

INVENTORY OF NON-DUCTILE CONCRETE BUILDINGS IN HIGH SEISMIC RISK AREAS OF CALIFORNIA

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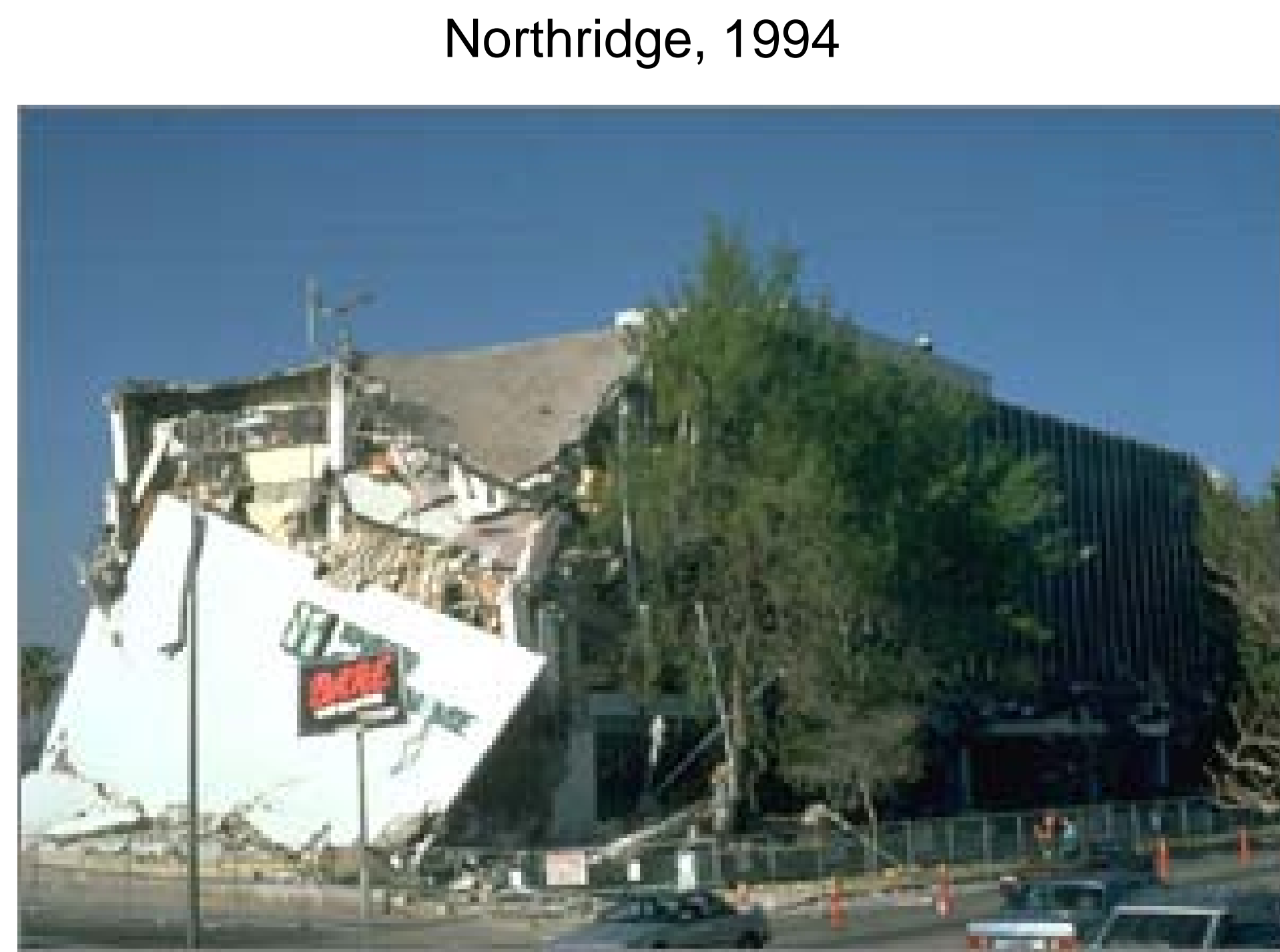
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RESULTS

