Los Angeles Inventory of Nonductile Concrete Buildings for Analysis of Seismic Collapse Risk

PEER Annual Meeting

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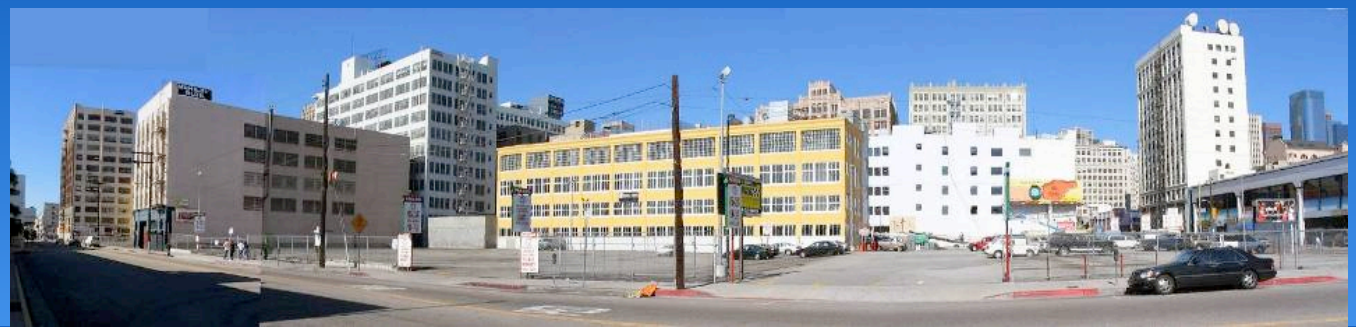


Pilot Study

- Regional seismic hazard
- Loss estimate
- Simulation of mitigation

Laboratory and Field Tests

- Older-type columns
- Retrofitted columns
- Beam column connections
- Simplified wall-frame system

NEES Grand Challenge
Mitigation of Collapse Risk in Older Concrete Buildings

Modeling & Simulation

- Improved engineering models
- Improved simulation models

Mitigation Strategy Development

- Develop public policy alternatives
- Test concepts through focus groups and pilot studies

City of Los Angeles Pilot Study

- Identify concrete buildings in city
- Evaluate characteristics of inventory (age, height, size, location, use, structural type)
- Develop rules to classify buildings into risk categories, for example:
  - pre-1976, concrete frame, high-rise, residential → high risk
  - pre-1976, one story, shear wall, commercial → low risk
  - post-1976 → low risk
- Estimate collapse risk
- Simulate improved inventory and evaluate impact on estimated risk

Inventory Data Challenges

- Each building is unique but must classify into distinct number of well defined groups
- Impossible to do building-by-building review for a large city
- No single place to locate inventory data
- Available data sources developed for other purposes
- Data sources can be unreliable (e.g. assessor)
- Data sources have different classification systems
- Not all data sources are public

