

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

**PEER Annual Meeting
October 16, 2009**

**T. Anagnos, M. C. Comerio, C. Goulet,
H. Na , J. Steele, J. P. Stewart**



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

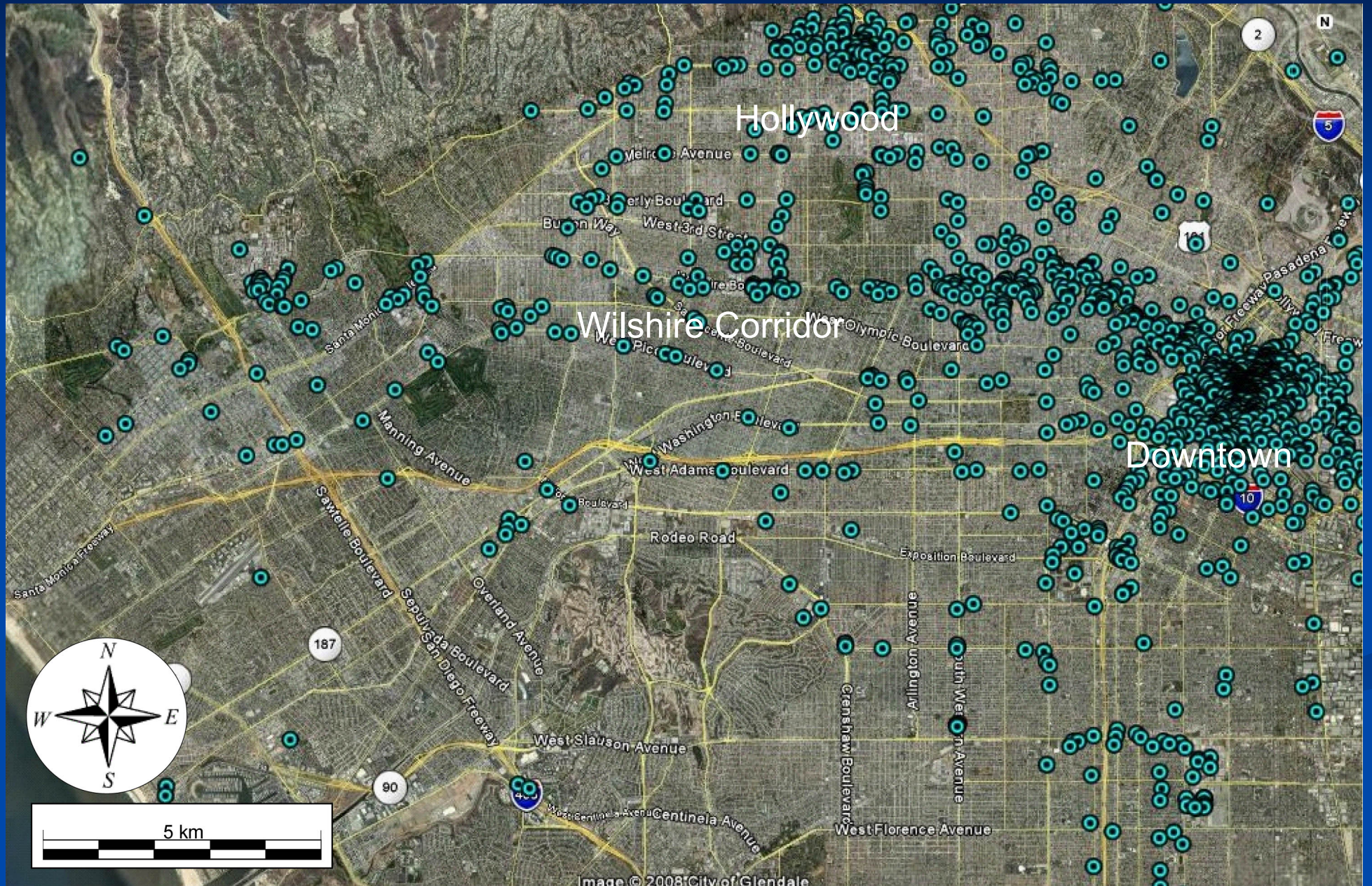
- **Assessors files** (limited to privately owned and selected city owned properties)
- **Publicly available databases** (ZIMAS, LUPAMS, Adaptive Reuse projects)
- **AB 300 database of schools** (CA Seismic Safety Commission)
- **State-owned buildings** (Dept. of General Services)
- **Public universities** (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

