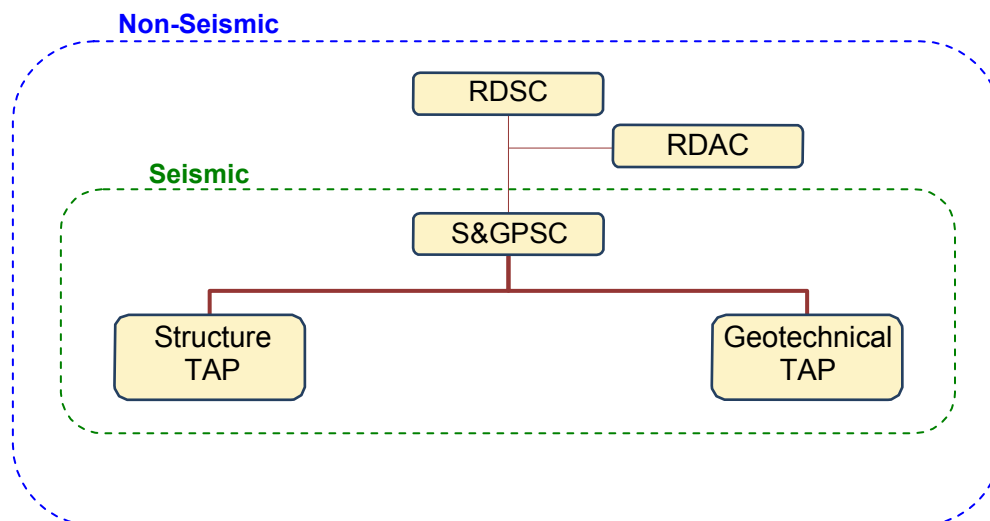


## The Division of Engineering Services Structure, Seismic and Geotechnical Research Program

**SUMMARY:** *The Division of Engineering Services (DES) manages a multi-million dollar problem-focused research program to investigate issues and develop results that can be deployed to meet Project Delivery and Department goals. This program utilizes practitioners to identify research needs and to provide technical support to research projects to ensure they meet Caltrans needs and can be deployed into practice. Cross-functional management level oversight committees have been created to provide broad strategic insight and to support the implementation of research into practice. DES Research Notes will be published and distributed regularly as a tool to communicate activities associated with the DES Research Program and to share research results.*

### Organizational Structure:

The Structure, Seismic and Geotechnical Research Program is managed in coordination between the Division of Engineering Services (DES) and the Division of Research & Innovation (DRI). Office-Chief level representatives from Structure Design, Geotechnical Services, Structure Maintenance & Investigations, Structure Construction, Materials Engineering and Testing Services, Design Technical Services, Earthquake Engineering, and DRI form the Structure and Geotechnical Technical Advisory Panels (TAPs). The TAPs are responsible for coordinating the research program, developing strategic research plans, evaluating and prioritizing research problem statements and research proposals, and sponsoring Technical Support Teams for guiding research projects and deploying results. The Structure & Geotechnical Research Program Steering Committee (S&GPSC) provides oversight and guidance to the TAP, reviews and approves prioritized research problem statements, oversees the development of strategic research plans, and approves funding for seismic research projects. The S&GPSC recommends funding priorities to the Department's Research & Deployment Steering Committee (RDSC) for non-seismic projects utilizing funds managed through DRI. The Research and Deployment Advisory Committee (RDAC) provides funding and program recommendations to the RDSC. The key to success of the Structure, Seismic and Geotechnical Research Program is practitioner participation throughout the process including the development of Problem Statements, evaluation of Research Proposals, providing technical support to ongoing research projects, and serving on work teams to deploy the results.



## **DES Structure, Seismic and Geotechnical Research Program Strategic Plan:**

The DES Structure, Seismic and Geotechnical Research Program has developed a Strategic Plan to help guide its management and operation and to ensure a focus on developing results that are deployed into practice.

