RECENT EARTHQUAKES & GEER

GEESD IV Sacramento

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Georgia Institute of Technology

Session Outline

- Complimentary efforts…Youd
- GEER…Bray
- Pisco 8/15/07 Response…Rodriguez-Marek
- Niigata Chuetsu-Oki 7/16/07 Response…Kayen
- Panel & Audience Discussion…ALL

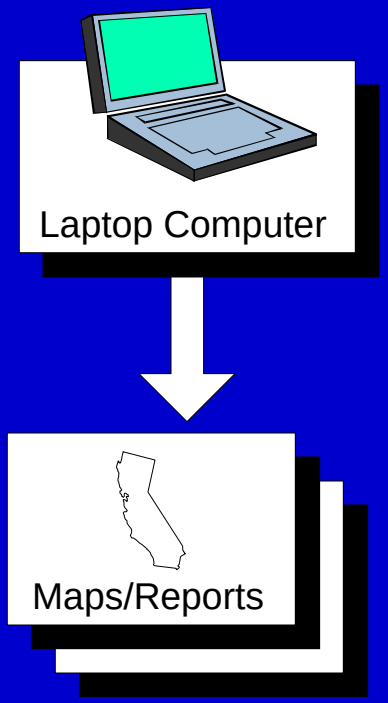
Traditional Field Data Collection

Technology for “Smarter” Engineer

Field Reconnaissance Equipment

Conduit to Upload & Link Data

Analysis & Data Reduction Equipment



Example of Technology Usage

- 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

Example Data Categories

Building
Residential Commercial Industrial Religious Government Educational

Lifeline Infrastructure
Water Sewer Gas Telecom Electrical

Transportation Facility
Road Rail Bus Ferry Port Airport

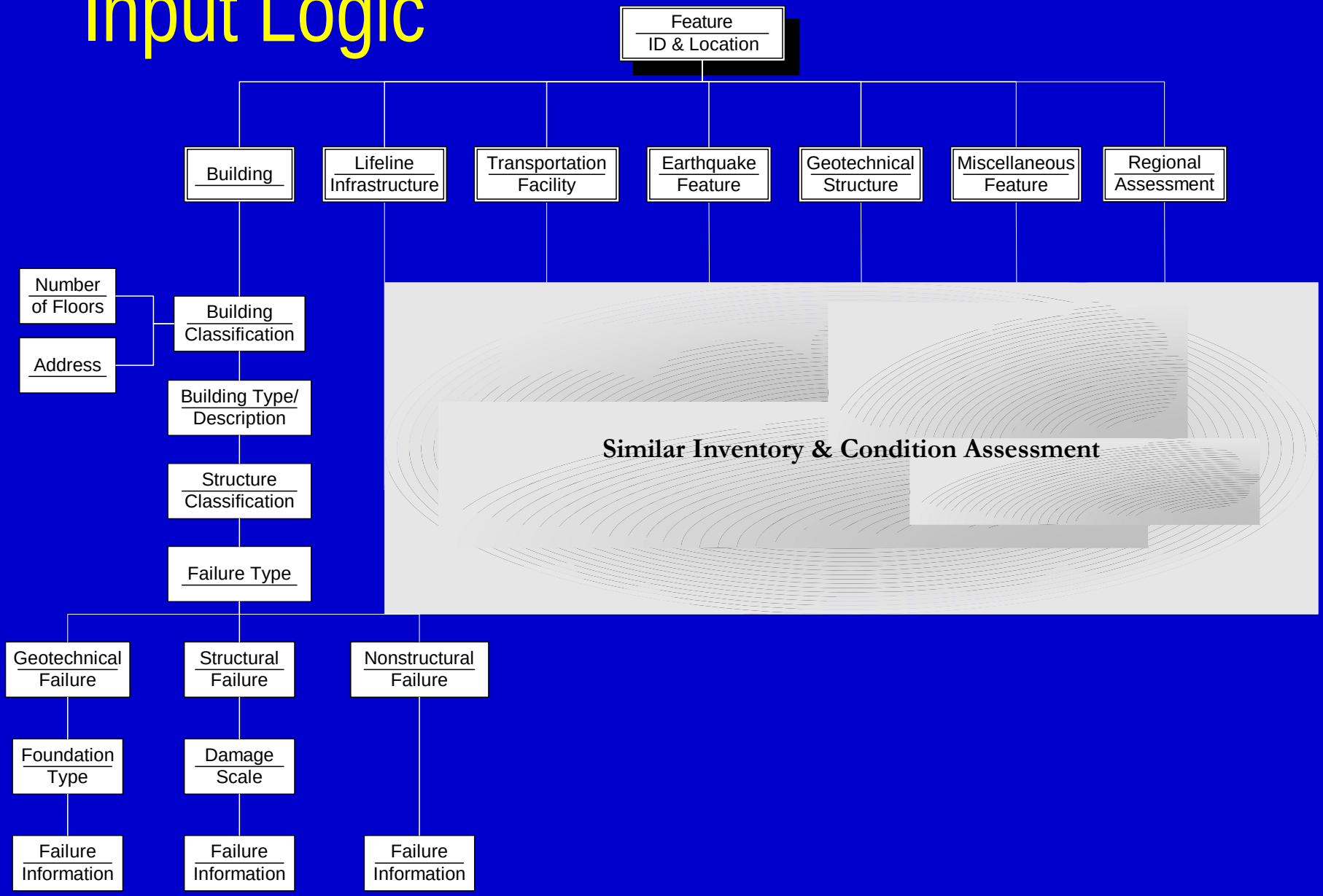
Geotechnical Structure
Dam/Levee Retaining Wall Landfill Embankment Cut Slope