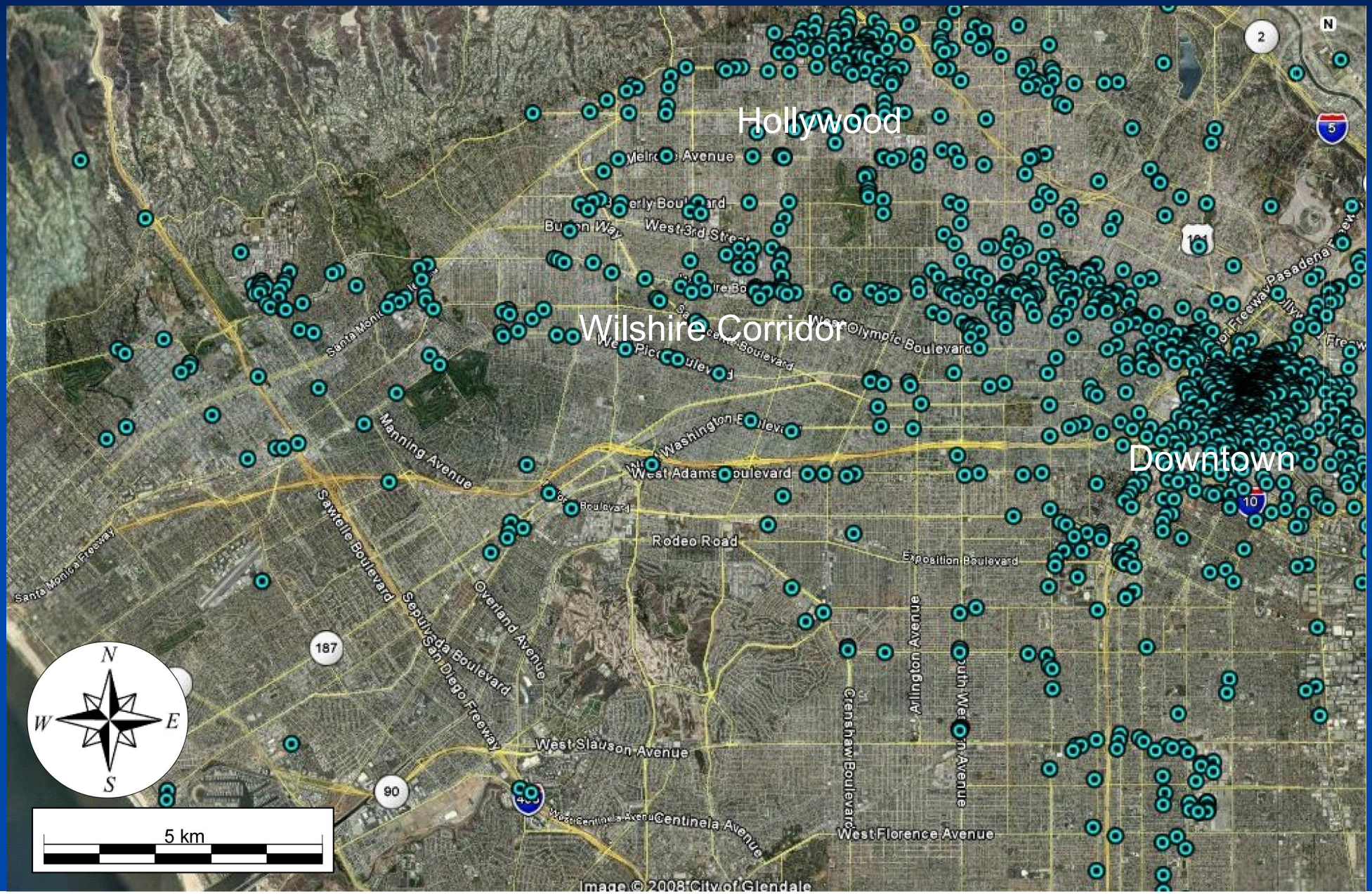
Data & Sources

- **Assessors files** (limited to privately owned and selected city owned properties)
- **Publicly available databases** (ZIMAS, LUPAMS, Adaptive Reuse projects)
- **AB 300 database of schools** (CA Seismic Safety Commission)
- **State-owned buildings** (Dept. of General Services)
- **Public universities** (CSU Chancellor & UC Office of Pres.)
- **Hospitals** (OSHPD)
- **Harbor facilities** (Port of LA)
- **Building plans** (LA Building & Safety, visits to engineers)
- **Visual Data Confirmation** (Sidewalk surveys, Google Streetview, Live Search, Sanborn maps)