<b>GOALS</b>	<b>OBJECTIVES</b>
<b>Ensure structure and seismic research effectively supports the goals of the Department and meets the needs of practicing bridge engineers.</b>	<ul style="list-style-type: none"> <li>• Involve practicing bridge engineers in multidisciplinary Work Teams to provide technical support throughout the research process from identifying problems to implementing results.</li> <li>• Utilize the Structure/Geotechnical Technical Advisory Panels (TAP) to advise and provide recommendations to the Structure &amp; Geotechnical Research Program Steering Committee (PSC) on structure, seismic and geotechnical research needs.</li> <li>• Utilize Management level oversight committees to develop strategic research objectives and allocate funds.</li> </ul>
<b>Develop overarching research thrust areas to create a framework for the development and evaluation of structure, seismic and geotechnical research proposals.</b>	<ul style="list-style-type: none"> <li>• Obtain input from DES Technical Committees and Offices, other Divisions, research institutions, and the Seismic Advisory Board.</li> <li>• Hold regular workshops with participants from academia, industry, and internal and external practicing bridge engineers to develop Structure and Geotechnical Research Roadmaps.</li> <li>• Develop Problem Statements focused on the needs identified in the Roadmaps.</li> </ul>
<b>Ensure the highest priority research is being investigated by the most qualified research institution.</b>	<ul style="list-style-type: none"> <li>• Develop a process to request research proposals that ensures responses from a large pool of capable research institutions.</li> <li>• Utilize the Structure and Geotechnical TAPs and PSC to review and prioritize research problem statements, and evaluate and approve research proposals.</li> <li>• Develop a comprehensive, objective procedure to evaluate research proposals.</li> <li>• Ensure a comprehensive literature search is conducted prior to beginning new research projects.</li> </ul>
<b>Ensure the successful evaluation and implementation of structure, seismic and geotechnical research results.</b>	<ul style="list-style-type: none"> <li>• Evaluate proposals based on the likelihood of the research resulting in recommendations that can be implemented into practice.</li> <li>• Require that research reports provide implementation recommendations.</li> <li>• Assign a multi-disciplinary Work Team to negotiate the final scope of work, provide technical support during the research project, evaluate final research reports, develop implementation recommendations, and assist with implementation through Caltrans Technical Committees or Technical Specialists.</li> <li>• Utilize Work Team members to assist other practicing bridge engineers in the implementation of final recommendations.</li> <li>• Effectively communicate research results which would include distributing and posting a database of completed, ongoing, and pending research online, inviting principal investigators to address technical</li> </ul>
<b>Develop and document an effective, efficient Structure, Seismic and Geotechnical research program process.</b>	<ul style="list-style-type: none"> <li>• Maintain a database tracking the status of structure, seismic and geotechnical research projects.</li> <li>• Perform regular progress reviews of ongoing research projects and verify their ongoing viability.</li> <li>• Use Project Management processes to ensure project costs are reasonable, and projects are completed in a timely manner.</li> <li>• Provide training to the Structure, Seismic and Geotechnical Research contract management team.</li> <li>• Define clear roles and responsibilities of contract managers, technical support team members, and research TAP and Steering Committee members.</li> <li>• Define deliverables for each research project.</li> <li>• Develop an abbreviated research process, which can quickly address urgent research needs.</li> <li>• Allocate personnel and travel resources to manage approved research projects.</li> </ul>
<b>Maintain strong internal and external lines of communication and forge strategic partnerships to support the Structure Research program.</b>	<ul style="list-style-type: none"> <li>• Develop and maintain a strong communication network with structure and seismic experts in academia, industry and practitioners to broaden the perspective of the program.</li> <li>• Sponsor structure research workshops or conferences to present results from recently completed or ongoing research.</li> <li>• Leverage research funds in collaborative efforts with other states, agencies, associations, organizations, and research institutions.</li> <li>• Participate and make presentations at technical conferences, workshops and symposiums.</li> <li>• Coordinate activities with other Divisions, Technical Advisory Panels and others that can help to advance the Structure, Seismic and Geotechnical Research program.</li> </ul>

## **Research Roadmap:**

In the Fall of 2005, the Division of Engineering Services held a one-day workshop with participation by DES practitioners, consultants and academia. This initial Roadmap has been updated and presented in multiple formats, but remains focused on these primary research areas.

