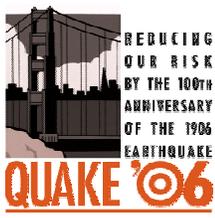


# **APPENDIX C**

## **EERI CA Summary**



# Unreinforced Masonry Buildings Fact Sheet

## 1. What is a URM, and why are they so hazardous?

In California, unreinforced masonry buildings, often called URMs or UMBs, are generally brick buildings constructed prior to 1933, predating modern earthquake-resistant design. The brick is not strengthened with embedded steel bars and is therefore called “unreinforced.”

In earthquakes, the brick walls (especially parapets) tend to disconnect from the building and fall outward, creating a hazard for people below and sometimes causing the building to collapse. URM failures have been responsible for deaths in California earthquakes since at least 1868, and as recently as Loma Prieta in 1989 and San Simeon in 2003.

## 2. Haven’t URM risks been eliminated through California’s 1986 “URM Law”?

No. The URM Law requires certain jurisdictions to adopt a mitigation program, but many have adopted only voluntary programs, contrary to the recommendation of the Seismic Safety Commission. Most URM owners have taken some action, but only some of those actions have substantially reduced the risk by complying with a recommended technical standard (or by demolition). Some URM risks can be reduced by bracing parapets and by generically bolting the brick walls to the building’s roof and floors. More reliable risk reduction, however, requires engineering to technical standards developed specifically for URMs. The first such standard widely used in the Bay Area was published in the 1991 Uniform Code for Building Conservation (UCBC).

## 3. What’s the status in the Bay Area?

In 1990, there were about 6800 URMs in ten Bay Area counties. As of early 2003, about 3000 still do not meet the minimum standards recommended by engineers, though most program deadlines have passed. The current status:

Region (Counties)	URM Buildings	Subject to Mandatory Program	UCBC Compliant in 2003	Demo’d as of 2003	% UCBC compliant or demo’d
East Bay (Alameda, Contra Costa)	3166	2685	2112 <sup>3</sup>	155	72%
North Bay (Marin, Napa, Solano, Sonoma)	1006	254	218	23	24%
Peninsula (San Mateo, Santa Clara, Santa Cruz)	662	305	388	62	68%

Major City	URM Buildings	Program Type & Technical Standard	UCBC Compliant in 2003	Demo’d as of 2003	% UCBC compliant or demo’d
San Francisco	1832	Mandatory strengthening, UCBC w/ exemptions and “Bolts+” modifications. Low interest loan funding available.	1018 <sup>3</sup>	117	62% <sup>3</sup>
Oakland	1612	Mandatory hazard reduction, including “Bolts+”. Voluntary UCBC compliance.	1329 <sup>3</sup>	108	89% <sup>3</sup>
Berkeley	729	Mandatory. Some prescriptive but mostly matching or exceeding UCBC.	612 <sup>3</sup>	6	85%
San Jose	146	Mandatory strengthening to 1991 UCBC. Financial incentives available.	103	12	79%

## Notes and Sources

1. About 25,000 URMs, in various stages of retrofit, remain throughout the state in areas designated as Seismic Zone 4 per the California Building Code in effect in 1986 (SSC, see References below). Zone 4 covers most of coastal California and all ten Bay Area counties considered by this Fact Sheet. Most URMs house commercial uses. In San Francisco, about 38% are residential buildings (Recht Hausrath). About 20% of the Bay Area URMs are designated Historic (SSC). Northridge earthquake inspection data showed that some URMs are more prone to damage (and likely more hazardous) than others: URMs that are tall (4+ stories), narrow, or elongated in plan (as opposed to squarish) suffered more damage in Northridge (p. 2-11) (Lizundia et al.). California earthquake and URM damage history: [http://neic.usgs.gov/neis/states/california/california\\_history.html](http://neic.usgs.gov/neis/states/california/california_history.html) and <http://www.sfmuseum.org/hist4/68oakl.html>.
2. The "URM Law" is SB 547, passed in 1986 (section 8875 of the California Code). It required every jurisdiction in Seismic Zone 4 (including all of the Bay Area) to inventory its URMs by 1990, to adopt a loss reduction program, and to report progress to the Seismic Safety Commission. The 2003 SSC report discusses the relative effectiveness of mandatory, voluntary, and "notification only" programs. For more on the history of the URM Law, refer to the 2003 SSC report, previous SSC reports, and Tobin and Turner.