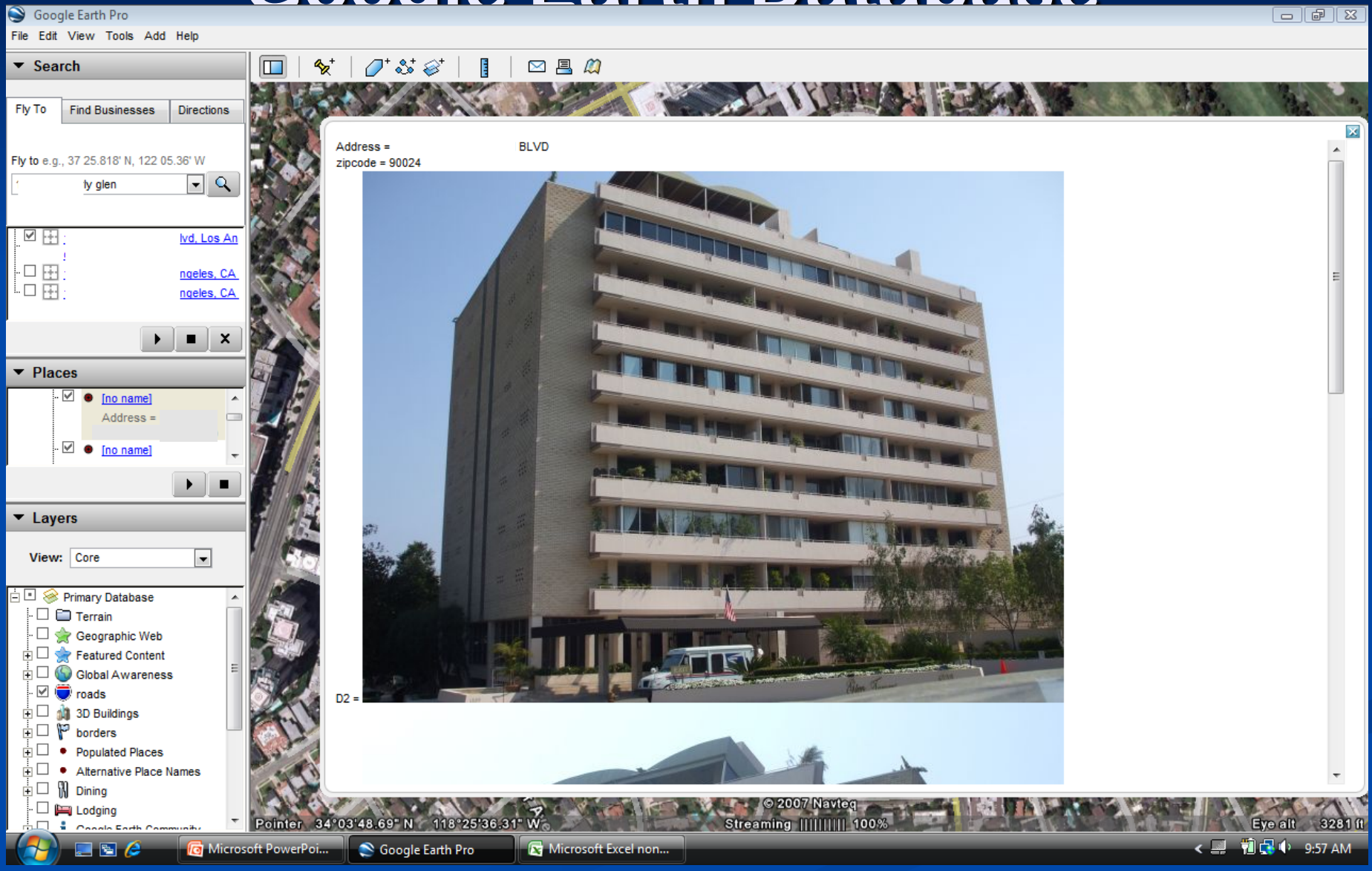
Attributes of Database

- Compiled in Google Earth Pro
  - Geocoding, overlay capabilities, calculation tools
  - Store associated photos, drawings, documents
  - Retrieve data as data file or by viewing individual points
  - Portable to other database software
- Data fields compatible with HAZUS (e.g. # stories, year built, sq ft, structure type etc.)

