Resilient Transportation Infrastructure and Emergency Management

The Road Engineering Association Of Asia and Australasia (REAAA) New Zealand Chapter
2017 REAAA ROADSHOW

Herby G. Lissade, P.E.
Maintenance Assistant Division Chief
California Department of Transportation (Caltrans)

- World Road Association/PIARC
- American Association of State High and Transportation Officials (AASHTO)
- President – Haiti Engineering, INC.

August 2017
Caltrans 12 Districts
Caltrans Organizational Profile

Infrastructure
• 15,000 centerline miles of highway
• 26,000 state and local bridges
• 440 Caltrans building facility sites

Organization
• 19,000 employees
• 12 Districts
Caltrans Resourced Based Response to Emergencies

- 19,047 Department Employees (thousands of engineers and field personnel)
- 7,750 Pieces of equipment
- 2 Aircraft
- 50,679 Lane miles of road
- 12,747 Bridges
- 330 Maintenance stations
- 713 Changeable Message Signs (CMS)
- 87 Safety roadside rests
- 364 Vista points
- 309 Park and Ride Lots
- 25,000 Acres of Landscaping
- 310 Pumping plants
- Tunnels and tubes

- 1,703 Closed Circuit TV Cameras (CCTV)
- 87 Safety roadside rests
- 323 Park and Ride Lots (P&R) and 87 Safety Roadside Rest Areas
- 143 Highway Advisory Radio stations (HAR)
- 4,000 handheld radios
- 1,000’s of mobile radios
- Signals
- Safety barrier systems
- Drainage systems
- Electrical systems
- Ferries
Office of Maintenance Field and Technical Support

DRAFT
OFFICE OF MAINTENANCE
TECHNICAL AND FIELD SUPPORT
Organization Chart
August 2017

"Provide a safe, sustainable, integrated and efficient transportation system to enhance California’s economy and livability."
Caltrans Office of Emergency Management & Infrastructure Protection

<table>
<thead>
<tr>
<th>Division of Maintenance</th>
<th>Office of Emergency Management &amp; Infrastructure Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency Operations Branch - 3613</td>
<td></td>
</tr>
<tr>
<td>Chris Smith</td>
<td>916-455-5762</td>
</tr>
<tr>
<td>Maintenance Mgr. 1 (M)</td>
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<tr>
<td>Emergency Management Special Projects - 3612</td>
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<tr>
<td>Liz Ochoa</td>
<td>916-577-4026</td>
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<td>Retired Assistant</td>
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<tr>
<td>Hazardous Materials Branch - 3616</td>
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<tr>
<td>George Avila</td>
<td>916-709-2096</td>
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<td>Maintenance Mgr. 1 (M)</td>
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<tr>
<td>Homeland Security &amp; Infrastructure Protection Branch - 3612</td>
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<tr>
<td>René T Garcia</td>
<td>916-603-8003</td>
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<tr>
<td>Senior Transportation Engineer (R)</td>
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<tr>
<td>Recovery Engineering Branch - 3616</td>
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<tr>
<td>Vacant</td>
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<tr>
<td>Donald Emukpoero (Acting)</td>
<td>916-533-3128</td>
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<tr>
<td>Senior Transportation Engineer (R)</td>
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<tr>
<td>Coop-Cog &amp; Resilience Engineering Branch - 3616</td>
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<tr>
<td>Dana Hendrix</td>
<td>916-214-0954</td>
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<tr>
<td>Senior Transportation Engineer (R)</td>
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<tr>
<td>Winter Operations Branch - 3513</td>
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<tr>
<td>Russell Modrell</td>
<td>209-610-0245</td>
</tr>
<tr>
<td>Maintenance Mgr. 1 (Acting)</td>
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</tbody>
</table>

- Durval Avila
  - CMA
  - Emergency Operations Coordinator
  - 916-455-4488
  - (M)
- James Chisago
  - Emergency Management Analyst
  - 916-455-4488
  - (Acting)
  - (M)
- Spencer Adams
  - Emergency Operations Support CMA
  - 916-455-5421
  - (M)
  - (Acting)
- Michelle Trotter
  - Emergency Management Research Coordinator
  - 916-455-4488
  - (Acting)
  - (M)
- Vacant
  - Research Analyst IV
  - (G)
  - (M)
- Dewayne Lockwood
  - CMA
  - Emergency Operations Coordinator
  - 916-455-4488
  - (M)
  - (Acting)
- Andrew Lazaro
  - CMA
  - Student Assistant
  - 916-455-4488
  - (M)

