RAPID NHERI
Natural Hazards Reconnaissance

Introduction to Natural Hazards Reconnaissance with the RAPID Facility

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RAPID Facility Workshop
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RAPID Facility Team

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RAPID Facility Mission and Values

- The RAPID facility provides investigators with the equipment, software, and support services needed to collect, process, and analyze perishable data from natural hazard events. The facility supports natural hazard and disaster researchers through training and educational activities, field deployment services, and facilitating engagement between scientists, engineers, stakeholders, and the public.
- We promote reconnaissance-based science, shared resources, open data, interdisciplinary research, community engagement, and innovation to reduce the adverse impacts of natural hazards.

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RAPID Facility Strategic Activities

To achieve its mission, the RAPID facility engages in the following strategic activities.

- Acquiring, maintaining, and operating state-of-the-art data collection equipment
- Developing and supporting mobile applications to support interdisciplinary field reconnaissance
- Providing advisory services and basic logistics support for research investigations
- Facilitating the systematic archiving, processing and visualization of acquired data in DesignSafe-CI
- Training a broad user base through workshops and other activities
- Engaging the public through citizen science, as well as through community outreach and education

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RAPID Timeline

Year 1
Community Input and Resource Requirement Development

Year 2
Acquisition, Commissioning and Training

Years 3-5
User Service, Field Operations, Continued Training

September 2016-September 2017

- Developing facility headquarters
- Hiring staff (site operations, IT, administrative)
- Workshop
- Science plan revision
- Specification development
- Trial equipment deployment and testing
- NHERI summer institute
- Coordination with DesignSafe
- Facility operating documents
- Outreach via conference presentations
- Mobile app development
- Citizen science app development and workshop

September 2017-September 2018

- Procurement and commissioning
- Staff training
- Facility operating plan and site users manual
- User training workshops (4)
- REU program
- IT cyber security
- RApp development and testing
- Fiscal operating plan
- Proposal support

September 2018 and beyond

- Supporting field missions and data use/reuse
- Training
- Maintenance

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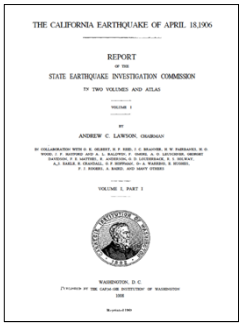
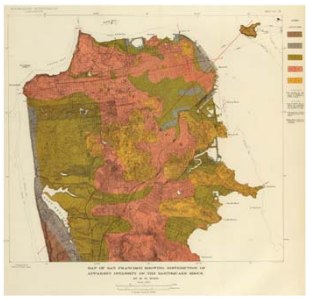
Natural Hazard Reconnaissance in the U.S.

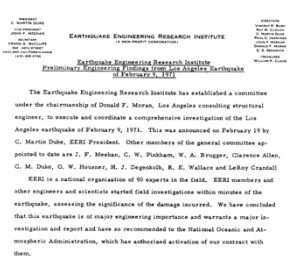

THE CALIFORNIA EARTHQUAKE OF APRIL 18,1906

REPORT
OF THE
STATE EARTHQUAKE INVESTIGATION COMMISSION
IN TWO VOLUMES AND ATLAS

ANDREW C. LAWSON, CHAIRMAN

WASHINGTON, D. C.




EARTHQUAKE ENGINEERING RESEARCH INSTITUTE

Earthquake Engineering Research Institute
Preliminary Engineering Findings from Los Angeles Earthquake of February 9, 1971

The Earthquake Engineering Research Institute has established a committee under the chairmanship of Donald F. Moran, Los Angeles consulting structural engineer, to execute and coordinate a comprehensive investigation of the Los Angeles earthquake of February 9, 1971. This was announced on February 19 by G. Martin Duke, EERI President. Other members of the general committee appointed to date are J. F. Meehan, C. W. Pinkham, W. A. Brugger, Clarence Allen, C. M. Duke, G. W. Housner, H. J. Degenkolb, R. E. Wallace and LeRoy Crandall

EERI is a national organization of 90 experts in the field. EERI members and other engineers and scientists started field investigations within minutes of the earthquake, assessing the significance of the damage incurred. We have concluded that this earthquake is of major engineering importance and warrants a major investigation and report and have so recommended to the National Oceanic and Atmospheric Administration, which has authorized activation of our contract with them.

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Value of Natural Hazard Reconnaissance Data

• Data generated by an extreme event is unique and often highly "perishable" —and thus, must be collected quickly

• Disaster data sets include the real-world complexities (e.g., interplay between natural, human, and built systems) that allow us to better understand and to quantify the socio-technical dimensions related to damage, restoration, and resiliency of the built environment

• Such data is difficult to duplicate in the laboratory

• These data can be used to:
  - develop new, fundamental discoveries and insights
  - test and verify simulation models
  - reduce uncertainties in probabilistic models
  - inspire next generation simulation models

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Enabling the Next Generation of Natural Hazards Reconnaissance

Courtesy of J. Bray, (2017) Ishihara Lecture, Simplified procedure for estimating liquefaction-induced building settlement

• *Fundamental insights*

• *Critical data for validation*

• *Lots of highly perishable data*

• 2D "point" data

• Manual measurements

• 10 cm resolution

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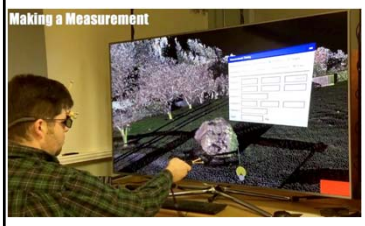
Enabling the Next Generation of Natural Hazards Reconnaissance



- Large amount of high-quality data
- High-resolution (<1 cm), systematic data collection
- 3D (and 4D)
- Automation
- Geo-referenced data sets that can be later analyzed and interrogated
- Open data archived in DesignSafe

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Enabling the Next Generation of Natural Hazards Reconnaissance

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Enabling the Next Generation of Natural Hazards Reconnaissance

Tsunami Inundation

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Amanda South, reporter, Newstalk ZB, 8-5-12.

