

'Rapid Rehab' Accelerated Urban Highway Reconstruction: I-15 Devore Project Experience

Since 1998, the California Department of Transportation (Caltrans) has been implementing a Long-Life Pavement Rehabilitation Strategies (LLPRS) program to address the need for cost effective approaches to rebuilding 2,800 lane-km of aging pavements in the urban highway network. This case study presents an innovative fast-track reconstruction approach applied to a heavily trafficked LLPRS project on Interstate-15 (I-15) in Devore in southern California. A 4.5-km stretch of badly damaged concrete truck lanes was rebuilt in only two 210-hour (about 9 days) one-roadbed continuous closures (called "extended closures" hereafter), using counter-flow traffic and 24-hour operations. The same project would have taken 10 months using traditional nighttime closures.

Innovations adopted for this groundbreaking "Rapid Rehab" project also included:

- Automated Work Zone Information Systems (AWIS) to update travelers with the real-time travel information
- Quickchange Moveable Barrier (QMB) system with a dynamic lane configuration to minimize traffic disruption

- Mix design of rapid strength concrete (RSC) to enable the project to be opened to traffic 12 hours after placement,
- Web-based information system for disseminating project updates and surveying public perception,
- Incentive/disincentive provision to encourage the contractor to complete the closures on time, and
- Multifaceted outreach program to gain public support.

Engineers on the project used CA4PRS (Construction Analysis for Pavement Rehabilitation Strategies) incorporated with traffic simulation models to arrive at an optimal and economical rehabilitation closure scenario, construction schedule, and traffic management plan. The post-construction data validated the analysis and simulation estimates of productivity and traffic delay.

As a result of AWIS and public outreach, a 20 percent reduction in traffic demand through the construction work zone (CWZ) was achieved, thereby reducing the maximum peak-hour delay by 50 percent (45 minutes instead of the expected 90 minutes).





Figure 1. Location of project.

Surveys on the project website showed dramatic changes in public perception of the 'Rapid Rehab' approach of the extended closures from initial reluctance and objection to positive support.

Advantages of using this method of fast-track accelerated reconstruction included: a shorter period of disruption for the traveling public, 30-year life expectancy for the new pavement, improved safety for motorists and workers, and a 25 percent reduction in construction costs (\$6 million savings) when compared to traditional repeated nighttime closures.

PRE- AND POST-CONSTRUCTION EVALUATION

The I-15 Devore corridor has consistently high weekday commuter peaks and even higher volume (120,000 ADT) on weekends, when leisure travelers in the Los Angeles area often travel to and from Las Vegas and to resort locations along the Colorado River. The project scope was to rebuild a 4.5 km stretch of the damaged concrete slabs and base pavements with a new cross-section of 290-mm doweled slabs using rapid strength concrete and 150-mm AC base on top of the remaining aggregate base or native material. The I-15 northbound roadbed was closed for reconstruction first, switching traffic to the southbound side through median crossovers at the ends of the work zone. The

two directions of traffic shared the southbound lanes as "counter-flow traffic" separated by QMB. The same process was repeated for the reconstruction of the southbound direction.

The pre-construction analysis sought the most economical reconstruction closure scenario while integrating the competing concerns of construction schedule, traffic impacts, and agency cost. Four construction closure scenarios — 72-hour weekday, 55-hour weekend, one-roadbed continuous (24 hours per day, seven days per week), and 10-hour nighttime — were compared. The pre-construction analysis concluded that the extended closure was the most economical scenario.

Compared to traditional 10-hour nighttime closures, the extended closure scenario had about 80 percent less total closure time, about 30 percent less road user cost due to traffic delay, and about 25 percent less agency cost for construction and traffic control. Rehabilitation constructability issues comparing pavement design and material alternatives were reviewed from the perspective of production scheduling and traffic inconvenience. CA4PRS analysis was used to identify the costs associated with road user traffic delay in order to determine appropriate incentives and disincentives for the construction contract.