Earthquake Feature
Landslide Fault Rupture Circular Sand Blow Linear Sand Blow Ground Cracking Lateral Spread

Miscellaneous Feature
Seismograph Wall

Regional Assessment
Block Street District Village Town City

Input Logic

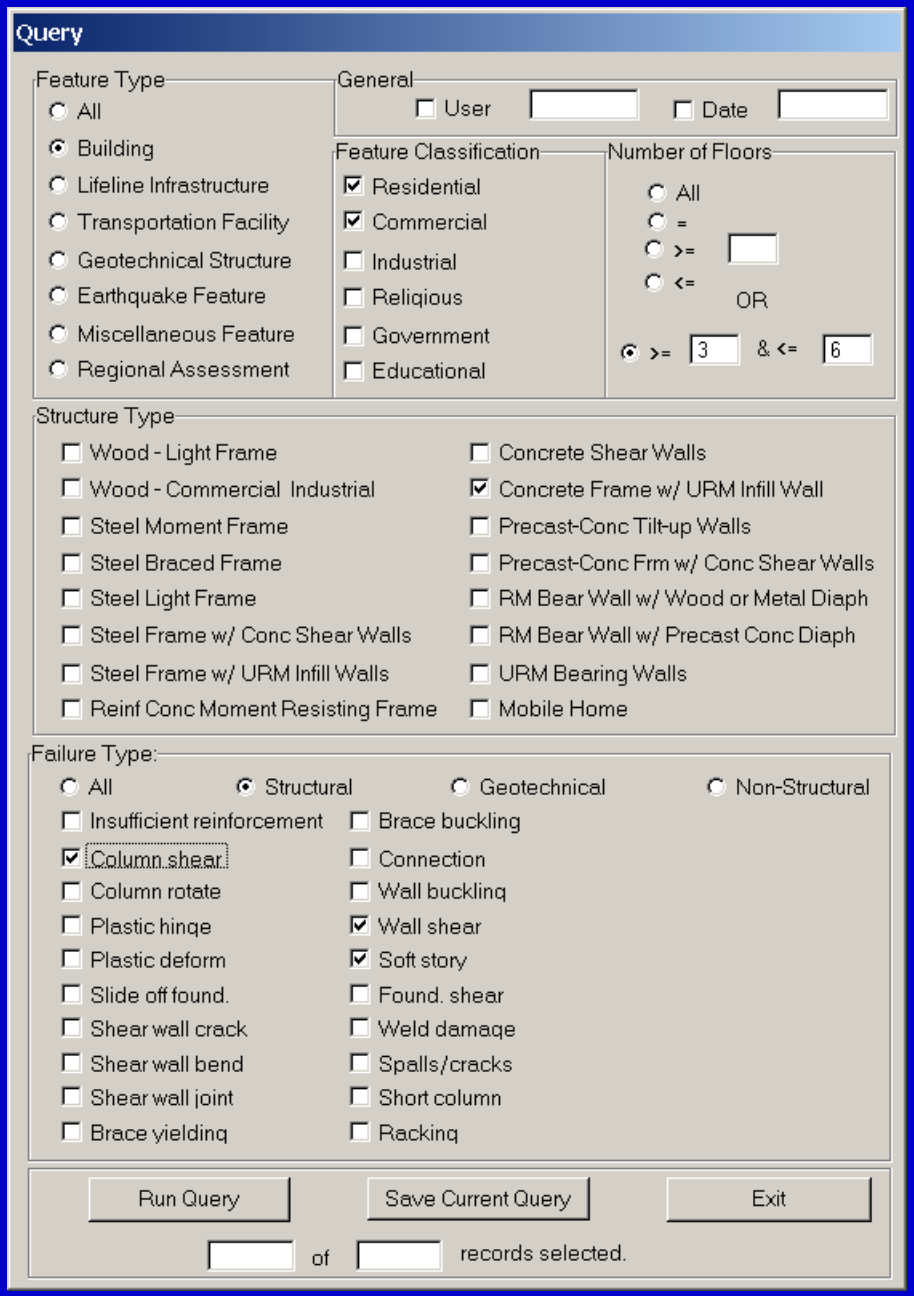

Feature
ID & Location
Building
Lifeline
Infrastructure
Transportation
Facility
Earthquake
Feature
Geotechnical
Structure
Miscellaneous
Feature
Regional
Assessment
Number
of Floors
Address
Building
Classification
Building Type/
Description
Structure
Classification
Failure Type
Similar Inventory & Condition Assessment
Geotechnical
Failure
Structural
Failure
Nonstructural
Failure
Foundation
Type
Damage
Scale
Failure
Information
Failure
Information
Failure
Information

