**Pavement Research Roadmap (2011 - 2014)**  
**Caltrans Division of Research & Innovation and UC Pavement Research Center**

**Vision**  
Pavement research improves mobility across California by finding ways to deliver pavement projects more efficiently, preserving pavement assets through longer service life, reducing environmental impact through smoother pavements and reduced maintenance, and providing the safest transportation system in the nation.

**Mission**  
Provide implementable research results enabling new and innovative business practices that span the Department's functional program areas through enhanced designs, materials, specifications, methods, tests, equipment, manuals, policies, and procedures.

### CALTRANS PROGRAM AREAS

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<th>PRIORITY TOPICS</th>
<th>DESIGN, MATERIALS &amp; ENVIRONMENTAL</th>
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<tr>
<td><strong>DESIGN, MATERIALS &amp; ENVIRONMENTAL</strong></td>
<td>Mechanistic-Empirical Design</td>
<td>Improving Pavement Performance</td>
<td>Recycling and Sustainability</td>
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<td><strong>STATEGIC PROBLEMS</strong></td>
<td>Reducing life cycle costs of pavements requires the ability to predict pavement performance more accurately than is possible with Caltrans' traditional design and analysis methods.</td>
<td>Congestion, increased travel times, and accidents associated with frequent construction and maintenance activities have become more prevalent with increases in population.</td>
<td>Decreasing availability of high quality material sources for pavement construction requires innovative methods of reusing or recycling sound, in-place materials.</td>
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<td><strong>STATEGIC OBJECTIVES</strong></td>
<td>Develop Mechanistic-Empirical (ME) methods, based on theories of mechanics, that can enable more accurate predictions leading to optimized pavement performance and lower life cycle costs.</td>
<td>Design and construct pavements with higher quality control and pavement characteristics that provide longer service lives and reduce congestion from recurring maintenance and rehabilitation work.</td>
<td>Develop and promote high quality pavement recycling techniques (both hot and/or cold) in order to preserve and enhance California’s resources and investments.</td>
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<td><strong>RESEARCH APPROACH</strong></td>
<td>After committing in 2005 to transitioning to ME, Caltrans has implemented a first version of ME design for concrete pavements. Further research is needed to enhance this tool and to develop and implement an ME design tool for asphalt pavements. Research includes developing models, climate and materials databases, seasonal adjustments, sensitivity analyses, calibrating models with field data, developing simple design tools, and assisting with implementation.</td>
<td>Development of long life pavements requires innovative designs, materials, and construction followed by monitoring of pavement condition to evaluate short- and long-term performance. Results from monitoring provide validation and further calibration data to realize cost-efficient, long-life designs of major urban corridors. Projects also provide data to help implement ME and validate innovative construction practices.</td>
<td>High quality pavement recycling will be improved over several years. Research will identify the most promising recycled materials through literature review and laboratory testing, evaluating techniques (both hot and cold) developed by other organizations and Caltrans’ experience, then followed by HVS validation before evaluation in pilot projects.</td>
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<td><strong>PRIORITY TOPICS</strong></td>
<td><strong>PROJECT TITLES and descriptions</strong></td>
<td><strong>SMOOTHNESS</strong></td>
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| Mechanistic-Empirical Design | • Coefficient of Thermal Expansion in PCC Pavement Design and Specification (SPE 4.30, TID 2310)  
Assess the significance of CTE on early and longer term cracking performance to determine how CTE should be considered in design and materials specifications for use in PCC pavements in California. | • Certification of Inertial Profilers used in PMS and Construction Monitoring (SPE 3.24, TID 2364)  
• Develop guidelines, revised test procedures, and revised specifications for mix design of open-graded friction courses. | • Improved Methodology for Mix Design of Open-Graded Friction Courses (SPE 3.25, TID 2362)  
• Develop guidelines, revised test procedures, and revised specifications for mix design of open-graded friction courses. | • Performance Modeling (SPE 4.43, TID 2358)  
• Develop and refine existing performance prediction models for California. Develop initial estimates of future condition using models. |
| Improving Pavement Performance | • Early-Age Cracking Performance (SPE 4.32, TID 2352)  
Identify potential causes and develop appropriate design parameters and/or construction procedures to limit or prevent early age cracking in PCC pavements. | • Effects of Milling and Other Repairs on Smoothness of Thin Overlays (SPE 4.42, TID 2363)  
• Develop guidelines and revised specifications for pre-overlay treatments and smoothness for thin overlays. | • Complete QA on Automated Pavement Condition Survey and GPR contracts (SPE 3.28, TID 2354)  
• Quality assurance on the automated pavement condition survey and GPR contracts. | |
| Recycling and Sustainability | • Life-Cycle Cost and Environmental Life-Cycle Analysis for Composite Pavements (SPE 3.20, TID 2371) | • Use Environmental Life Cycle Assessment to Develop Simplified Tools and Recommend Practices to Reduce Environmental Impact of Pavements (SPE 4.37, TID 2376)  
• Identify network and project-specific practices for pavement design, materials selection, traffic handling, and maintenance and rehabilitation practices that will reduce environmental impact and use of finite resources. Develop approach to consider agency costs with environmental impact, through development of a multi-criteria decision making process. | • Performance Modeling (SPE 4.43, TID 2358)  
• Develop and refine existing performance prediction models for California. Develop initial estimates of future condition using models. |
| Quieter Pavements | • Use of Higher Quantities of RAP and RAP Warm-Mix Interactions (SPE 4.35, TID 2373)  
• Incorporate the life-cycle cost and environmental life-cycle assessment of composite pavements into Caltrans documents. | • Effects of WMA Technologies on Binder Aging (SPE 4.40, TID 2370)  
• Develop revised HMA, RHMA-G and RHMA-O performance models that take the effects of different binder aging behavior related to the use of warm-mix asphalt into consideration. | • Improved Methodology for Mix Design of Open-Graded Friction Courses (SPE 3.25, TID 2362)  
• Develop guidelines, revised test procedures, and revised specifications for mix design of open-graded friction courses. | |
| Construction Practices and Project Delivery | • Implementation of New Quicker Pavement Research (SPE 3.21, TID 2380)  
• Develop specifications, guidelines, standardized laboratory and field test methods and other information needed to incorporate quicker pavement research into standard Caltrans practice. | • Environmental Impacts and Energy Efficiency of Warm Mix Asphalt (SPE 4.41, TID 2366)  
• Quantified environmental benefits of using warm-mix asphalt technologies. | • Performance Modeling (SPE 4.43, TID 2358)  
• Develop and refine existing performance prediction models for California. Develop initial estimates of future condition using models. |
| Smoothness | • Acoustical Longevity of Noise Reducing Pavement (SPE 4.38, TID 2377)  
• Develop models for pavement acoustics for use in the PMS, LCCA, and by district and HQ managers and engineers. | • Evaluation of Compacted HMA Moisture Sensitivity (SPE 3.23, TID 2365)  
• Develop data relating laboratory mix moisture sensitivity to field performance. Prepare revised guidelines, test methods, limits, and specifications for moisture sensitivity testing. | | |
| Preservation | • Continued Monitoring of Selected Quicker Pavement Test Sections (SPE 4.39, TID 2375)  
• Complete data sets to failure for concrete and asphalt quieter pavement and experimental test sections that remain in service. Data will be used in the proposed project “Acoustical Longevity of Noise Reducing Pavement”. | | | |