Updated: May 2017
Caltrans Capabilities

- Architectural and Engineering Services
- Maintenance Field Operations
- Telecommunications
- Procurement and Warehousing
- Traffic Management
- Right of Way – Real Estate Assets
- Aeronautics
- Construction Management/Engineering
- Planning
- Human Capitol
State DOT’s Major Responsibilities

- Highways
- Transit
- Freight and Passenger Rail
- Ports and Ferries
- General and Commercial Aviation Facilities
- Bike/Pedestrian
- Motor Carrier/Motor Vehicle Services
- State Patrol

DOT’s own & operate 1.8 million lane miles & 273,200 bridges

5 billion daily vehicle miles (DVMT) traveled on DOT’s roads and bridges, or 65% of total DVMT

$92 billion/year needed just to preserve system without extra security

Governance

Government, control, or authority
Stafford Act Support to States

In response to Emergencies/Disasters, through CalOES, Caltrans will assist other agencies and local authorities with the restoration of function and mobility to affected city and county critical infrastructure.

Caltrans will also carry out “Mission Tasking” through CalOES, in areas not related to the transportation system (based on capabilities).
Definition and Context for Resilience
California Emergency Functions
CA – EF’s

1. Transportation
2. Communications
3. Construction & Engineering
4. Fire and Rescue
5. Management
6. Care and Shelter
7. Resources
8. Public Health & Medical
9. Search & Rescue
10. Hazardous Materials
11. Food & Agriculture
12. Utilities
13. Law Enforcement
14. Long-Term Recovery
15. Public Information
16. Volunteer & Donations Management
17. Cybersecurity
### FEMA Recognized Types of Disasters

1. Chemical Emergencies
2. Dam Failure
3. Earthquake
4. Fire or Wildfire
5. Flood
6. Hazardous Material
7. Heat
8. Hurricane
9. Landslide
10. Nuclear Power Plant Emergency
11. Terrorism
12. Thunderstorm
13. Tornado
14. Tsunami
15. Volcano
16. Wildfire
17. Winter Storm
All Hazards Planning Fundamentals

- **Prevention**: Capabilities necessary to avoid, prevent, or stop a threatened or actual act of terrorism.
- **Protection**: Capabilities necessary to secure against acts of terrorism and manmade or natural disasters.
- **Mitigation**: Capabilities necessary to reduce loss of life and property by lessening the impact of disasters.
- **Response**: Capabilities necessary to save lives, protect property and the environment, and meet basic human needs after an incident has occurred.
- **Recovery**: Capabilities necessary to assist communities affected by an incident to recover effectively.

Pre-Event Recovery Planning
For Transportation Infrastructure
Why is Pre-Event Recovery Planning For Transportation Infrastructure recovery important?

- Effective and efficient Transportation Systems helps drive a nation’s economy
- Pre-Event planning helps to accelerate the response and recovery of the Transportation System
- Opportunity to build back better
- Adds to the overall Resiliency of the Transportation System
Basic Principles

Recovery Efforts are executed better when:

- Resources are prepositioned
- Contractors are pre-approved
- Alternate Facilities are identified
- Recovery Is Different from Response
- Response Can Impact Recovery
- Short-Term Approaches Have Impact on Long-Term Recovery
- Rebuilding Is an Opportunity to Improve Infrastructure and Incorporate Resilience
- Economic Impact Is a Part of Recovery
- Take a Collaborative Approach
- Take a Regional Approach
- Establish Priorities in Advance
- Organize Roles and Responsibilities
- Be Aware of Funding Realities
- Link the Pre-Event Recovery Planning to Other Plans
- Incorporate Flexibility and Identify Alternatives
Assessing Disaster Risk

- Vulnerability Assessments
- Threat and Hazard Identification and Risk Assessment (THIRA)
- California MULTI-HAZARD MITIGATION PLAN
- Assessing Disaster Risk - Economic Studies
- Plans
- Human Behavior
- Hazard Mapping
- Exercise and Training
- Caltrans Division of Research, Innovation and System Information Hazard Assessment and Response Tools
- RRAP & HayWired
- Implementation of New Technology
- Transportation Research Board
- Haiti Engineering, Inc.
Statewide Vulnerability Assessments