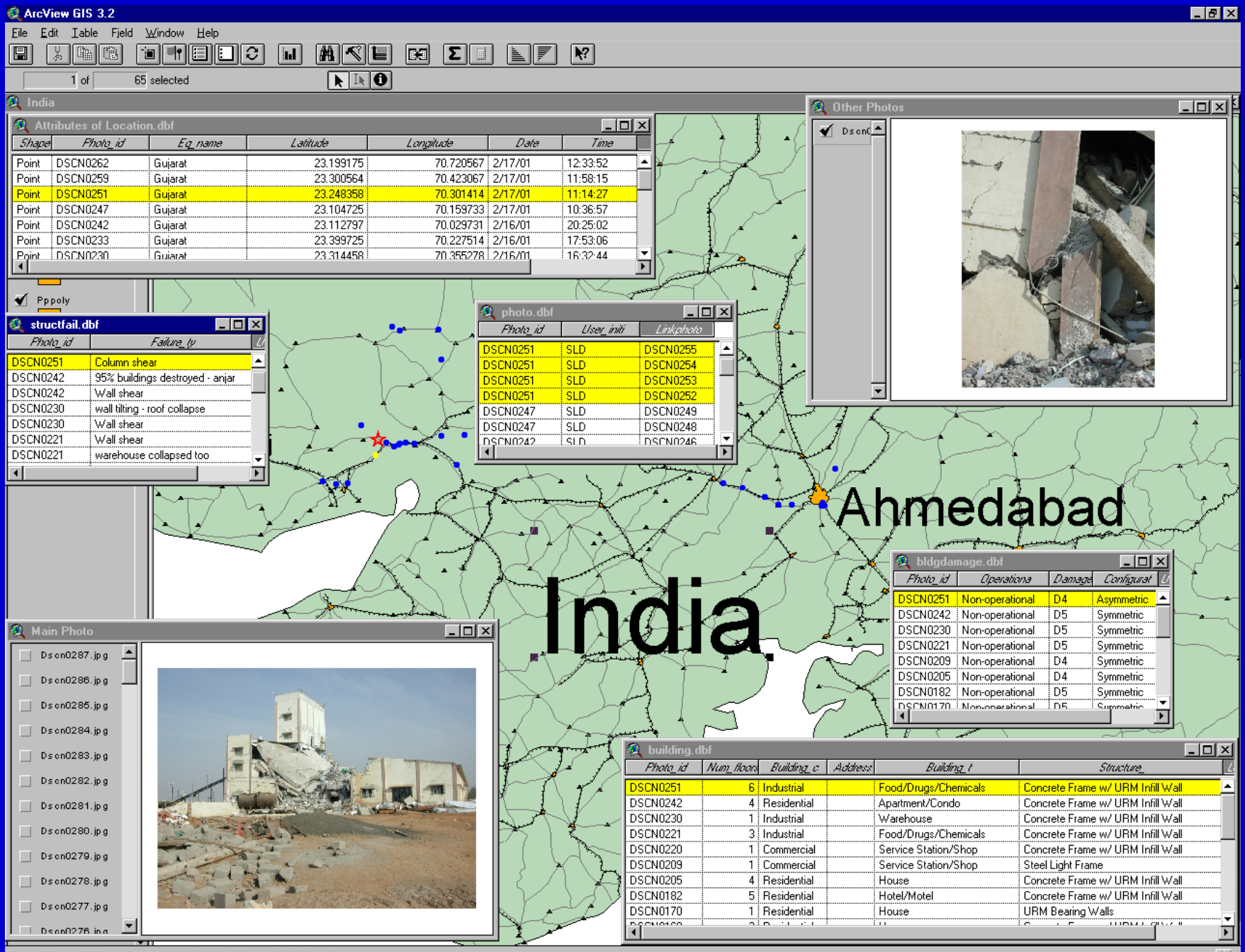
Dam Failure Example

Back-end – (e.g. 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”