As a result of high project bids from the first round of construction bidding, the initial rehabilitation scope to reconstruct both truck lanes was altered to include reconstruction of only the outer truck lane and targeted slab replacement on the inner truck lane. The consequence of a five percent traffic volume increase as construction was delayed from spring to fall 2004 was significant: the estimated road user cost increased by 90 percent (from \$5 million to \$9.5 million) and the estimated maximum peak-hour queue delay increased from 75 to 90 minutes.

Contractor production rates exhibited a significant learning curve. The majority of the reconstruction operations during the southbound reconstruction (later in the project) showed 28 percent more rapid progress for slab removal and 22 percent more rapid progress for paving than those of the northbound reconstruction (earlier in the project). The continuous lane reconstruction on the outer truck lane had twice the productivity of the random slab replacement operation on the inner truck lane.

WORK ZONE TRAFFIC CONTROL

Use of QMB, at a cost of about \$1.5 million for one month's rental, helped to balance traffic impacts to commuters and weekend travelers by providing a dynamic lane configuration with one additional lane converted temporarily from the rehabilitated AC shoulder. The barrier was moved twice a day to accommodate peak directional traffic.

The Devore project represents the first implementation of AWIS in California for LLPRS projects. The system played a useful

role in informing motorists of real-time travel and detour route information. AWIS travel estimate information was posted on the permanent and temporary changeable message signs (CMS) that were strategically located at key decision points for roadway users. The information was also posted on the traffic roadmap on the project website as part of an interactive public outreach campaign. Surveys conducted on the project website indicated that the majority (72 percent) of visitors found the project information on the web useful for their trip planning. The impact of reconstruction closures on traffic was "acceptable" according to a traffic measurement study and web surveys conducted during and after the construction. The maximum peak delay was measured at about 75 minutes on weekends (northbound) and 45 minutes on weekdays (southbound) during the extended closures, compared to the predicted 90 minutes delay during weekdays with the assumption of a 10 percent reduction. The traffic demand through the CWZ was greatly reduced by diverting it to major freeway detour routes. I-10 eastbound was used as the I-15 northbound detour and showed 10 percent daily traffic volume increase with a peak of 36 percent in the morning peak hours. I-215 southbound was used as the I-15 southbound detour and showed about 15 percent daily volume increase. A total of 20 percent traffic demand reduction through the CWZ (15 percent more than the initial expectation) due to diversion and travel time changes was attributed to public outreach and automated traffic control efforts.

The I-15 Devore project combined conventional construction materials and operations with state-of-practice technologies to