Sea Level Rise Adaptation Options

Defend

Planned retreat

Adapt

Forced retreat
Threat and Hazard Identification and Risk Assessment (THIRA)

Threat and Hazard Identification and Risk Assessment Guide

Comprehensive Preparedness Guide (CPG) 201

Second Edition
August 2013

Homeland Security
- State Hazard Mitigation Plan
- Emergency Operations Plan
- Continuity of Operations/Continuity of Government
- Pandemic Plan
- All Hazards Infrastructure Protection Plan
- Security Plan
- Recovery Plans
- IT Recovery Plan
How do people actually react & why during emergencies?

Accept what is, not what we want to believe.

What we plan, and what people actually do are increasingly different.

Design systems to support what people actually do.

Engage Law enforcement in Planning and Response
HAZARD MAPPING
The effective use of Hazard Maps decreases the magnitude of disasters.

Hazard Maps provide information on the range of possible damage and disaster prevention activities.
CALTRANS MAPS

Earthquake + Fire Maps
Flood + Landslide Maps
Supply Chain Maps
Traffic Flow Maps
HIGHWAY MAINTENANCE STATIONS & Emergency Supply Chains

30 Mile Buffer – Assess for response time
Along Emergency Lifeline Routes and NHS
Exercises and Training
Training Videos

Fire

Flood

Earthquake
Caltrans Division of Research, Innovation and System Information (DRISI)
Hazard Assessment and Response Tools

- ShakeCast
- FloodCast
- FireCast
- SnowCast
- Avalanche Path Atlas Map
What is ShakeCast?
ShakeCast System Overview

ShakeMap Web Servers

User's Databases

Facilities

Notifications

Fragilities

Estimated Damage

Internal Web Page & User Interface

Notifications: Email, PDA, Cell
ShakeCast at Caltrans

- Automatic delivery of ShakeMap products to Caltrans.
- Automatic analysis of potential bridge damage state based on Basoz & Mander methodology using ShakeMap peak spectral accelerations.
- Email/Page bridge inspection prioritization lists.
### Bridge Assessment Summary

**Maximum Peak 1.0 sec Spectral Acceleration:** 198.76%g  
**Total number of bridges assessed:** 3133

**Summary by inspection priority:**
- **High**: 119  
  - High Priority for full engineering assessment
- **Medium High**: 156  
  - Medium-High Priority for full engineering assessment
- **Medium**: 152  
  - Medium Priority for full engineering assessment
- **Low**: 2706  
  - Low Priority for full engineering assessment; quick visual inspection likely sufficient

