

## Soft-Story Residential Buildings in Earthquakes – Risk Management and Public Policy Opportunities

### What are soft-story buildings and what happens to them in earthquakes?

Many apartments and condos can collapse in earthquakes because they have parking, “tuck-under” parking, or open commercial space on the first floor, making this story “weak” or “soft” and likely to lean or even fall over in earthquakes.



Soft-story apartment collapsed due to the Northridge earthquake

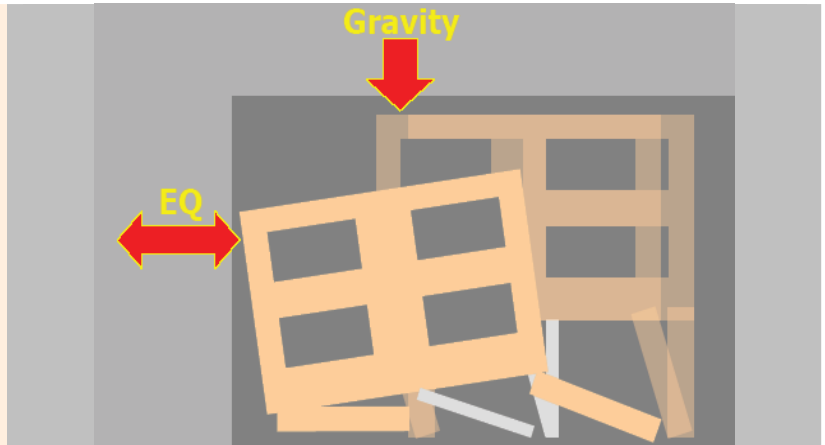


Diagram of collapsed building

**Soft-Story** apartment and condo buildings were responsible for about **two-thirds** of the 46,000 uninhabitable housing units in the Northridge earthquake. This type of building frequently houses those who have the fewest resources after quakes and thus are **most likely to need shelter** for the longest periods of time.

### The importance of adopting model codes –

If an owner voluntarily decides to upgrade the earthquake resistance of a soft-story building, it is extremely important that the work be carefully designed to actually do some good. Thus, these retrofits should be **designed by an engineer who has experience in these types of retrofits**, a requirement typically implemented by a city or county building department. In addition, they should comply with **appropriate building codes or guidelines** adopted by the city or county.

Virtually all of the local government annexes to the ABAG multi-jurisdictional Local Hazard Mitigation Plan list policies dealing with engineering requirements and applicable codes as **existing** policies. **Local governments, however, need to ensure that they have an ordinance adopting the latest model code for retrofits.** They should also consider requiring that any retrofits, whether voluntary or mandatory, comply with this code as a minimum to protect owners from ineffective retrofits.

A related program would be for local building departments to provide **technical assistance** to owners in how to manage a retrofit in a cost-effective manner. While several cities and counties provide this assistance, many view it as only a moderate priority due to lack of funds and higher priorities for spending funds when available.

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HSNG-c-2

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## Why inventory soft-story buildings? What does an inventory count?

Some local governments in the Bay Area have conducted *inventories of soft-story structures* in their communities. However, these inventories were created using different methodologies to supply different types of information for emergency response and the design of mitigation programs. Thus, the number of units can't be added together for a regional inventory.

- The Emergency Preparedness Council of **Santa Clara County** and its cities hired the Collaborative for Disaster Mitigation at San Jose State to count the number of these buildings and map them so that fire departments would **know where to conduct search and rescue operations after an earthquake**. Their inventory defines a multifamily building as one containing 4 or more units. They identified 2,630 buildings containing 33,119 units.
- The **City of Berkeley** inventory includes buildings both with units on the first floor and with only parking. Their inventory was conducted due to the City's concern about **potentially high shelter populations after quakes and the preservation of its housing stock**. The inventory defines a multifamily building as one containing 5 or more units. The City identified approximately 400 buildings containing about 5,000 units.

Other users require more consistent and reliable information:

- State and federal government agencies are concerned about counting the number of such buildings and the residential units in them to **estimate potential dollar losses** in future earthquakes.
- ABAG uses estimates of the number of these units to **estimate the number of uninhabitable housing units**, which, in turn, are used to generate the **number of people who will require emergency shelter** so that the American Red Cross and others can plan for such services.