Example Event Query

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1 of 65 selected
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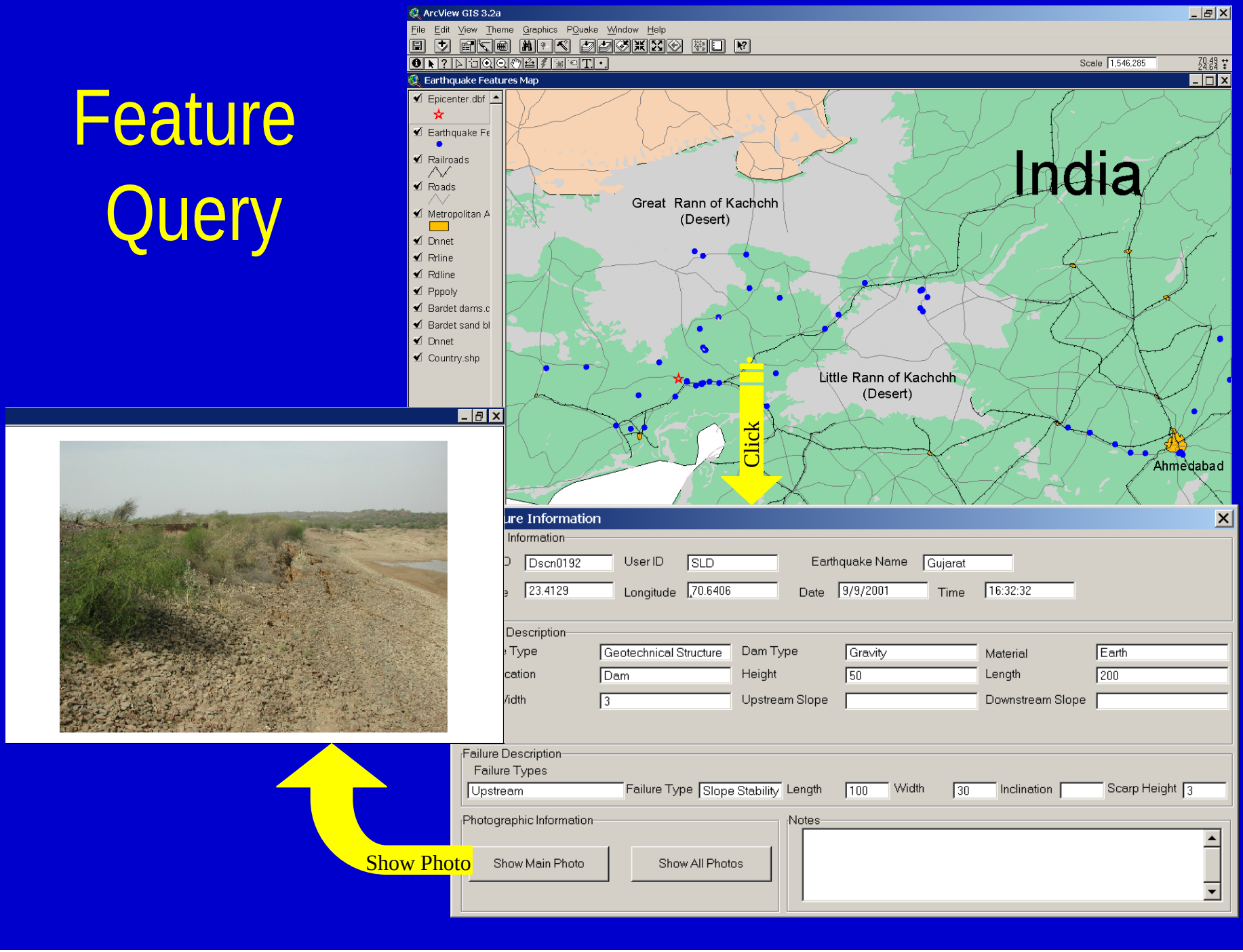
Point DSCN0259 Gujarat 23.300564 70.423067 2/17/01 11:58:15
Point DSCN0251 Gujarat 23.248358 70.301414 2/17/01 11:14:27
Point DSCN0247 Gujarat 23.104725 70.159733 2/17/01 10:36:57
Point DSCN0242 Gujarat 23.112797 70.029731 2/16/01 20:25:02
Point DSCN0233 Gujarat 23.399725 70.227514 2/16/01 17:53:06
Pppoly
structfail.dbf
Photo_id Failure_ty
DSCN0251 Column shear
DSCN0242 95% buildings destroyed - anjar
DSCN0242 Wall shear
DSCN0230 wall tilting - roof collapse
DSCN0230 Wall shear
DSCN0221 Wall shear
DSCN0221 warehouse collapsed too
photo.dbf
Photo_id User_initi Linkphoto
DSCN0251 SLD DSCN0255
DSCN0251 SLD DSCN0254
DSCN0251 SLD DSCN0253
DSCN0251 SLD DSCN0252
DSCN0247 SLD DSCN0249
DSCN0247 SLD DSCN0248
Other Photos
Ahmedabad
India
bldgdamage.dbf
Photo_id Operationa Damage Configurat
DSCN0251 Non-operational D4 Asymmetric
DSCN0242 Non-operational D5 Symmetric
DSCN0230 Non-operational D5 Symmetric