### Bridge Assessment Details

<table>
<thead>
<tr>
<th>Bridge Name</th>
<th>Bridge Number</th>
<th>Dist.Cty/Reg.PM</th>
<th>Inspection Priority</th>
<th>1sec Peak Spectral Acceleration (g)</th>
<th>Exceedance Ratio</th>
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<tbody>
<tr>
<td>Railroad Avenue OC</td>
<td>35 0114</td>
<td>04-SM-101-8.53-EMT</td>
<td>High</td>
<td>185.3903</td>
<td>2.934</td>
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<tr>
<td>Via Del Oro OH</td>
<td>37 0477L</td>
<td>04-SCL-085-1.22-SJS</td>
<td>High</td>
<td>49.2711</td>
<td>2.472</td>
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<tr>
<td>San Mateo-Hayward Bridge</td>
<td>35 0054</td>
<td>04-SM-052-R14.44-FSTD</td>
<td>High</td>
<td>49.0514</td>
<td>2.167</td>
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<tr>
<td>Constitution Way OC</td>
<td>33 0513K</td>
<td>04-ALA-200-0.85-ALR</td>
<td>High</td>
<td>68.2735</td>
<td>1.145</td>
</tr>
<tr>
<td>Meridian Road Underpass</td>
<td>37 0268</td>
<td>04-SCL-200-4.35-SJS</td>
<td>High</td>
<td>59.9229</td>
<td>1.122</td>
</tr>
<tr>
<td>Campbell Underpass</td>
<td>37 0135</td>
<td>04-SCL-17.12.22-SMB</td>
<td>High</td>
<td>70.8722</td>
<td>1.087</td>
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<td>East Hillsdale Blvd OC</td>
<td>35 0130</td>
<td>04-SM-101-11.15-5M</td>
<td>Medium High</td>
<td>88.3762</td>
<td>1.071</td>
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<tr>
<td>Redwood Creek</td>
<td>35 0145</td>
<td>04-SM-101-6.2-RDWY</td>
<td>Medium High</td>
<td>61.0924</td>
<td>1.064</td>
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<tr>
<td>Slalom-Approach Lower Deck</td>
<td>34 0119R</td>
<td>04-SF-088-4.96-SF</td>
<td>Medium High</td>
<td>33.2578</td>
<td>1.057</td>
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<td>Holy Street OC</td>
<td>35 0037</td>
<td>04-SM-101-8.4</td>
<td>Medium High</td>
<td>65.904</td>
<td>1.048</td>
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<td>Route 13&amp;80 Separation (North)</td>
<td>33 0191G</td>
<td>04-ALA-013-13-92-BER</td>
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<td>66.7666</td>
<td>1.046</td>
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<td>Race Street Crossing</td>
<td>37 0269</td>
<td>04-SCL-200-4.35-SJS</td>
<td>High</td>
<td>59.9229</td>
<td>1.045</td>
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<td>Firebaugh Walkway</td>
<td>34 0019</td>
<td>04-SF-19.1-4.98-SF</td>
<td>High</td>
<td>68.3128</td>
<td>1.035</td>
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<tr>
<td>South Delaware Street UC</td>
<td>35 0158L</td>
<td>04-SM-052-R11.51-SM</td>
<td>High</td>
<td>35.1822</td>
<td>1.020</td>
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<tr>
<td>South Delaware Street UC</td>
<td>35 0158R</td>
<td>04-SM-052-R11.51-SM</td>
<td>High</td>
<td>35.1822</td>
<td>1.030</td>
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<td>Powell Street UC</td>
<td>33 0020</td>
<td>04-SM-100-3.75-EMV</td>
<td>High</td>
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<td>Redwood Harbor Overhead</td>
<td>35 0065</td>
<td>04-SM-101-6.3-RDWY</td>
<td>Medium High</td>
<td>58.8966</td>
<td>1.018</td>
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<tr>
<td>Macarthur Avenue OC</td>
<td>35 0106</td>
<td>04-SCL-200-6.18-SJS</td>
<td>High</td>
<td>54.4613</td>
<td>1.012</td>
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<tr>
<td>N101-SBB Connector OC</td>
<td>35 0851G</td>
<td>04-SM-101-6.3-RDWY</td>
<td>Medium High</td>
<td>56.8696</td>
<td>1.009</td>
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<tr>
<td>N101-NBS Connector Separation</td>
<td>35 0515G</td>
<td>04-SCL-017.9-24-LETS</td>
<td>Medium High</td>
<td>68.2137</td>
<td>1.008</td>
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<tr>
<td>San Francisco Creek</td>
<td>35 0013</td>
<td>04-SM-101-0.1</td>
<td>Medium High</td>
<td>58.3678</td>
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<tr>
<td>N887-S826 Connector</td>
<td>37 0390H</td>
<td>04-SCL-087.1-5-SJS</td>
<td>Medium High</td>
<td>50.5664</td>
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<tr>
<td>Separation</td>
<td>37 0345</td>
<td>04-SCL-082-4.35-SJS</td>
<td>Medium High</td>
<td>49.4096</td>
<td>1.001</td>
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<tr>
<td>Marble Slough Road OC</td>
<td>36 0099</td>
<td>05-SG-001-R2-27-MAT</td>
<td>High</td>
<td>56.7678</td>
<td>0.980</td>
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<tr>
<td>Sunlink Street Rr UIC</td>
<td>37 0265L</td>
<td>04-SCL-200-4.31-SJS</td>
<td>High</td>
<td>52.8878</td>
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<tr>
<td>Sunlink Street Rr UIC</td>
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<td>Winchester Boulevard OC</td>
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<td>0.986</td>
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<td>South sheriff Dr.</td>
<td>33 0302L</td>
<td>04-SM-101-65-5</td>
<td>Medium High</td>
<td>43.2729</td>
<td>0.956</td>
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</table>
ShakeCast identified the only bridge damaged in this event as the top priority for inspection.