### Structure TAP Roadmap Focus Areas:

STAP1	Improved Methods to Monitor and Assess the Performance of Existing Transportation Structures
STAP2	Extended Service Life of Highway Structures
STAP3	Reduced Impact of Structure Construction and Maintenance Activities on the Traveling Public (Accelerated Construction)
STAP4	Optimized and Validated New and/or Existing Materials, Systems and Components for Bridges and Highway Structures
STAP5	Improved Soil-Foundation-Structure-Interaction Analysis Tools, Techniques, and Methods
STAP6	Improved Seismic Analysis and Design Tools, Techniques, and Methods
STAP7	Improved Understanding of Seismic Hazards
STAP8	Improved Performance of Highway Structures to Earthquake and Other Man-made and Natural Extreme Events, and Improved Ability to Quickly Restore Facilities to Full Functionality
STAP9	Nationally Accepted Specifications Advanced for Implementation in California

### Geotechnical TAP Roadmap Focus Areas:

GTAP1	Improved Methods for Collecting, Storing and Disseminating Geotechnical Data
GTAP2	Improved Reliability and Consistency of Geotechnical Recommendations and Designs through the Development of Standardized Best Practices.
GTAP3	Development of a Comprehensive Risk Management Strategy for Geotechnical Hazards
GTAP4	Development of More Cost-Effective Foundations
GTAP5	Reduced Impact of Foundation Construction on the Environment

## **Current Research Projects:**

Currently the DES Research Program has over 60 research projects under contract. Topics currently under investigation include the following:

- Analytical Modeling
  - Effective System Damping
  - Suspension Bridge Modeling
  - Live Load Effects on Seismic Response
  - Skew Effects
  - Archive Toll-Bridge ADINA Models for Post-Earthquake Assessment
  - Caltrans Strong Motion Instrumentation Program
  - Multi-Support Response Spectrum/Near Fault Response Spectrum Analysis
  - Nonlinear Analysis
  - Battered Piles and Sloping Ground Analysis
- Post-Earthquake Capacity
  - Post-Earthquake Live Load Capacity
  - Post-Earthquake Emergency Repair with Fiber Reinforced Polymer (FRP) Composites
  - Next Generation Bridges with Improved Serviceability and Accelerated Bridge Construction (ABC)
  - Post-Earthquake Assessment
  - Accessible Hinges for Bearing Replacement and Inspection
  - Innovative Foundations for Improved Performance
- Column Connections
  - Pipe Pin
  - Slab Bridge Superstructure/Pile Extension Connections
  - Epoxy Bonded Couplers
  - Adhesive Anchors
  - Low Cycle Fatigue Characteristics of Large Diameter Rebar
- Near Fault Effects
  - Vertical Acceleration
  - Fault Crossing
  - Near Fault Ground Motion and Fault Rupture