DSCN0221 Non-operational D5 Symmetric
DSCN0209 Non-operational D4 Symmetric
DSCN0205 Non-operational D4 Symmetric
DSCN0182 Non-operational D5 Symmetric
Main Photo
Dscn0287.jpg
Dscn0286.jpg
Dscn0285.jpg
Dscn0284.jpg
Dscn0283.jpg
Dscn0282.jpg
Dscn0281.jpg
Dscn0280.jpg
Dscn0279.jpg
Dscn0278.jpg
Dscn0277.jpg
building.dbf
Photo_id Num_floors Building_c Address Building_t Structure_
DSCN0251 6 Industrial Food/Drugs/Chemicals Concrete Frame w/ URM Infill Wall
DSCN0242 4 Residential Apartment/Condo Concrete Frame w/ URM Infill Wall
DSCN0230 1 Industrial Warehouse Concrete Frame w/ URM Infill Wall
DSCN0221 3 Industrial Food/Drugs/Chemicals Concrete Frame w/ URM Infill Wall
DSCN0220 1 Commercial Service Station/Shop Concrete Frame w/ URM Infill Wall
DSCN0209 1 Commercial Service Station/Shop Steel Light Frame
DSCN0205 4 Residential House Concrete Frame w/ URM Infill Wall
DSCN0182 5 Residential Hotel/Motel Concrete Frame w/ URM Infill Wall
DSCN0170 1 Residential House URM Bearing Walls
Origin: (71.14, 22.22) dg Extent: (81.30, 42.34) mi Area: 3,442.17 sq mi