An inventory is also part of a disclosure program. ABAG held a policy forum, or "charrette," to brainstorm ideas on how to increase the pace of soft-story retrofitting. The consensus was that **mandatory disclosure** of the hazard to current and future tenants, together with non-technical explanations, or **warnings**, of the hazard, could be helpful. For such uses, the inventory needs to be more consistent than one intended to estimate losses.

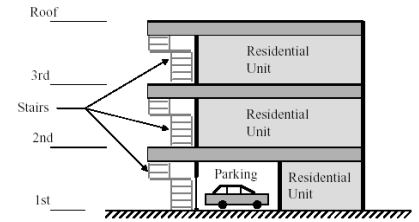
**Before additional local governments in the Bay Area conduct inventories, a consensus format of the inventories is needed based on the following:**

- Clearly define what is meant by "soft-story" throughout the Bay Area using, as a start, the definition in the International Existing Building Code Appendix Chapter A4 (IEBC-A4) as "**wood-frame buildings with soft, weak or open-front walls.**" Thus, soft-story buildings can include those with wood-frame walls and parking on **all or part** of the first floor. Soft-story buildings due to large open commercial space on the first floor are more difficult to identify in an inventory.
- Define multifamily residential buildings **for purposes of this inventory** based on IEBC-A4 as apartments or condos with **3 or more units** per building. (IEBC-A4 also currently includes hotels with 6 or more units, lodging houses, and congregate residences.)
- **Be conservative in conducting the initial drive-by inventory.**
- Allow owners to contest the designation of their building as having a soft-story using the technical definitions in the IEBC-A4.
- Identify procedures for change in status based on compliance with the IEBC-A4 retrofitting standards.

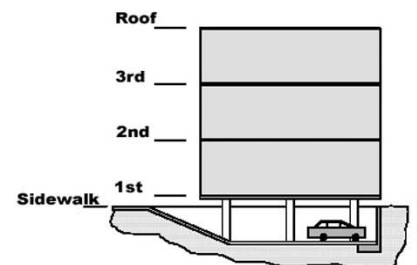
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Hazard Mitigation Plan  
(LHMP) Policy Number

HSNG-c-4

**Both the Santa Clara County inventory and the City of Berkeley inventory cover buildings with "tuck under" parking so there are housing units on the first floor, as well as buildings with only parking on the first floor.**



**Tuck-Under Parking**



**Building with Parking on Entire First Floor**

LHMP Policy Number

HSNG-c-5

HSNG-c-6

## Evolution of State and local requirements –

One way to visualize the development and evolution of a retrofit program is to look at the history of the **State requirements** for the retrofit of unreinforced masonry (URM) buildings. This program started with a state mandate for an inventory of the buildings, followed by mandatory disclosure to owners, and finally mandatory disclosure to tenants and the public through the posting of signs. While cities are not required to mandate URM retrofits by state law, over three-quarters of URM buildings are now part of mandatory retrofit programs.

California enacted AB 304 (Hancock) during the 2005-2006 session to allow local governments to regulate the retrofit of soft-story buildings. This legislation is modeled after early URM law.

## Retrofit carrots and sticks –

Different programs or incentives may need to be used for apartments of 5 or more units, for these buildings may be defined as commercial, whereas 3 or 4 unit apartments may be defined as residential. Sometimes local governments may view building departments as logical leads in all activities associated with encouraging soft-story retrofits. However, these programs work best if a variety of departments are involved. The role of planning and community development departments is particularly essential. For example, one way to encourage soft-story retrofits is through the imaginative **use of financial, procedural, and land use incentives**. Several ideas were developed during a 2005 policy “charrette” hosted by ABAG.

- ◆ **Parking, zoning, and density trade-offs** – Local governments might allow owners to have fewer parking spaces per unit in exchange for retrofit work on the parking under a building. Another option might be for an owner to be allowed to add an additional ground-floor unit to a building to partially offset the cost of a retrofit, even if addition of such a unit might result in densities that exceed those of existing zoning.
- ◆ **Redevelopment funds** – Local governments could use a portion of their Community Development Block Grant (CDBG) funds as an incentive for retrofit of housing in identified neighborhoods. CDBG funds are given to cities by the U.S. Department of Housing and Urban Development to help ensure decent affordable low- and moderate-income housing, particularly when existing conditions pose a threat to the health, safety, or well-being of a community.
- ◆ **Tax credits** – One option might be for a city to waive a portion of a business tax for a set number of years to encourage owners to retrofit. As another option, a portion of property transfer tax might be rebated in exchange for earthquake retrofitting.
- ◆ **Transfer of development rights** – A local government could allow rights to additional units in an area be sold or transferred to parcels with soft-story buildings as another way to allow construction of additional units that might help recoup the cost of retrofitting.
- ◆ **Reducing setbacks** – Setbacks to the street or to adjacent properties might be reduced to create an opportunity for construction of an additional unit on a parcel, the rents from which might be used to partially offset the costs of retrofitting. This idea is particularly appropriate where a new two-story unit can be constructed with windows facing the street for added security.
- ◆ **Coordination with rent control boards** – Coordination between local planning, building, and rent control boards may result in at least part of the costs of retrofit work being passed on to tenants through increased rents.