The screenshot displays the Google Earth Pro application window. The interface includes a menu bar (File, Edit, View, Tools, Add, Help) and a toolbar with various navigation and search tools. On the left side, there are three main panels: 'Search', 'Places', and 'Layers'. The 'Search' panel shows a search for 'ly glen' with a dropdown menu and a search button. Below it, there are search results for 'lyd, Los An', 'ngeles, CA', and 'ngeles, CA'. The 'Places' panel shows a list of places, including '[no_name]' with an address field. The 'Layers' panel shows a list of layers, including 'Primary Database', 'Terrain', 'Geographic Web', 'Featured Content', 'Global Awareness', 'roads', '3D Buildings', 'borders', 'Populated Places', 'Alternative Place Names', 'Dining', and 'Lodging'. The main view area shows a 3D rendering of a multi-story building with balconies, identified as 'BLVD' with 'Address = zipcode = 90024'. The building is shown in a perspective view, with a street and other buildings visible in the background. The status bar at the bottom of the window shows the current coordinates (Pointer 34°03'48.69" N, 118°25'36.31" W), the streaming status (© 2007 Navteq Streaming 100%), and the eye altitude (Eye alt 3281 ft). The Windows taskbar at the bottom shows the Start button and several open applications: Microsoft PowerPoint, Google Earth Pro, and Microsoft Excel non... The system tray on the right shows the time as 9:57 AM.