For information on past research projects, visit (Caltrans) [http://www.dot.ca.gov/research/researchreports/index.htm](http://www.dot.ca.gov/research/researchreports/index.htm) and (PPRC) [http://www.ucprc.ucdavis.edu](http://www.ucprc.ucdavis.edu)  
For additional information on Caltrans Pavement Research Program, email Nick Burmas, Office Chief of Materials and Infrastructure at nick.burmas@dot.ca.gov

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<td>Quarter 3</td>
<td>• Coefficient of Thermal Expansion in PCC Pavement Design and Specification (SPE 4.30, TID 2310)</td>
<td>• Life-Cycle Cost and Environmental Life-Cycle Analysis for Composite Pavements (SPE 3.20, TID 2371)</td>
<td>• Use of Higher Quantities of RAP and Warm-Mix Interactions (SPE 4.35, TID 2373)</td>
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<td>1/31/12 to 3/31/12</td>
<td>• No progress this period</td>
<td>• No progress this period</td>
<td>• Completed literature review to determine state of the practice and identify specific research needs. Continued review of FHWA/NAPA technical working group on WMA proceedings. Submitted NCHRP proposal on expanded study into binder aging as subcontractor to Texas A&amp;M. Contract was awarded to the Texas AAMA/RAP team. Completed project workplan. Started collection of binder samples and binder testing. Expected major progress next quarter</td>
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### PROJECT UPDATES

**Quarter 3** - 1/31/12 to 3/31/12 (continued)

- Interlayer Performance (SPE 4.34, TID 2359)
  - Continued literature review and industry meetings to determine state of the practice, identify specific research needs, and which technologies should be tested. Completed workplan for project.

- Evaluation of Compacted HMA Moisture Sensitivity (SPE 3.23, TID 2365)
  - Literature review mostly completed and draft work plan prepared. Some aggregate preparation. Reproducibility and repeatability studies of Hamburg Wheel Tracking Test, HWTT and Superpave Gyratory Compactor, SGC specimens concepts being developed and to be discussed with Caltrans. Identification of test sections has started.

- Complete QA on Automated Pavement Condition Survey and GPR contracts (SPE 3.28, TID 2354)
  - Starting APCS data upload to PaveM.
  - Continued quality assurance of APCS data.
  - Analyzing existing 6 field verification sites (FVS) as Fugro image data comes in. Prepared plan for next set of APCS FVS.
  - Performed QA on 10,000 lane-km (6,200 lane-miles) of raw GPR/GPS data.
  - Performed QA on 13,600 lane-km (8,450 lane-miles) of analyzed GPR data.
  - Blind Verification Sections are complete (63 sections). Follow-up Verification Sections were selected (5 sections in D3 and D6).
  - Continued to develop, implement and test a pavement structure segmentation algorithm. Continued to incorporate the other segmentation parameters into the complete segmentation process. Segmented D3 including all parameters; segmented other 11 districts using all parameters except structure.
  - The truck volumes, ESALs, and TIs for the segments were calculated and added to the traffic table. 95 percent of the segments on the entire routes were completed.
  - Continued to assist Caltrans in the engineering configuration of PaveM. Continued to assemble and provide data to the PaveM team to perform test data imports into PaveM.

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