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Hazard Mitigation Plan  
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# A role for local governments in educating the public –

**Why should local governments promote educating the public?** The best building codes in the world do nothing for buildings built before that code was enacted. Fixing problems in older buildings – retrofitting – is typically the responsibility of the building's owner. Thus, local governments can promote retrofitting through targeted education of building owners and tenants.

## What can owners and tenants do?

Some condo and apartment **owners** have retrofitted the buildings that they own. Typical solutions involve strengthening of the walls in the parking area and the addition of steel frames in the openings.

**Renters** can ask landlords:

- What retrofitting has been done on this building?
- What does my lease say about how responsible I am for payment of rent if I can't live in the building due to earthquake damage?

## ABAG information –

ABAG developed a quiz for owners and residents of apartments and condos to help them determine if their buildings are at risk. The quiz, on the ABAG web site at <http://quake.abag.ca.gov/fixit>, asks simple questions to gauge if a building is healthy enough to stand up to a quake. This web site also has links to engineers to help design an appropriate way to improve the strength of these buildings.

Local governments can include this link on their web site and add information on retrofitting in their newsletters.

## Does retrofitting make cent\$?

While owners of single-family homes retrofit their homes to increase their safety, apartment owners often do not live in the buildings they own. Thus, since many of these buildings are owned as commercial properties, owners need information on whether the benefits of retrofitting outweigh the costs.

Researchers at Caltech performed a general benefit-cost analysis on several types of residential buildings including a soft-story apartment building. The conclusion – **for every dollar in retrofitting, owners could expect to save up to 7 dollars.**

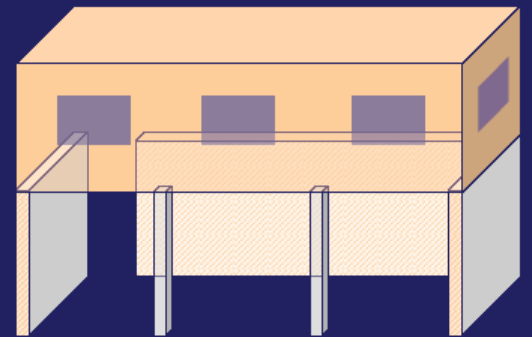
The researchers examined two common retrofit schemes – adding or strengthening a wall down the length of the building, and adding a steel frame to the front of the parking. While the addition of the shear wall had a benefit-cost ratio in high seismic areas of up to 7:1, the more expensive (but also more effective) steel frame retrofit had a lower benefit-cost ratio of up to 4:1.

**These benefit-cost ratios should be used for general background only, not for a specific project.** The researchers were quite conservative in their loss estimates, for they did not include loss to contents, alternate living expenses, or deaths and injuries, all of which would significantly increase the benefit-cost ratios. On the other hand, both estimated retrofit costs and repair costs were significantly lower than the Bay Area.

**CREDITS** – This pamphlet was prepared by J. Perkins, Earthquake and Hazards Program Manager, Association of Bay Area Governments (ABAG), using funding, in part, from FEMA for the development of the Bay Area Local Hazard Mitigation Plan. The information has been reviewed by the ABAG Earthquake and Hazards Outreach Review Committee. Color diagrams courtesy of D. Bonowitz; Black & white diagrams courtesy of City of San Jose/CDM. Cost-benefit analysis from “Cost Effectiveness of Seismically Better Woodframe Housing,” by K. Porter, C. Scawthorn, and J. Beck, *2005 Annual Hazards Research and Applications Workshop, July 10-13, 2005, Boulder, CO*, Natural Hazards Research and Applications Information Center, University of Colorado at Boulder.

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### Retrofit scheme: enhance walls



### Retrofit scheme: add frame

