developed and developing nations. Two recent highway projects underway in the Asia-Pacific region exemplify the innovative methods used to address sustainability issues while delivering best-in-class transportation solutions. Technology played a vital role in meeting these goals efficiently and effectively.

Improving Karnataka State Highways

Located in the south of India, Karnataka State has a population of 53 million people, with 30 percent living in urban areas and more than 5 million crowded into the capital city of Bangalore, the fastest-growing city in Asia. Karnataka currently has one of the lowest density road networks in India, where road density relative to population averages just 2.53 kilometers per 1,000 people compared to 22.68 per 1,000 in the United States. The Government of Karnataka's Public Works Department maintains a 17,075-kilometer state highway system that carries a major portion of the burgeoning traffic generated by economic and population growth. Carrying capacity has become severely compromised, with a whopping 77.5 percent of the system operating inadequate single-lane roads.

The second phase of the Karnataka State Highways Improvement Project (KSHIP-II) is part of an ongoing program to improve the state road network capacity, management and maintenance. The first project, initiated in 2001 with $360 million in funding from the World Bank, repaired and upgraded 2,985 kilometers of state roads. KSHIP-I was completed in 2007 at a cost of $474.5 million.

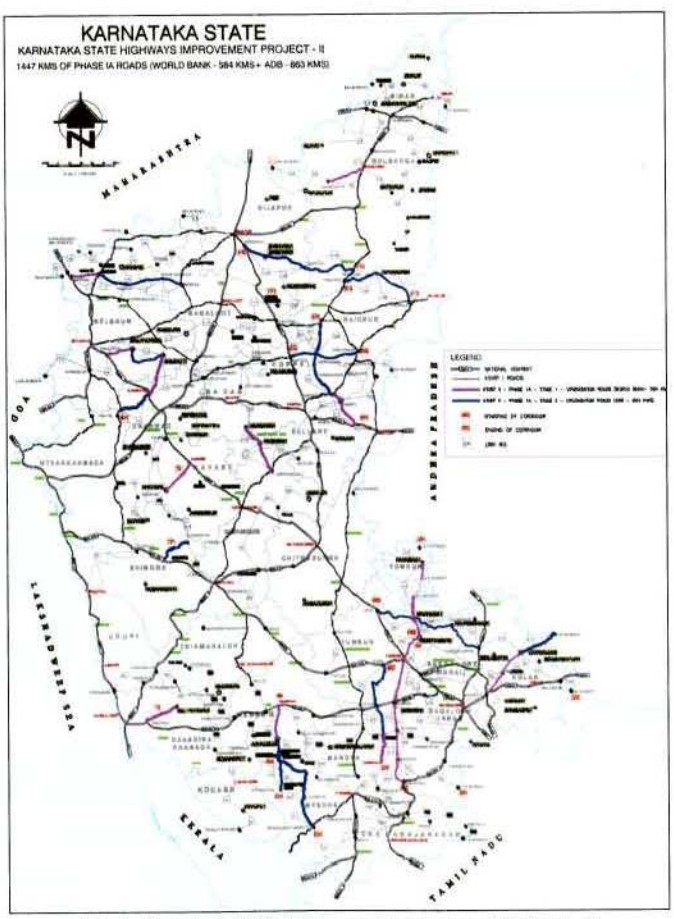

Fig 1: Karnataka State Highways Improvement Project - II

The second project, estimated at $1.1 billion, is improving 3,411 kilometers of highway, with the first of two phases to be completed by 2012.

In January 2007, the Public Works Department awarded the project to Scott Wilson India Pvt. Ltd. in joint venture with Scott Wilson Ltd. United Kingdom. Work began in March 2007 with the Phase 1A detailed project reports (DPRs) for 1,447 kilometers of roads, including 443 bridges, six railway crossings, and nine bypasses for major cities. One of the main objectives was to alleviate the current unsafe and congested conditions by providing better quality roads in a sustainable and environment-friendly manner.