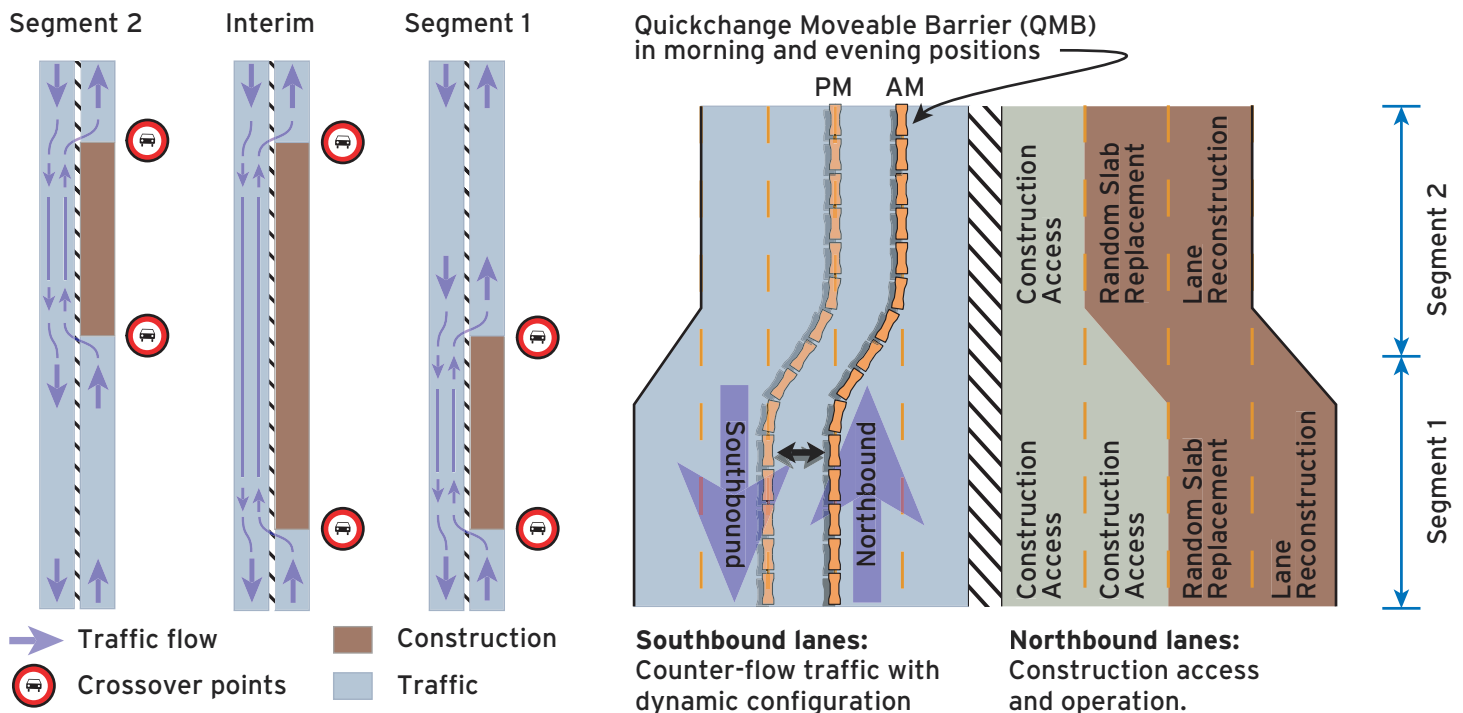


Figure 2. Dynamic lane configuration during northbound reconstruction; pattern was reversed for southbound lane reconstruction.

expedite construction and minimize adverse traffic impact. Additional features of the project which contributed to traffic control were:

- **A project command center** facilitated department coordination with other agencies and disciplines (construction, design, traffic, and public affairs) and monitored traffic and construction remotely on CCTV.
- **Caltrans shared information and received constructive feedback** from the local community through the High Desert Commuter Advisory Committee (HDCAC).
- **Caltrans funded a free commuter bus service** to promote ridesharing at a cost of \$65,000 with 14 buses from the High Desert to the south, which increased ridership by 40 percent.
- **The Construction Zone Enhanced Enforcement Program (COZEEP)** cost \$300,000 and was implemented with a total of 1,034 traffic citations issued during one month of construction by the California Highway Patrol.
- **The Freeway Service Patrol (FSP)** service removed 1,243 disabled vehicles from the CWZ at a cost of about \$100,000.

OUTREACH AND PUBLIC PERCEPTION

To achieve the goal of 20 percent reduction in traffic demand, Caltrans implemented an extensive public outreach program. Outreach materials included a comprehensive project brochure, construction flyers, a construction advisory electronic bulletin, fast-fax through email, a project information help hotline, and several public meetings for local communities. The project website was created with the cooperation of local agencies and the surrounding three Caltrans District Offices (Los Angeles, Orange, and San Diego) to provide up-to-date comprehensive project information. The project website had a total of about 100,000 views for three months before and during the extended closures and played an important role in gaining input from the public.

