



REDARS™ DEMONSTRATION PROJECT FOR CALIFORNIA DEPARTMENT OF TRANSPORTATION, SACRAMENTO CA

- **Project to Enable Caltrans' Staff to Apply and Test REDARS™ 2 Software, and to Assess its Applicability to Caltrans' Future Statewide Seismic-Risk-Reduction Programs**

Introduction. Effects of earthquake damage to highway components (e.g., bridges, tunnels, roadways, etc.) can go well beyond life-safety risks and costs to repair the damaged components. Such damage can also disrupt traffic flows which, in turn, can impact the region's economic recovery and emergency response. These impacts will depend not only on the seismic performance of the components, but also on the characteristics of the overall highway system such as its network configuration and roadway-link characteristics (e.g., link locations, redundancies, and traffic capacities). Unfortunately, such traffic impacts are usually not considered in seismic-risk-reduction activities at state transportation departments. One reason for this has been the lack of a technically-sound and practical tool for estimating these impacts. Therefore, since the mid-1990s, the FHWA has sponsored multi-year seismic research projects at MCEER that have included development of such a tool. This has led to a new methodology for deterministic or probabilistic seismic risk analysis (SRA) of highway systems nationwide that is named REDARS™ (Risks from Earthquake Damage to Roadway Systems). This methodology was programmed into a software package (REDARS™ 2) that was released for public use during March 2006. It is further summarized in the companion handout titled *REDARS™ Software for Seismic Risk Analysis of Highway Systems*.

Demonstration Project Overview. A REDARS™ Demonstration Project was recently carried out for the California Department of Transportation (Caltrans), Sacramento CA. It began in July 2003 and was completed in June 2006. The purpose of this project was to enable Caltrans' staff to assess the applicability of the REDARS™ technology and software to Caltrans' future seismic-risk-reduction programs statewide. This was accomplished through a close collaboration between Caltrans' staff and the REDARS™ Group (RG), which includes the team of earthquake engineers, programmers, transportation network analysts, and risk analysts that had developed REDARS™ under the FHWA-MCEER project. This collaboration focused on:

- Enabling Caltrans' staff to systematically evaluate emerging SRA technologies and to gain an understanding of the REDARS™ 2 SRA methodology and software.
- Enabling the RG to improve the REDARS™ 2 methodology and software for California applications by developing a California-based earthquake model, an improved transportation network analysis procedure, and an improved component module. This included: (a) modification of the HAZUS99-SR2 fragility model for bridges subjected to ground shaking, in order to include retrofitted bridge performance and to also improve comparisons between the model's predictions of bridge damage during the 1994 Northridge Earthquake and bridge damage observations during that earthquake; (b) collaboration with Caltrans' engineering and maintenance staff to develop bridge repair models and tunnel, approach-fill, and roadway-pavement vulnerability models that represent Caltrans' post-earthquake repair experience and their construction and design practices; and (c) improvement of the REDARS™ transportation network analysis model to enable it to make trip demands responsive to traffic delays caused by earthquake-induced damage to the highway-roadway network, and to also include traffic flows from freight-carrying trips throughout the network.
- Enabling Caltrans' staff to use this improved software in a demonstration application to a Northern California testbed highway-roadway system that is located within the eastern and northern sections of the San Francisco Bay area. This application also served as a beta test of REDARS™ 2 by the Caltrans project staff.

For more information, contact Stu Werner of the REDARS™ Group (email: sdwerner@ix.netcom.com); phone: (510) 531-7489) or Mandy Chu of Caltrans (email: Mandy_Chu@dot.ca.gov); phone: (916) 654-7656)