"We have adopted a methodology to assess and predict the potential environmental impacts due to project activity and provide the means for prevention and mitigation of those impacts," said Venkat Sheela, principal engineer with Scott Wilson India in Bangalore. "Thus, we are enhancing the project benefits to the overall socio-economic growth of Karnataka State."

KSHIP-II will improve the quality of life for the citizens of Karnataka State by removing transportation barriers to growth, improving mobility and safety, and reducing costs for transportation and distribution of goods and services. Better roads leading to popular tourist destinations - from wild game sanctuaries at Bandipur to temples in Bijapur - will also generate more revenue from tourism.

With shorter travel times and fewer vehicles idling in traffic, the project is expected to lower vehicle operating costs and fuel consumption. The consequent reduction in carbon emissions will reduce the state highway system's impact on global warming. The Government of Karnataka is expected to claim carbon credits from the United Nations Framework Convention on Climate Change valued at $6 million.

Three additional strategies will minimize the ecological footprint of the improved state highway system. Using Bentley's MXROAD, an advanced modelling tool that enables the rapid and accurate design of all road types, the project team was able to conserve materials by retaining existing pavement in suitable sections, reusing existing soil/pavement as subgrade for new construction, and reducing overlay quantities. These measures will save an estimated $3 million in Phase 1A alone.

Extensive modelling of road alignments aided in forest preservation and wildlife protection in the forest reserves. In addition, more than 40,000 trees lining city avenues are impacted by the project. Widening the roads along one side only protected as many trees as possible. These efforts, combined with an aggressive afforestation program, will contribute to the carbon credit balance.

The state highways also pass through towns and villages where population densities vary dramatically. Through public awareness programs and consultation with stakeholders, the project team developed strategies to protect these communities, including improved road geometry and traffic-calming measures, adjusted alignments for bridges and railway crossings, reduced design speeds and adequate traffic signage, and nine major bypasses totaling 125 kilometers to circumvent severely congested urban centers.

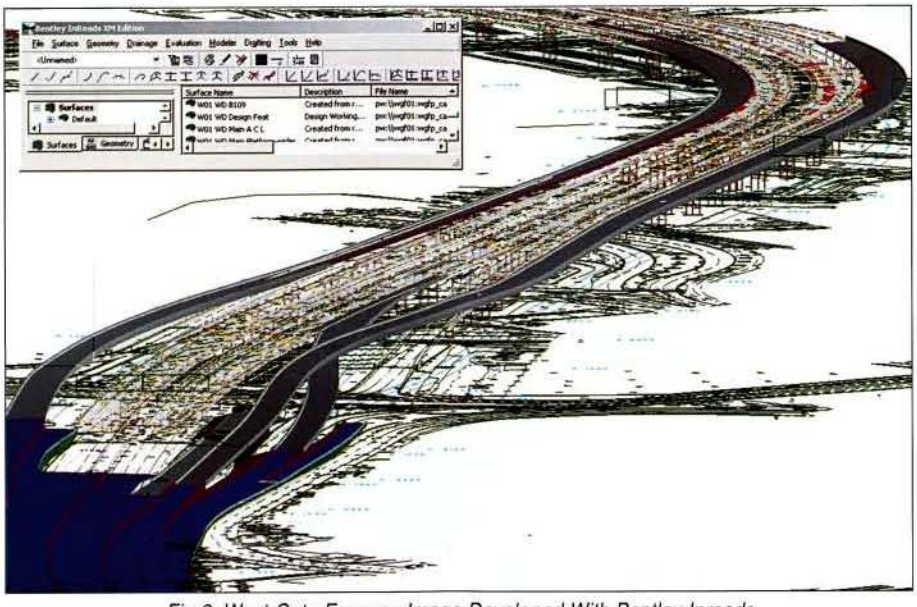

Fig 2: West Gate Freeway Image Developed With Bentley Inroads

Working within a managed environment, where Bentley solutions enabled rapid analysis of multiple alternative alignments, the project team completed Phase 1A alignment DPRs within 10 months. Upon completion, KSHIP-II will help meet the challenge of sustainability through infrastructure by improving the availability of transportation services in Karnataka State.