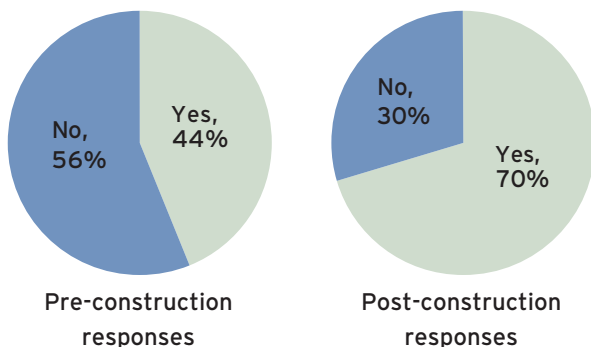


Figure 4. Change in public perception to support 'Rapid Rehab' construction.

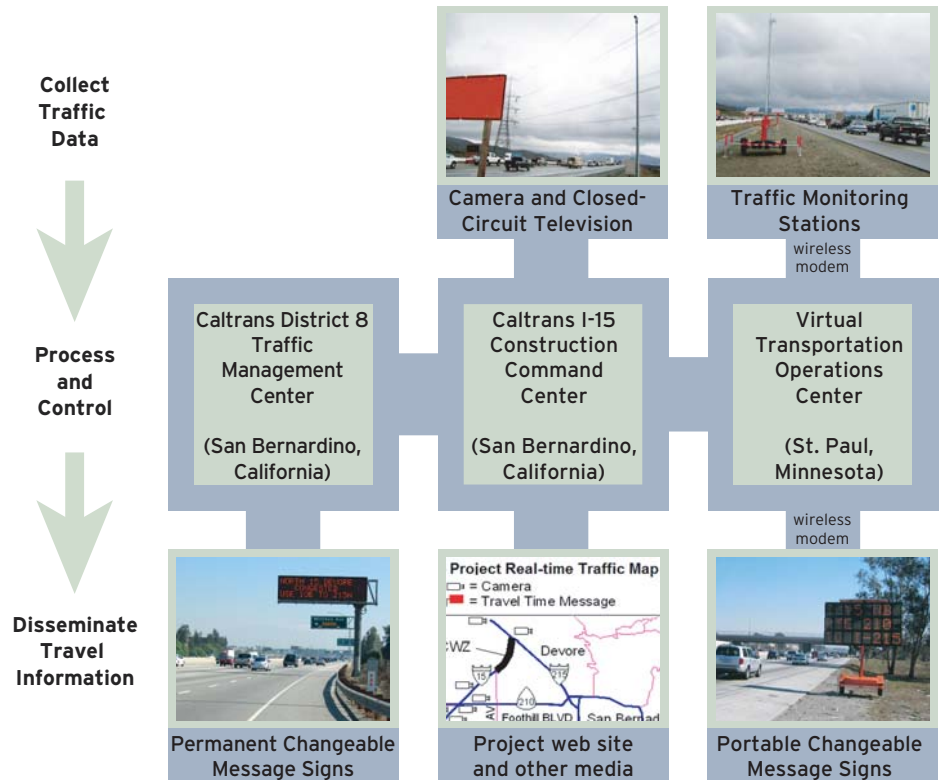


Figure 3. Automated Work Zone Information System (AWIS) framework.

Pre- and post-construction traffic web surveys were conducted to examine the public perception of the 'Rapid Rehab' approach. Of 400 pre-construction respondents, 64 percent expressed an initial preference for the traditional nighttime or weekend closures and 14 percent even requested to cancel the project. However, public perception substantially changed because of the public outreach efforts. Of the post-construction respondents, 70 percent expressed support for 'Rapid Rehab' projects. This result indicates that with the expectation of the benefits from accelerated project completion, the public is willing to bear increased construction cost in exchange for reduced construction schedules, thus mitigating the inconvenience of traffic disruption.

MORE INFORMATION

On the Web:

<http://www.dot.ca.gov/research/roadway/roadway.htm>

David K. Thomas, Design Chief (Design C)
 Caltrans District 8
 T: (909) 384-4118
 E: david_k_thomas@dot.ca.gov

Dr. E.B. Lee, Principal Investigator
 University of California at Berkeley
 Institute of Transportation Studies
 Pavement Research Center
 T: (510) 231-5693
 E: eblee@berkeley.edu