Mapping Data - Shows Clustering



Individual Point from Google Earth Database

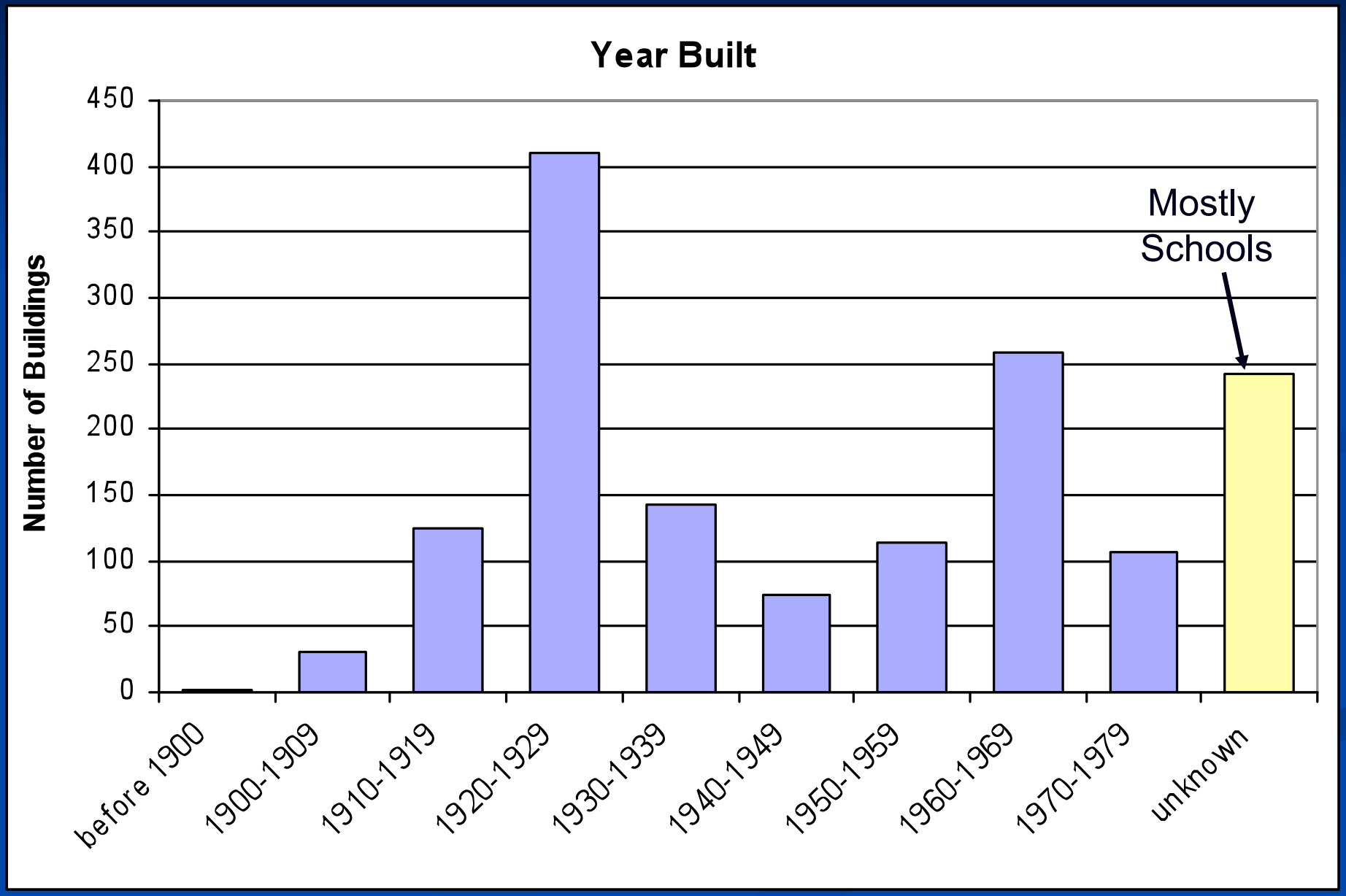


First_Floor_Building_Use = Commercial
Second_Floor_and_Above_Building_Use = Office Space
Year_Built = 1966
Approximate_Length_and_Width__ftxft_ = unknown
Number_of_Stories__without_Penthouse_or_Mezzanine_ = 10
Additional_Levels = 1 penthouse
Number_of_Basements = 3 (parking)
Tall_First_Floor = no
Signs_of_Retrofit = no
Building_Narrows_as_it_Gets_Taller = no
Building_Includes_Address_Range = no
Building_Type = Shear wall around elevator? Gravity columns above pedestal.
Additional_Observations = Vertical discontinuity. 10 columns on 1st floor, 29 above. Saw shear wall around elevator and stairs.

D1 =

Sample Data Entry

Inventory Characteristics



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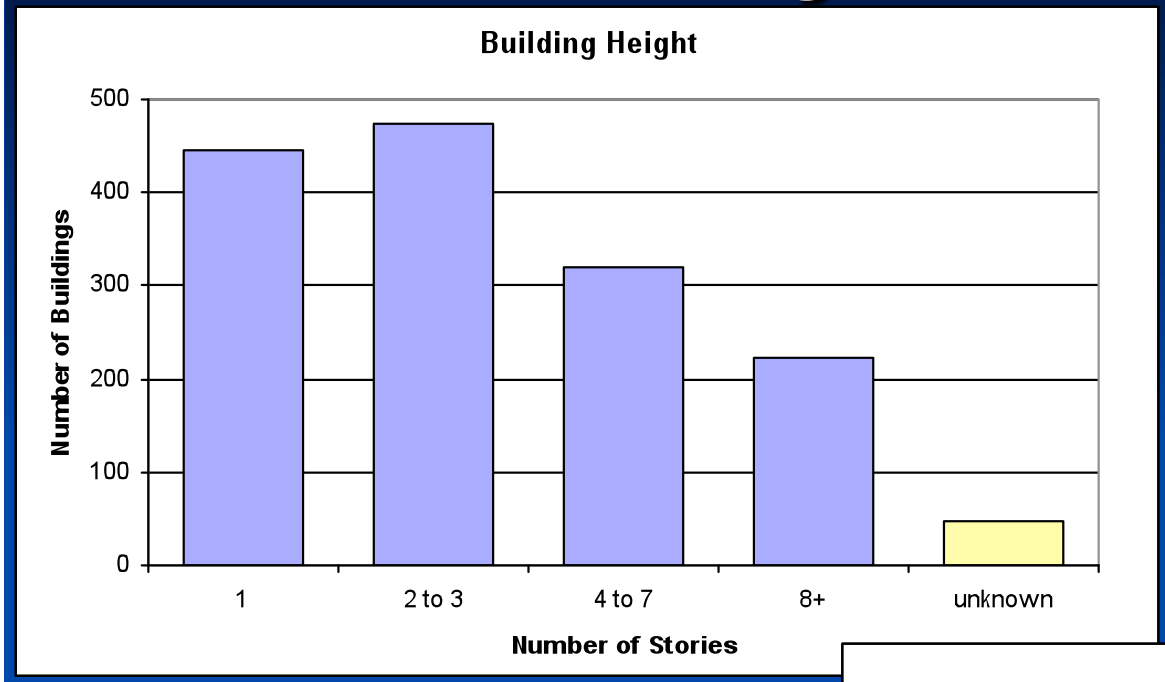