Feature Query



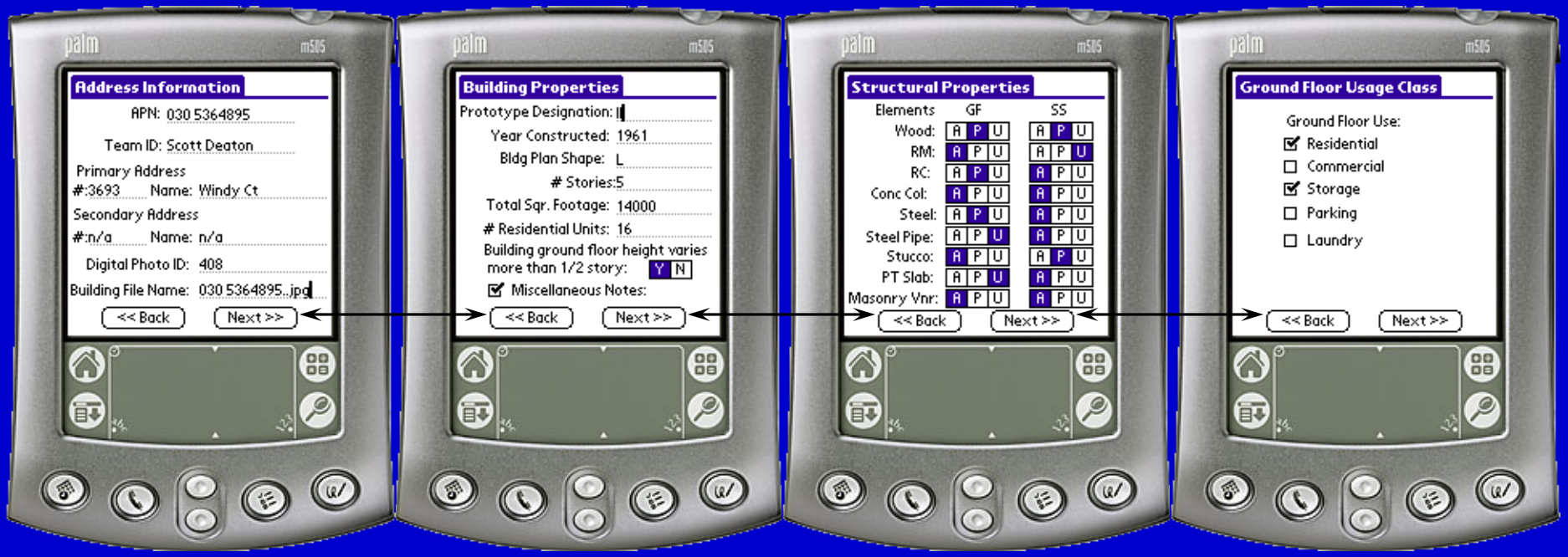
What About “Event Planning”

