The Future of Seismic Geo-Forensics

(which would make us the Seismic Geo-Forensics Working Group as opposed to Geo-Recon Working Group)

J. David Frost, Ph.D., P.E., P.Eng.
Georgia Institute of Technology
Traditional Field Data Collection
Technology for “Smart” Engineer

Field Reconnaissance Equipment
- Digital Camera
- Handheld GPS
- Barcode Scanner
- Digital Voice Recorder

Analysis & Data Reduction Equipment
- Laptop Computer
- Maps/Reports

Conduit to Upload & Link Data
“Soft-Story” Inventory
PSoft™ Overview

- Utilized for rapid pre-event screening of buildings with a potential soft story for municipal program.
- Software based on a form that city engineers created
- Types of data recorded
  - Building/structure properties
  - Usage (know where to search for survivors)
  - Vulnerabilities
  - Possible solutions/retrofit
- Upload field data into Access database
PSoft™ Example
PSoft™ Example (cont.)
Earthquake Damage Reconnaissance
PQuake™ Overview

- Integrated data acquisition and analysis software
- Record feature and/or area damage
- Links location, photographic and other digital data
- Keeps engineer “within data loop”
- Facilitates consistent/complete data
- Upload data into GIS extension
Dam Failure Example
ArcGIS® Extension

• Rapidly assimilate data from multiple users
• Query data based on information type
  – e.g. Select all 5 story buildings that collapsed from soft story failure
  – e.g. Show location of all sand blow features
• Query individual features
• Create comprehensive maps of damage sites
• Real-time reconnaissance planning
• Integrated transfer of data to “home base”
**PQuake™ Event Query**

### Feature Type
- All
- Building
- Life Line Infrastructure
- Transportation Facility
- Geotechnical Structure
- Earthquake Feature
- Miscellaneous Feature
- Regional Assessment

### General
- User: [ ]
- Date: [ ]

### Feature Classification
- Residential
- Commercial
- Industrial
- Religious
- Government
- Educational

### Number of Floors
- All
- > [ ]
- < [ ]
- OR
- > [ ] & < [ ]

### Structure Type
- Steel Moment Frame
- Wood - Light Frame
- Steel Braced Frame
- Steel Light Frame
- Steel Frame w/ Conc Shear Walls
- Steel Frame w/ URM Infill Walls
- Point Conc Moment Resisting Frame
- Mobile Home
- Concrete Shear Walls
- Concrete Frame w/ URM Infill Wall
- Precast-Conc TiltUp Walls
- Precast-Conc Frm w/ Conc Shear Walls
- RM Bear Wall w/ Wood or Metal Diaphragm
- RM Bear Wall w/ Precast Conc Diaphragm
- URM Bearing Walls
- Mobile Home

### Failure Type
- Insufficient reinforcement
- Column shear
- Column rotate
- Plastic hinge
- Plastic deform
- Slides off found.
- Shear wall crack
- Shear wall bend
- Shear wall joint
- Brace yielding
- Brace buckling
- Connection
- Wall buckling
- Wall shear
- Soft story
- Found. shear
- Weld damage
- Spalls/cracks
- Short column
- Rocking

### Query Controls
- Run Query
- Save Current Query
- Exit
PQuake™ Feature Query

Click to view earthquake feature information.
Beyond Handheld Systems
Next Generation...
Importance of Seismic Geo-Forensics

- Proposed approach opens up new opportunities for integration of forensic studies in education and research
- Ability to involve larger “Response Team” than those operating in immediate earthquake zone
- Ability to “take” students to site and show them consequences of poor engineering and/or unanticipated loading conditions
Research Issues

• Data collection protocols and standards
• Platform software development
• Multi-scale system integration
• Tele-reconnaissance
• Information compression and transmission
• Simulation analysis and feedback
Conclusions

• All forensic engineering studies rely on information.....

• Digital technologies offer key to ensuring information of highest quality in sufficient quantity is available in a timely manner.....

• Need to develop protocols for data collection and information archiving.....

• Forensic education can be significantly enhanced by adoption of these technologies into practice.....
Thank you.