NHERI RAPID Facility

Equipment Wishlist

W
ADL
OSU
VT
UF
Rapid EF: Intellectual Merit

The RAPID EF will provide *infrastructure* and *services* to enable the next generation of reconnaissance-based natural hazards research.

- Portfolio of state-of-the-art field data collection tools
- Software tools
- Visualization facility
- Advisory and field services to support reconnaissance
- Training workshops and activities
RAPID EF: Transformative Aspects

Unprecedented amount of high-quality, open-source disaster data

- High-resolution, systematic data collection (reduce biases; increase certainty)

- Shift from 2D to 3D; leads to new analysis and scientific approaches that consider the 3D nature of these hazards and the systems affected by them

- Collection and integration of engineering, and natural and social science data sets

- Greatly expanded community of reconnaissance investigators
Facility Resources

> Advanced Geomatics Technologies
> Seismic Instrumentation
> Wind and Storm Surge Instrumentation
> Social Science Reconnaissance Equipment
> Ground Investigation
> Imaging Equipment
> Software tools
# Technology and the Science Plan

<table>
<thead>
<tr>
<th>Category</th>
<th>Subcategory</th>
<th>Surveying &amp; Adv. Visualization Technology</th>
<th>Seismic, Ground, Wind &amp; Storm Surge Instrumentation</th>
<th>Social Science</th>
<th>Image/Video</th>
<th>Computer Servers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community Resilience Framework</td>
<td>Systematic Data Collection</td>
<td>Accurately geospatial data digitally preserving site conditions after disaster.</td>
<td>Accurately local readings construct or site with high temporal resolution.</td>
<td>Enables a systematic framework to collect and document information from the public.</td>
<td>Visual documentation of post-disaster conditions</td>
<td>Provides data storage and processing capabilities prior to DesignSafe archiving</td>
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<tr>
<td></td>
<td>Advance Existing Seismic Loss Models</td>
<td>Provides detailed record of what was lost as well as high-quality data to support the development of fragility curves and damage estimates.</td>
<td>Supports investigation of immediate damage and loss and subsequent recovery.</td>
<td>Engages community and obtains input on their perceptions and priorities.</td>
<td>Visual documentation of post-disaster conditions</td>
<td>Provides data storage and processing capabilities prior to DesignSafe archiving</td>
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<tr>
<td></td>
<td>Calibrate Resilience Framework</td>
<td>Provides a virtual replica of the site and conditions</td>
<td>Supports investigation of immediate damage and loss and subsequent recovery.</td>
<td>Engages community and obtains input on their perceptions and priorities.</td>
<td>Visual documentation of post-disaster conditions</td>
<td>Provides data storage and processing capabilities prior to DesignSafe archiving</td>
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<tr>
<td>Hazard and Impact Simulation and Decision Making</td>
<td>Computational Simulation and Data to Support Simulations</td>
<td>Visualization and interaction with simulations</td>
<td>Input data to feed simulations</td>
<td>Input data to feed simulations</td>
<td>Visual documentation of post-disaster conditions</td>
<td>Provides data storage and processing capabilities prior to DesignSafe archiving</td>
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<td>Identifying Critical Vulnerabilities</td>
<td>Digital record of the site can be virtually explored to identify vulnerable sections and contextualize observations.</td>
<td>Help identify locations and structural types that experience the highest intensities.</td>
<td>Understand how the public utilities infrastructure and what poses the most risk.</td>
<td>Visual documentation of post-disaster conditions</td>
<td>Provides data storage and processing capabilities prior to DesignSafe archiving</td>
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<tr>
<td>Mitigation</td>
<td>Evaluate Loss Estimation Methods</td>
<td>Provides detailed damage state information.</td>
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<td>Provides detailed damage state information.</td>
<td>Visual documentation of post-disaster conditions</td>
<td>Provides data storage and processing capabilities prior to DesignSafe archiving</td>
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<td></td>
<td>Evaluate Mitigation Techniques</td>
<td>Data can be collected and analyzed to evaluate performance of various techniques.</td>
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<td>Visual documentation of post-disaster conditions</td>
<td>Provides data storage and processing capabilities prior to DesignSafe archiving</td>
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<td>Sustainable and Resilient Building Materials</td>
<td>Can be used to evaluate the performance of such materials.</td>
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<td>Visual documentation of post-disaster conditions</td>
<td>Provides data storage and processing capabilities prior to DesignSafe archiving</td>
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<td>Design Tools</td>
<td>Innovative Structural Concepts</td>
<td>Can be used to evaluate the performance of innovative design techniques.</td>
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<td>Visual documentation of post-disaster conditions</td>
<td>Provides data storage and processing capabilities prior to DesignSafe archiving</td>
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<td>Define Model/Relationship</td>
<td>Input and validation data for models. Geospatial data provides a basis to link and contextualize observations.</td>
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Virtual Reconnaissance