Soft Story Failures

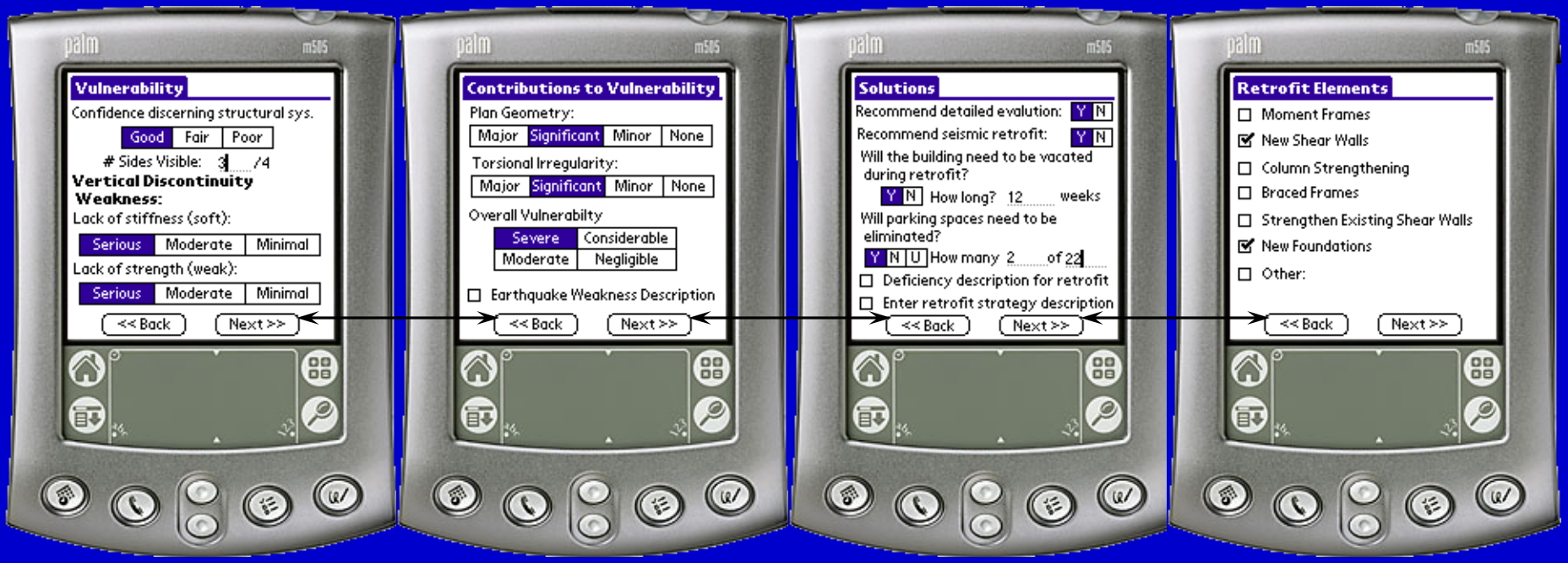
Example of Technology Usage

- 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

Soft Story Example



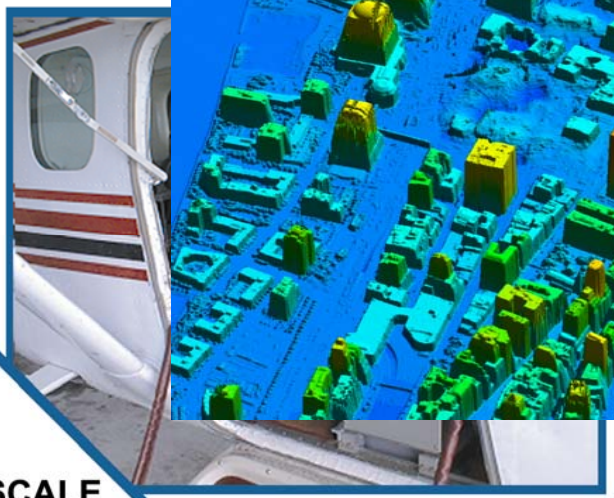
Soft Story Example (cont.)



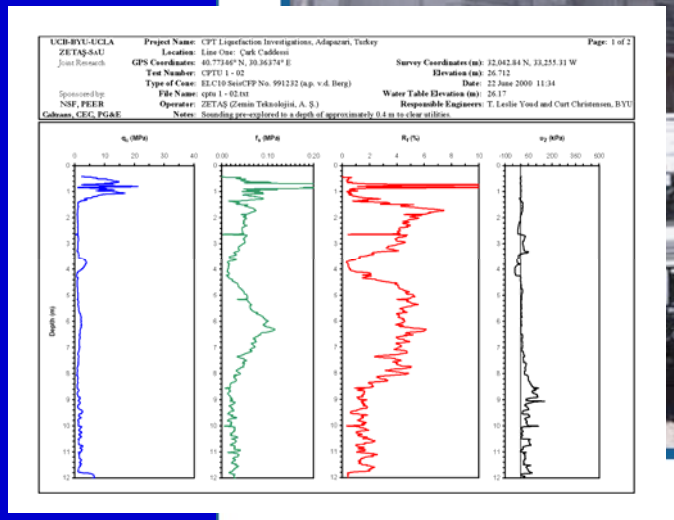
Beyond Handheld Systems

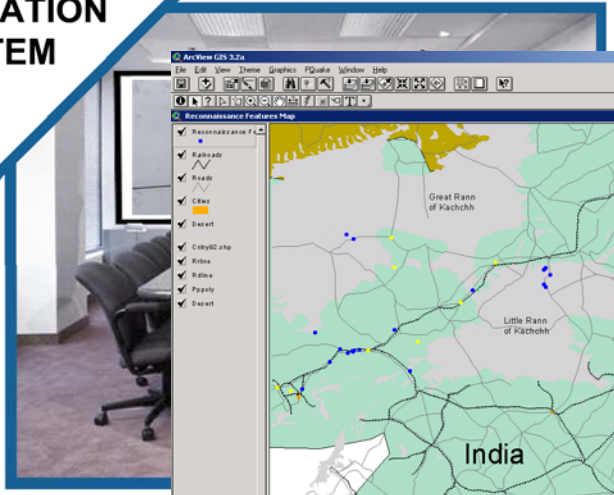
Next Generation...

Next Generation...



MULTI-SCALE DIGITAL INFORMATION SYSTEM





Important Future Role of Technology

- Opens up new opportunities for integration of geo-reconnaissance studies in education and research
- Ability to involve larger “Response Team” than those operating in immediate earthquake zone
- Ability to access areas that may have been isolated by event damage
- Ability to “virtually take” students to field and show them consequences of poor engineering and/or unanticipated loading conditions

Research & Development Issues

- Data collection protocols and standards
- Platform issues
- Multi-scale system integration
- Tele-reconnaissance
- Information compression and transmission
- Simulation analysis and feedback

Conclusions

- All geo-engineering studies rely on information…..
- Digital technologies offer key to ensuring information of highest quality in sufficient quantity is available in a timely manner…..
- Urgent need to develop protocols for data collection and information archiving…..
- Geo-earthquake engineering education can be significantly enhanced by adoption of these technologies into practice…..

Thank you.