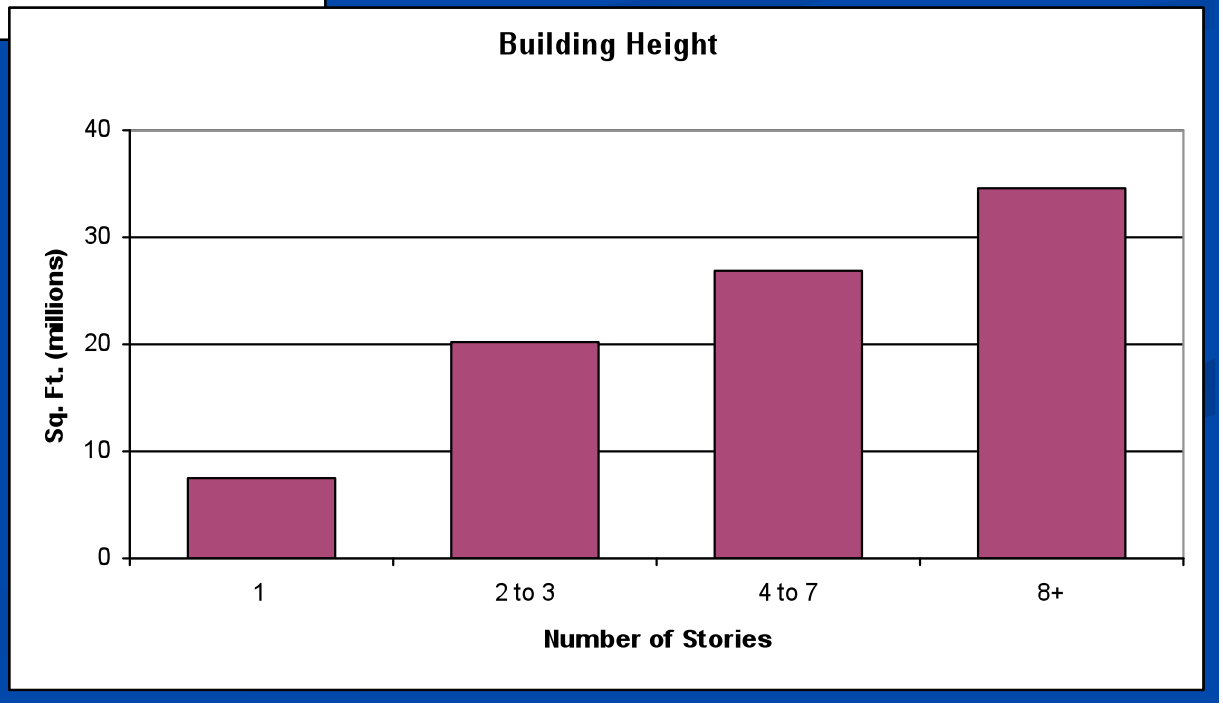

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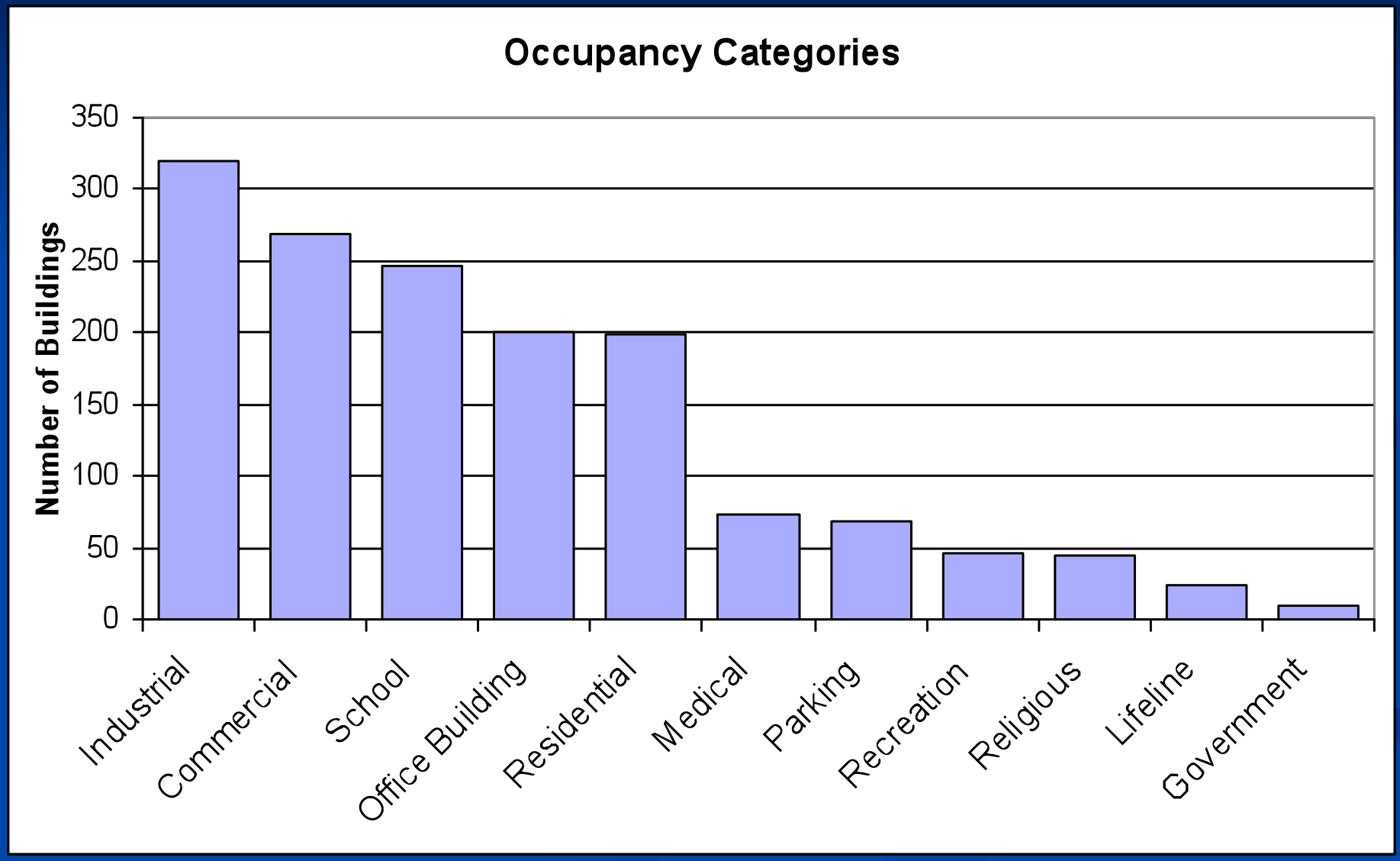

Database Validation

- Select several areas of city
  - A – high concentration in database
  - B – low concentration in database
- Perform detailed sidewalk survey of these areas

Observations

- Concrete bldgs clustered in certain parts of city (likely due to zoning and development era)
- Close to 400 1-story bldgs – these may be buildings we can classify as lower risk
- ~350 buildings in the 1960s and early 1970s, many are high rise →deserve a closer look
- State-owned bldgs & universities → aggressive programs for retrofit – few additional data points
- Schools and hospitals are incomplete may add another 100 buildings
- More than 6.1 million sq ft of identified retrofit

Conclusions

- Database will be incomplete
  - hospitals, schools, airports, utilities, non-profits, and other public buildings
- Los Angeles data not universally representative
  - Each city has unique development and redevelopment patterns
- Understanding the inventory guides engineering approaches
  - knowing prevalent structural types can focus on specific collapse mechanisms
- Understanding inventory guides policy approach
  - number and types of building uses and occupancies influence how cities plan for mitigation