Los Angeles enacted a parapet ordinance in 1949, San Francisco in 1969. Prescriptive (i.e. generic) approaches for URMs include the so-called "Bolts+" method adopted by San Francisco and Oakland. The UCBC, which evolved from procedures first used in Los Angeles, is no longer published; its URM provisions are now found in Appendix A1 of the 2003 International Existing Building Code (IEBC) and in Chapter 1 of the 2000 Guidelines for Seismic Retrofit of Existing Buildings, both published by the International Code Council ([www.iccsafe.org](http://www.iccsafe.org)). For additional history of codes and design guidelines for URMs, see SSC and SEAOC EBC.

The Structural Engineers Association of Northern California takes the position that UCBC-like criteria are the recommended minimum standard for URM structural retrofit, but acknowledges that a simplified or prescriptive approach can also be beneficial (Phipps), especially where socioeconomic conditions will not support the higher standard. Since most Bay Area jurisdictions started URM programs after Loma Prieta, we do not have robust data linking earthquake performance to retrofit standards. Los Angeles began its program in 1981 with a UCBC-like standard. Lizundia et al. studied the 1994 Northridge earthquake data and concluded that retrofitted buildings performed better than unretrofitted buildings (p. 1-4), though the level of shaking was not high enough in many areas to provide an ideal test. They also found that poor performance of some wall anchors was related to poor quality masonry, poorly located anchors, and undersized hardware (p. 2-15), suggesting that the engineering input and quality control of a higher technical standard might provide better performance than simplified or prescriptive approaches.

3. All figures are from SSC, except for Berkeley and San Francisco. Program deadlines are jurisdiction specific, and larger jurisdictions have phased deadlines for buildings of different priority. For example, Oakland allowed between two and four years from the 1993 notification. San Francisco assigned its buildings to four risk levels. Work on the first three groups was to have been completed by February 15, 2004. The final group is supposed to be complete by February 15, 2006. Source: SF DBI

San Francisco (Source: Ho): UCBC compliance is unknown because 1992 San Francisco Ordinance 225-92 adopted the UCBC as a general procedure but allowed a simplified prescriptive approach (Bolts+) for some buildings. SF DBI estimates that 25% of the city's URMs used Bolts+ (Ho). The 1018 buildings counted here comply with San Francisco's program. It is expected that a large majority of them, even those using Bolts+, also essentially comply with the 1991 UCBC. The actual number of UCBC-compliant buildings might be lower. Re funding: In 1992, voters authorized \$350M in bonds to fund low interest loans to URM owners. 2.5% interest rates are available if the building is maintained for low-income housing. Sources: San Francisco and SF DBI

Oakland: 1107 of the 1329 buildings counted as UCBC-compliant actually comply only with the Oakland's Bolts+ criteria for reduction of falling hazards. Most probably also comply with the 1991 UCBC, but the actual number of UCBC-compliant buildings might be lower.

Berkeley: Figures from <http://www.ci.berkeley.ca.us/news/2000/00dec/121300masonry.html> and Lambert. Berkeley's program allowed prescriptive measures for a narrow class of 1- and 2-story buildings but otherwise met or exceeded the UCBC requirements. The small number of prescriptive cases are ignored here, and all program-compliant buildings are counted as UCBC-compliant. The actual number might be slightly smaller. As of January 2004, 111 remained to comply.

San Jose: The San Jose Redevelopment Agency runs an Unreinforced Masonry Grant Program. Source: <http://www.do-biz-here.com/businessassistance/financialassistance.asp> or <http://www.sanjoseretail.com/resources/index.asp?WhichHdr=i>.

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