**Bridge Assessment Summary**
Maximum Peak 1.0 sec Spectral Acceleration: 48.5782%g
Maximum Acceleration: (not measured)
Total number of bridges assessed: 219
Summary by inspection priority:
- **High**: [NULL]
- **Medium-high**: [NULL]
- **Medium**: [NULL]
- **Low**: 219

**Bridge Assessment Details**
Bridges presented in the table below are sorted in order of severity of impact (exceedance ratio). The list Acceleration exceeds 10% g.

<table>
<thead>
<tr>
<th>Bridge Name</th>
<th>Bridge Number</th>
<th>Dist-Cty-Rte-PM</th>
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<tbody>
<tr>
<td>58 0274 - WESTSIDE MAIN CANAL</td>
<td>58 0274</td>
<td>11-IMP-086-22.02</td>
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<tr>
<td>58 0275 - WORMWOOD CANAL</td>
<td>58 0275</td>
<td>11-IMP-086-22.07</td>
</tr>
<tr>
<td>58 0212L - COYOTE WELLS OH</td>
<td>58 0212L</td>
<td>11-IMP-086-R13.97</td>
</tr>
<tr>
<td>58 0212R - COYOTE WELLS OH</td>
<td>58 0212R</td>
<td>11-IMP-086-R13.93</td>
</tr>
</tbody>
</table>
ASSESSING DISASTER RISK - ECONOMIC STUDY
REGIONAL RESILIENCY ASSESSMENT PROGRAM (RRAP)

- Caltrans is working with the U.S. Department of Homeland Security on a Regional Resiliency Assessment Program (RRAP) Project
- RRAP focuses on goods movement through high hazard areas from the Port of Long Beach through the Cajon Pass (I-15) to the State of Nevada - 390 kilometers
ASSESSING DISASTER RISK - ECONOMIC STUDY
U.S. GEOLOGICAL SURVEY
SAFRR - SCIENCE APPLICATION FOR RISK REDUCTION
HAYWIRED SCENARIO

--- Earthquake Planning Scenario ---
ShakeMap for haywiredm7.05 Scenario
Scenario Date: APR 9 2014 12:00:00 AM UTC  M 7.0 N 37.80 W 122.18 Depth: 8.0 km
Asian-Pacific Economic Cooperation (APEC)

Seven Principles of Supply Chain Resilience

- Share information and knowledge
- Promote disaster risk management and hazard mapping
- Support planning and business continuity management
- Promote best practice policy, regulations, and flexibility
- Leverage regional cooperation to support the supply chain
- Promote critical infrastructure protection and inter-modalism
- Recognize and promote best practice in human resource and capacity management.
Organizations

- PIARC/World Roadway Association
- American Association of State Highway Transportation Officials (AASHTO)
- Transportation Research Board of the National Academies (TRB)
- Federal Highway Administration (FHWA)
- United States Department of Transportation (USDOT)
- Federal Emergency Management Agency (FEMA)
- California Governor’s Office of Emergency Service (CalOES)
- Red Cross
Implementation of New Technology

Earthquake Early Warning System

Sustainable Snow and Ice Removal
Mechanical Ice-breaking
Icebreaker system

Eight units can be set to break the ice on the ground in real-time profiling
Earthquake Early Warning

Up to 90 sec warning depending on distance.
Caltrans Engineers and other Professionals giving back

Lessons learned applied to skill set and BMPs/SOPs
Transportation Research Board (TRB)
Promoting Innovation and Progress in Transportation
trb.org
TRB Brings People Together

- Manage Research
- Deliver Policy Analysis & Advice
- Information Exchange: Meetings, Publications, Website, Dissemination, Outreach
Identification of R&D Gaps & Needs

1. TRB Committee on Critical Transportation Infrastructure Protection shares research results from all sources & identifies research needs

2. AASHTO Special Committee on Transportation Security & Emergency Management (SCOTSEM) identifies and refers research needs

50+ other technical meetings

TRB Annual State Visits to DOTs, Universities, MPOs, Transit Agencies, Ports, Airports & other agency reps