Upgrading West Gate Freeway In Australia

On the tip of Australia's southeast coast, Victoria State has a vision to connect its people, communities, and businesses through road and bridge improvements that enhance efficiency and accessibility of the arterial road network. The Monash-CityLink-West Gate Freeway upgrade in the capital city of Melbourne is the largest state-funded project. As part of the State Government's "Meeting Our Transport Challenges" strategy, the upgrade is estimated to cost $1.39 billion upon completion in 2010, but ultimately save $14.5 billion by providing more efficient travel for passengers and freight.

More than 160,000 vehicles, including 20,000 heavy freight vehicles, use this corridor each day, causing congestion and slow travel times. It now takes more than 50 minutes to drive 8.5 kilometers on the West Gate Freeway from Port Melbourne across the West Gate Bridge to Williamstown, compared to 35 minutes just five years ago. Estimated peak travel periods on the freeway have been lengthening by 10 percent per year, according to VicRoads, which manages 22,320 kilometers of Victoria's arterial road network for the Minister of Roads and Ports.

The Government of Karnataka is expected to claim carbon credits from the United Nations Framework Convention on Climate Change valued at $6 million.

The Monash-CityLink-West Gate upgrade is being delivered in four sections through a partnership between VicRoads and Transurban, an infrastructure developer/owner/operator based in Melbourne. Each section, in turn, is being planned, designed and constructed under alliance agreements and design/build contracts. The West Gate Freeway Upgrade Alliance consists of VicRoads, Baulderstone Hornibrook, Thiess, Parsons Brinckerhoff, and Hyder. The Alliance is charged with improving traffic flow and safety on a 5.5-kilometer section of the freeway that has a choke hold on Melbourne city center.

The $350 million in freeway upgrades include additional lanes in both directions, widening of existing structures, and creation of at least five new bridges - the longest spanning 1.3 kilometers. The major challenge is to reduce the number of merges and lane changes to improve safety, while increasing carrying capacity by about 50 percent. Designers were under pressure to deliver the design ahead of ongoing construction, which began in May 2008, as well as to accommodate construction under heavy traffic conditions. Using Bentley solutions, such as ProjectWise for document management and MicroStation for improved productivity, enabled the project team to address these goals in a 3D environment.

"By maximizing the use of 3D, the key issues of safety and traffic congestion were considered carefully throughout the design process," said Richard Tabe, Principal Road Designer at Parsons Brinckerhoff, part of the West Gate Freeway Alliance. "By taking into account the third dimension of the design, vehicle redirections were achieved to a consistently safe standard, while ensuring existing traffic conditions were maintained."

The freeway upgrade will shorten commutes through the city, to Melbourne airport, and to the Port of Melbourne. In addition, sustainability initiatives outlined in the "Meeting Our Transport Challenges" strategy required the design to provide better connectivity between all modes of transport, safer bike paths at grade intersections, and reuse of materials for construction.

The project used recycled crushed concrete in pavement materials, recycled high-density polyethylene drainage pipes along road shoulders, captured storm water runoff for dust suppression, and remediated excavated soil for landscaping. Installation of new, more durable and energy-efficient products will reduce the cost of maintenance and operations over the life of the freeway. These seemingly small measures work together to shrink the ecological footprint of this major transportation improvement program. By improving the services provided by the infrastructure assets, the West Gate Freeway upgrade will help improve the quality of life for the now and future citizens of Victoria.

As society expands infrastructure services to meet basic human needs and improve quality of life, public safety, and security, there is mounting global pressure to simultaneously be good stewards of the planet. Technology solutions played a key role in meeting the sustainability challenge in both of these projects.

Acknowledgement: The information presented here is based on text provided by "Bentley Systems, Incorporated, Mumbai."