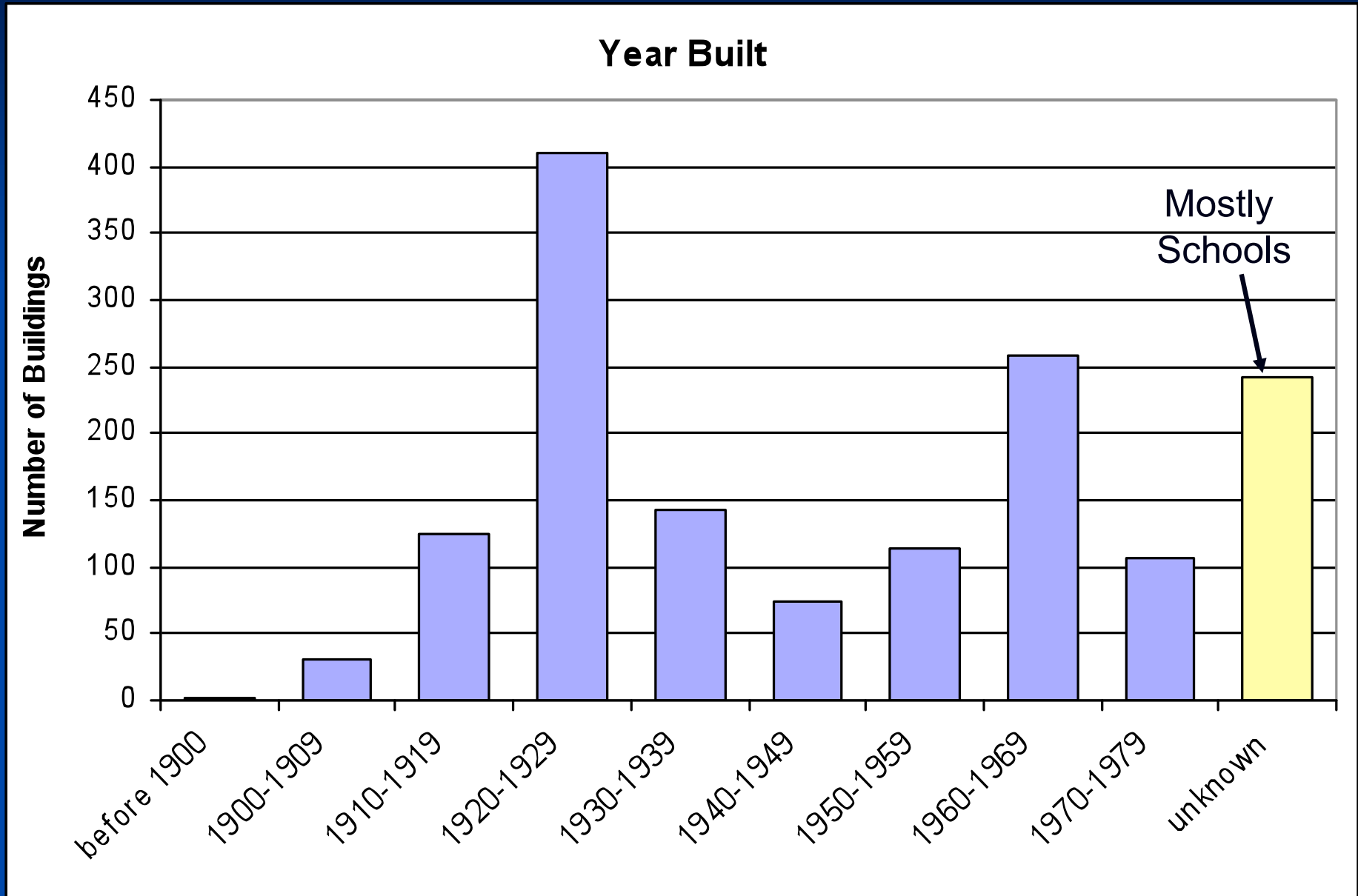
Sample Data Entry

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.