State/Local Government

Non-Government Organizations

Federal Agencies

Private Sector
TRB “Professional Society” Functions

- 200 Standing Technical Committees – about 4,000+ people
- Constitute communities of interest
- Identify research needs
- Sponsor sessions, conferences, and meetings – 50+ events in addition to Annual Meeting
- Review and publish papers and reports
- Share information
TRB Sponsors

- American Public Transportation Association
- Association of American Railroads
- State Departments of Transportation (All)
- South Coast Air Quality Management District
- U.S. Army Corps of Engineers
- U.S. Air Force Civil Engineering Center
- U.S. Coast Guard
- U.S. DOT: OST, FHWA, FTA, FRA, FMCSA, FAA
TRB Hot Topic: Transformational Technologies

Transformational, or “disruptive” technologies, are those that can be expected to completely displace the status quo, forever changing the way we live and work.

- General examples: internet, personal computer, email, smartphone, GPS, big data

- Transportation: Connected/automated vehicles, shared vehicles, advanced versions of on-demand shared ride and micro-transit services, NextGen, cog in “internet-of-things”
TRB Hot Topic: Resilience

Resilience is the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events.

- Natural disasters: blizzards, tornadoes, floods, hurricanes, wildfires, heat waves, earthquakes, and other natural hazards
- Human-induced disasters: acts of terrorism, financial crises, social unrest, cyber attacks
This report by the National Research Council defines "national resilience," describes the state of knowledge about resilience to hazards and disasters, and frames the main issues related to increasing resilience in the United States.
Resilience at The National Academies (2015)
TRB Key Products

Research Management

Cooperative Research Programs

• Highway
• Transit
• Airport
• Freight
• Hazardous Materials
• Rail
Objective: to develop a guide that provides pre-event recovery planning principles, processes, tools, and appended resource materials for use by planners and decision makers in pre-event planning to support transportation infrastructure recovery.

**FIGURE 2-2**


NCHRP Project 20-59(14B)
Fundamental Capabilities of Effective All-Hazards Infrastructure Protection, Resilience, and Emergency Management for State Departments of Transportation
2015
NCHRP Project 20-59(36)
Managing Catastrophic Transportation Emergencies:
A Guide for Transportation Executives
2015
NCHRP Project 20-59(30)
Incident Command System (ICS) Training for Field Level
Transportation Supervisors and Staff
December 2015

NIMS/ICS: Perform Reliably & Effectively

• Goal of NIMS/ICS: Reliable and effective response to an event, emphasizing safety of DOT staff
• Achieved through
  – Safety
    • Check-in, check out, demobilization
  – Personnel accountability
    • Food, shelter, family contacts
  – Reimbursement
    • The job you save may be your own
    • MAP-21 changes, debris removal reimbursement
TRB Projects in Development

Security, Emergency Management and Infrastructure Protection-related

1. Integrating Climate Risk into Airport Management Systems
2. Emergency Management Training for Airport Critical Incidents
3. Airport Emergency Operations Centers Design Guide
4. Forum on Airport Roles in Reducing Communicable Diseases Transmission
5. Improving Freight Transportation Resilience in Response to Supply Chain Disruptions
6. Incorporating Freight, Transit, and Incident Response Stakeholders into Integrated Corridor Management (ICM): Processes and Strategies for Implementation
7. A Contracting Strategies Guidebook for Administration of Concurrent Regional Emergencies
8. Proposed Guidelines for Performance-Based Seismic Bridge Design
10. Applying and Adapting Climate Change Models to Hydraulic Design Procedures
11. Leveraging Big Data to Improve Traffic Incident Management
12. Update of A Pre-Event Recovery Planning Guide for Transportation
13. Research on Enhancing Transportation System Resilience
14. Voice and Data Interoperability for Transportation
15. Command–Level Decision Making
17. Impacts of Connected/Automated Vehicles on State and Local Transportation Agencies
18. A Guide to Ensure Access to the Publications and Data of Federally Funded Transportation-Related Research
20. Deploying Transportation Security Practices in State DOTs
21. Emergency Management in State Transportation Agencies
22. Deploying Transportation Resilience Practices in State DOTs
California Department of Transportation
Office of Emergency Management
Division of Maintenance
We're Here to Get you There!

All Roads ... All Codes?

No Roads ... No Codes!