- Seismic Response Modification Devices (SRMDs)
  - Vincent Thomas Bridge Viscous Damper Forensic Investigation
  - In Service Evaluation and Inspection of SRMDs
  - Seismic Isolation Bearing Design Guidelines
  - Seismic Performance of Service Bearings
- Accelerated Bridge Construction
  - Concrete-Filled-Tube connections
  - Precast Piers with Energy Dissipating Joints
  - Precast I-girder on Inverted T Bent Cap Seismic Performance
  - Segmental Construction Seismic Performance and Design Guidelines
  - Post-Grouting to Improve Seismic Performance in Pileshafts
- Liquefaction
  - California Geological Survey Liquefaction Screening
  - Liquefaction Fragility
  - Comprehensive Design Recommendations
- Ductile Steel Cross-Frames
- Retaining Wall Seismic Loading and Design
- Type II Pileshafts
  - Analytical Study
  - Field Study
- Tsunami
- Fiber Reinforced Polymer (FRP) Composites
  - Long-Term Durability of FRP Composites
  - Non-Destructive Evaluation of FRP Bridge Decks
  - Pultruded FRP Sign Structures
- Condition Assessment
  - Long-Term Structural Performance Monitoring of Highway Bridges
  - Health Monitoring to Determine the Performance of Prestressing Steel in Segmental Box Girders
- Construction
  - Falsework Cap and Sill Beam
  - Sand Jacks
  - Closure Pour Waiting Time
  - Pre-weld Distortion Control Measures for Orthotropic Steel Bridge Decks
  - Column Cage Stability
- Structural Response to Blast Loading
- Concrete Materials
  - Controlling the Effects of Heat of Hydration
  - Corrosion Resistant Mineral Admixture Concrete
  - Creep and Shrinkage of Lightweight Concrete
  - Fiber Reinforced Concrete
- Soil-Structure Interaction
  - Battered Piles in Layered and Sloping Soils
  - Post-Grouting Methods to Increase the Load Capacity of Deep Foundations
- LRFD Specifications
  - LRFD Specification Strength Reduction Factors for FRP Composites
  - Prestress Losses in Long Span Post-Tensioned Bridges
- Replacement Alternatives for Concrete Approach Slabs

### ***New Research Projects:***

The Structure and Geotechnical Technical Advisory Panels (TAPs), with concurrence from the Structure and Geotechnical Research Program Steering Committee (PSC) and the Research and Deployment Steering Committee (RDSC) approved the following projects during the FY7/8 research project development cycle.

#### Seismic:

- Live Load Effects on Seismic Response of Bridges
- Abutment Soil-Structure Interaction and Modeling
- Assessment of the Performance of Dampers and Bearings In Service
- LRFD Specifications for Bearings and Isolators
- The Effects of Vertical Ground Motion on Column Shear Capacity
- The Effects of Seismic Ground Motion on Retaining Walls and Soundwalls
- Rapid Remote Post-Earthquake Damage Assessment
- Seismic Performance of Fiber-Reinforced Concrete Columns

#### Non-Seismic:

- Skew Effects on Concrete Box Girder Superstructures
- Validation of Bridge Deck Rehabilitation Strategies
- Use of Near Surface Mounted Rebar for Bridge Deck Rehabilitation
- Embedded Downhole Foundation Investigation Methods

### ***Additional Information:***

Additional information on the DES Structure, Seismic and Geotechnical Research Program is available at [http://www.dot.ca.gov/hq/esc/earthquake\\_engineering/Research/techreps.html](http://www.dot.ca.gov/hq/esc/earthquake_engineering/Research/techreps.html), [http://www.dot.ca.gov/research/researchreports/dri\\_reports.htm](http://www.dot.ca.gov/research/researchreports/dri_reports.htm), [http://www.dot.ca.gov/hq/esc/earthquake\\_engineering/stap/](http://www.dot.ca.gov/hq/esc/earthquake_engineering/stap/). These websites include a listing of past research projects, electronic copies of recent research reports, and information on the Caltrans research program. Hard copies of research reports can be found through the DES Technical Reference Center located on the 2<sup>nd</sup> Floor of Farmers Market I Building. For additional information on the DES Structure, Seismic and Geotechnical Research Program please contact Mike Keever, Chair of the Structure TAP at 916-227-8806 ([mike.keever@dot.ca.gov](mailto:mike.keever@dot.ca.gov)) or Mark Willian, Chair of the Geotechnical TAP at 916-227-7014 ([mark.willian@dot.ca.gov](mailto:mark.willian@dot.ca.gov)).