GeoMAT Mini-CAVE (~$10k)

Beyond the Hype

Data Quality Control

Data Extraction

Immersive, interactive experience

Observations in context

Unlimited measurement extraction

Perform visual assessments

Geometric modeling & Analysis

Data from the 2015 Ghorka Nepal Earthquake
Nyatapola Temple, Bhaktapur, Nepal (2015)
VR CAVE Demo

Port Hills, Christchurch, New Zealand (2014)
Online web access to data (Potree & Entwine)

Nyatapola Temple, Bhaktapur, Nepal (2015)
General Surveying & Mapping Devices

- Leica MS60 Multi-Station or TS60 Total Station
- Leica DNA03 Digital Level
- Trimble Geo 7x
- Trimble VR10
- Leica GS16
Lidar

Leica BLK-360

Riegl VZ400 with Trimble R8

Leica P40

Faro Focus 3D

Riegl VZ-1000

Maptek I-Site

Faro Freestyle

Leica Pegasus Backpack
Terrestrial lidar surveys

Dichato, Chile (2010)
Drones

- DJI Phantom 4
- DJI Inspire 2
- Sensefly-Albris
- Trimble UX5 HP
- Riegl Ricopter (VUX-1UAS)

**Sensors**
- Cameras
- Hyperspectral
- Thermal
- Lidar (and georef solution)
- Sense and Avoid
Drone (UAS) SfM 3D point clouds
Imaging Systems

Gigapan

FLIR T620 (Photo Busse 2013)

Spectra TF Imaging Systems
Seismic Instrumentation

Kinematics
Accelerometers

MEMS
(digikey.com)

Tiltmeter

Nanometrics Titan SMA

Ambient Vibration
(Photo from: Drexel Intelligent Infrastructure Institute)
Ground Investigation

- Geophones (GeoFact Gmbh)
- Vane Shear
- Dynamic Cone Penetrometer (Photo from: MnDOT)
- Pocket Penetrometer (Certifiedmtp.com)
- Torvanes (Durham Geo Slope Indicator)
Social Science

Mobile EEG Headset Devices

Photo by: Jeff Geerling

Balance of professional quality with portability

Wind

Tripod Mounted Anemometers

Video Cameras
Software

• What would you like to see? What features?
  – Media capabilities
  – Location
  – Synching with Design Safe
  – Collaborative tools
  – Crowdsourcing
RapPack

• Suggest packing list for rapid crews
• Or ready to go backpacks with smaller tools
• Items important to recon but inexpensive:
  – Smart device with camera, GPS, etc.
  – Measuring tapes, laser range finder, or disto
  – Pocket Penetrometer
  – First Aid
  – Hand level
  – Pocket Rod
  – Scale
  – Etc.

Smart Devices (Chen et al. 2013 & Intergraph Corp. 2013)
Consideration during discussion

> Portability
> Durability
> Cost
> Range
> Accuracy
> Resolution
> Integration

> Field efficiency
> Technology Maturity
> Technology Evolution
> Downstream data processing
> Ease of use/training
> Survey vs Citizen Science

Things you want available for periodic use through the RAPID.
Not things you would buy yourself or already have!
Blend of old school and new devices?
DISCIPLINE-SPECIFIC TOOLS AND SUPPORT NEEDS ACTIVITY

> Tables organized by disciplines
  - Structural, Geotechnical, Coastal, Social

> Brainstorm individually using worksheet
  - Place sticky notes on poster boards; describe & review ideas

> Refine as Group
  - Identify redundancies and similarities
  - Add more detail / replace ideas
  - Cluster
  - Name clusters

> Rank as Group
  - Discuss priorities
  - Dot vote: 5 dots, one dot per idea