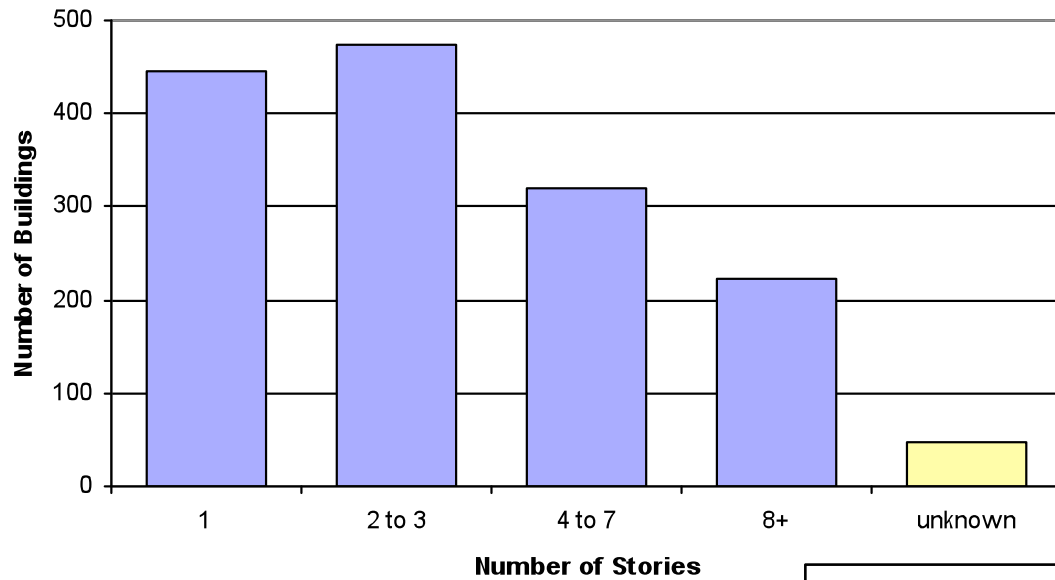
D1 =

Inventory Characteristics

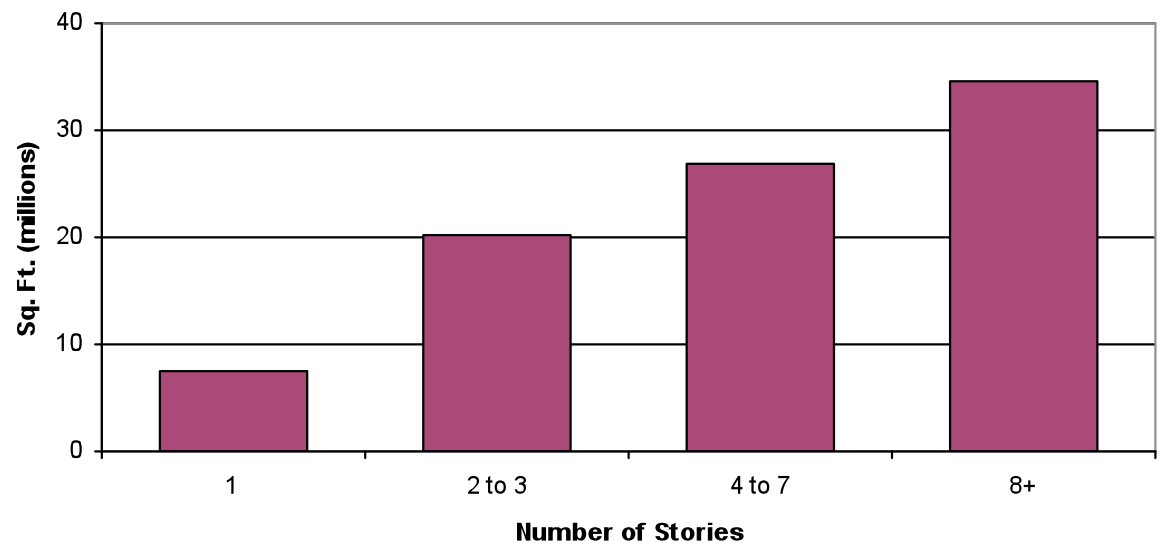


Inventory Characteristics

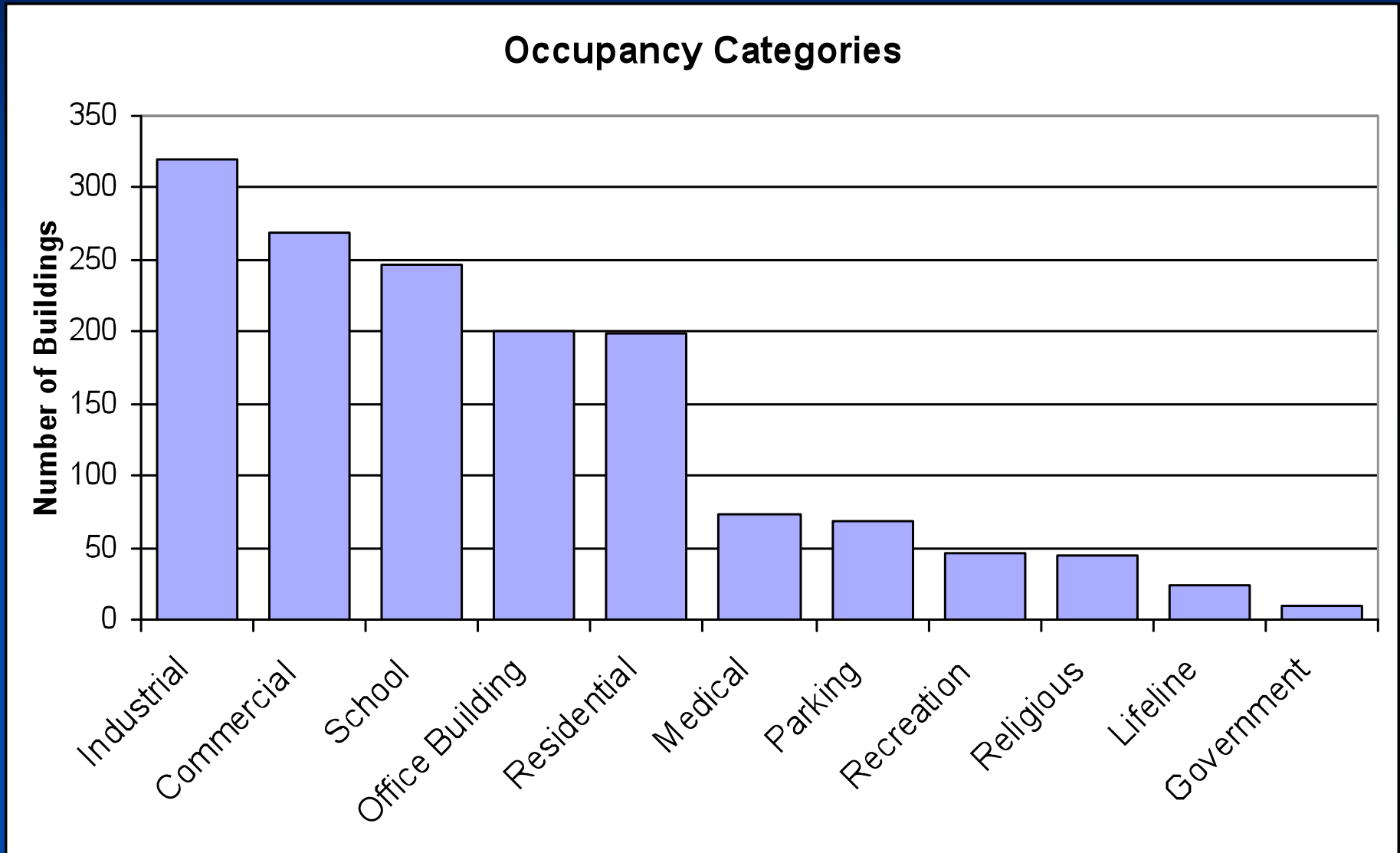
Building Height



Building Height



Inventory Characteristics



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