I: Right, let's start with February 22, can you describe your key experiences on that day?

IP: I was actually at home, ironically, because the Christchurch City Council was having its first dedicated earthquake recovery meeting so I would have started work at 1, so I was always haunted by that, but I was in Angus' bedroom getting him off for a nap and I guess the rest is history. The house started to explode around us. I just took him in by body in the middle of the room and things just fell around us. We were in this little bubble in the middle and it was horrific because everyone has that internal counter and you thought 'Oh my god this is going to on too long, it's supposed to stop'. It got angrier and stuff was just erupting in the hallway. I can just remember knowing it was horrific and trying to think about my kid and I can remember my

Example Eyewitness Interview Transcript

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Enabling the Next Generation of Natural Hazards Reconnaissance

DESIGNSAFE-CI
A NATURAL HAZARDS ENGINEERING COMMUNITY

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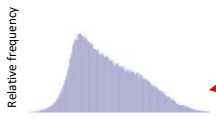

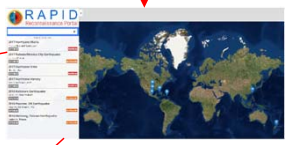

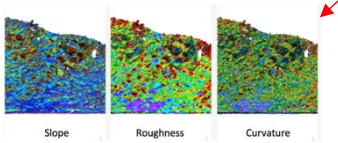

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Complementing Laboratory Instrumentation

Obtain 3D high- resolution point cloud models for NHERI experiments

- Record damage
- Determine precise instrument locations
- Benchmark experiments to field observations
- Develop damage detection and load history determination methods

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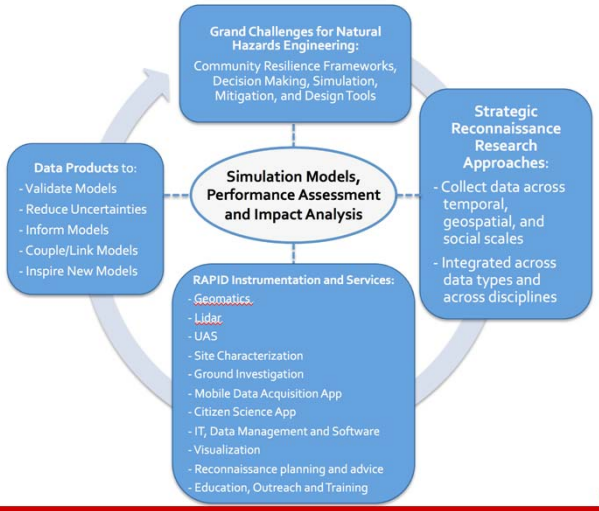
RAPID Facility Science Plan

Grand Challenges for Natural Hazards Engineering (after National Academies report)

- Community Resilience Framework
- Hazard and Impact Simulation and Decision Making
- Mitigation
- Design Tools

The principal scientific goal of the RAPID is to:

Inform natural hazards computational simulation models, infrastructure performance assessment, and socioeconomic impact analysis by supporting the collection, development, and assessment of high-quality disaster data sets



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Science Plan: Strategic Approaches – Acquire and integrate data over a range of temporal and spatial scales, across disciplines

EARTHQUAKE EXAMPLE ILLUSTRATING LINKS BETWEEN STRATEGIC APPROACHES, INSTRUMENTATION, AND DATA COLLECTION PRODUCTS

Overarching Strategic Reconnaissance Research Approaches

1. Collect data across temporal scales, e.g. evolution of co-seismic landslide with time, recovery and return to home for affected persons
2. Collect data across geospatial scales, e.g. community-level and site-specific damage mapping, regional geology trends and site period
3. Collect data and integrate across disciplines, e.g. collect building damage and socio-economic data in identical effected communities

UAS lidar: Aerial mapping of ground failure to obtain high-resolution, bare-earth DEM

UAS camera: Aerial mapping of building damage patterns to obtain orthophotos and DEM

Seismometer: measure natural period and aftershocks to obtain site characteristics

Camera and geomatics control: SfM survey to map building damage to obtain 3D model for interrogation

iPad App: interview affected persons to obtain social science data

Terrestrial lidar: map ground failure and affected structures to obtain high-resolution DEM

AUV/single beam: submarine mapping to obtain bathometry

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Science Plan: Strategic Approaches – Acquire and integrate data over a range of temporal and spatial scales, across disciplines

WIND (HURRICANE) EXAMPLE ILLUSTRATING LINKS BETWEEN STRATEGIC APPROACHES, INSTRUMENTATION, AND DATA COLLECTION PRODUCTS

Overarching Strategic Reconnaissance Research Approaches

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