- Volunteer reports from about 30 cities have yielded a total estimate of approximately 7700 pre-1980 concrete buildings
- Oakland, San Francisco and Los Angeles make up about 6000 of the total estimate
- None of the other cities' estimates break a few hundred, while most are less than 60
- It is possible the total number of non-ductile concrete buildings in California could be more than the once estimate 40,000, but at this point it is difficult to tell
- An accurate total estimate can be determined once we develop and refine a predictive model we feel confident in

CITY	POP.	EMPLOYEES	HOUSEHOLDS	ESTIMATED PRE-80 CONCRETE BUILDINGS
Emeryville	6,882	18,000	5,710	44
Albany	16,444	2,617	7,103	36
Millbrae	20,718	3,518	7,941	52
Burlingame	27,380	20,979	12,221	240
Alameda	70,576	17,391	30,664	150
San Leandro	78,178	39,549	30,805	40
Berkeley	100,744	39,047	46,092	275
Oakland	395,274	110,753	157,616	1300
San Francisco	739,426	390,254	321,692	3100
Los Angeles	4,018,080	1,068,844	1,274,791	1500



Northridge, 1994

INTRODUCTION

- The greatest earthquake risk in the United States is from damage and collapse of older buildings designed with insufficient consideration of earthquake effects
- Non-ductile concrete buildings have proven to perform very poorly in earthquakes
- Common construction type prior to the enforcement of modern seismic code standards for ductile detailing in 1976
- Construction probably continued until 1980 as it almost certainly took a few years for the new code to take full effect
- Has been estimated that there are 40,000 non-ductile concrete buildings in California alone
- Inventory of these buildings in California will provide a better total estimate and their location can also be determined
- Combined with research related to the failure type of these buildings and risk mapping, the most dangerous non-ductile concrete buildings can be pinpointed



Kobe, Japan 1995

WORK CITED

- Kircher, C., Seligson, H., Bouabid, J., and Morrow, G. (2006). "When the Big One Strikes Again – Estimated Losses due to a Repeat of the 1906 San Francisco Earthquake." 100th Anniversary Conference, An Affiliation of Earthquake Scientists, Engineers and Emergency Managers, San Francisco, CA.
- "Mitigation of Collapse Risk in Older Concrete Buildings." Pacific Earthquake Engineering Research Center, <http://peer.berkeley.edu> (Aug. 2009)



Sanborn Map

Google Earth

VOLUNTEER REPORTS

- Practicing engineers are volunteering to provide estimates for the number of non-ductile concrete buildings for numerous northern and southern California cities
- Currently about 30 reports have been submitted with more on the way
- Various approaches and techniques have been used to collect data and provide estimates
- Some sources used include: Sanborn maps (fire insurance maps), zoning & land use maps, Google Earth, talking with buildings officials, field work & street surveying and more.

DATA COLLECTION & PREDICTIVE MODELS

- Extensive census data has been collect for about 350 cities, particularly for the cities in which volunteer reports have been submitted with the goal of identifying characteristics and trends
- Using the census data and volunteer reports, we have been able to work with different samples of cities, looking to identify trends within the data in order to generate regression models
- Have been able to develop statistical predictive models with help of Peter May, a Political Science professor at the University of Washington.
- The predictive models produce estimates and confidence intervals for the cities without volunteer reports using the census data and reported estimates of the cities with volunteer reports.

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CONCLUSION

- "50% of the casualties are coming from 5% of the buildings."
- Not all non-ductile concrete buildings are dangerous and at risk of collapse
- Compiling inventory of non-ductile concrete buildings in California will help to identify which buildings are dangerous
- Once the most dangerous non-ductile concrete buildings are identified, actions can be taken to correctly retrofit the buildings and effective retrofit policy can be developed
- Identifying dangerous buildings and properly retrofitting them will help prevent the next large earthquake in California from being catastrophic

FURTHER INFORMATION

More information about the NEES Grand Challenge Project can be found at www.peer.berkeley.edu and more information about the California Inventory Project can be found at www.concretecoalition.org