State of California
Seismic Safety Commission

Memo

To: Seismic Safety Commission

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Date: December 3, 2014

Subject: **Update from the Ad Hoc Committee on Collapse-Prone Buildings**

In late 2013, the Commission created an Ad Hoc Committee to generate a guideline for local governments on how to identify and manage seismic risks of collapse-prone buildings. The Committee is chaired by Commissioner Randy Goodwin and includes Commissioners Kit Miyamoto and Fuad Sweiss. The attached draft is a 12-page overview of the common types of collapse-prone buildings and recommended steps for managing their risk that local governments have commonly used in California. The Committee is seeking input from other Commissioners, with the intent of issuing it to other selected stakeholders to obtain broader input at the Commission's direction.

The Committee hopes to eventually publish this overview online after considering additional public input and obtaining Commission concurrence. It could be followed by appendices developed later by the Committee with input from the full Commission. The appendices will provide local governments additional detailed advice in the form of an online resource.

Staff Recommendation

The Commission is asked to review and comment on the attached draft at the December 11th hearing and to discuss next steps for obtaining broader input on future drafts.

Guide to Identify & Manage Seismic Risks of Collapse-Prone Buildings For Local Governments

Draft Version 11

December 3, 2014

Overview

California's 14 million buildings include some of the most modern and earthquake- resistant in the world. However, most older buildings could be damaged and a few - perhaps less than 5 % - could collapse in severe shaking. That may seem like a few, but collapse can cause significant life loss, injuries and substantial social and economic disruption mounting to hundreds of billions of dollars. So where are these buildings? What can be done about them?

This guidebook summarizes California's laws and regulations to assist governments and to identify and reduce collapse risks, as well as best practices that building owners can take to further manage the risks.

Common Types of Collapse-Prone Buildings[1]

Buildings within the jurisdictions of state and local governments may be vulnerable to earthquakes because they were:

- Not constructed to comply with codes and standards, or
- Constructed before earthquake resistance was required in the 1930's or
- Built to codes that were later found to be inadequate, or
- Improperly altered, repaired or poorly maintained

Based on performance in past earthquakes, the following types of buildings generally pose exceptionally high risks of collapse near active earthquake faults:

- Pre-1940's unreinforced masonry (URM), primarily brick, buildings
- Pre-1980's concrete frame buildings
- Pre-1980's buildings with soft or open lower stories, unbraced crawl space walls below first floors, or other irregular shapes, including homes on steep hillsides
- Pre-2000's buildings with precast concrete tilt-up walls or masonry walls, and precast concrete parking structures.

Other types of buildings pose generally lower, harder-to-identify risks:

- Pre-2000's steel buildings
- Buildings that are not adequately constructed, repaired or maintained

[1] See Appendices for more specific information, benchmark years, and references.

- Buildings on sites subject to fault displacements, landslides, or soil liquefaction

Californians live, work, go to school, shop and worship in some of these buildings.

The Most Effective Methods of Managing Collapse-Prone Buildings

Ensuring that building construction and alterations are properly designed by licensed professionals using plan reviews and inspections by qualified regulators is the most effective way for governments to identify and reduce the risks of collapse.

Who is Responsible?

Building safety is typically regulated by the respective agencies at the federal, state or local level. Building Owners are responsible for ensuring their buildings are safe and are responsible for disclosing a building's vulnerabilities to occupants. Local jurisdictions are responsible for reviewing construction plans, issuing building permits and inspecting construction for most buildings, including local essential service facilities such as Fire and Police Department facilities. State agencies regulate (check plans and inspect) building safety for public schools, hospitals and state essential services buildings. Federal agencies regulate building safety for Federal Buildings and support research and development to improve building standards. Regulatory permits are required for new construction, alterations, and seismic retrofits of existing buildings at each level.

Nexus for Public/Private Partnerships to Manage Collapse Risks

Most buildings are privately-owned, but if they were to collapse, they would adversely impact the public spaces around their perimeters, create demands on government emergency and recovery services, and disrupt social and economic activities in communities. Both building owners and government agencies have major stakes in managing earthquake risks. Building owners stand to lose property values while governments lose tax revenue after earthquakes. It is in everyone's best interests for the government and building owners to collaborate in identifying vulnerable buildings and improving their earthquake resistance.

Steps to Managing the Seismic Risk of Collapse-Prone Buildings

There are many options to manage seismic risk presented by collapse prone buildings. They range from passive approaches that may gradually reduce collapse risk for some buildings over decades to active approaches that require seismic evaluations and retrofits within a few years.

Owners are often unaware or reluctant to find out about the earthquake resistance of their buildings. There may only be a few key opportunities during the useful lives of buildings to identify and address collapse risks, such as major alterations or changes in use. As a result, most buildings have not been seismically evaluated since they were originally constructed.

Success Story

Saint Helena's Unreinforced Masonry Building Program

Saint Helena has 33 buildings in their inventory and the owners have retrofitted all of them. The City provided numerous incentives including building permit fee waivers, creation of a historic district to take advantage of a 20% Federal Tax Credit, use of the State's Mills Act to preserve facades and reduce costs, and a streamlined design review process.

Pre-1930's buildings were most likely constructed without considering earthquake resistance since California's building codes did not include earthquake safety requirements before 1933. When buildings are sold, the California Seismic Safety Commission's *Commercial Property Owner's Guide to Earthquake Safety* and the *Homeowner's Guide to Earthquake Safety* encourage or require sellers to disclose typical earthquake weaknesses to buyers. When major buildings are refinanced, lending or insurance companies may require seismic evaluations as a condition for new mortgages or policies. When buildings undergo major alterations, additions or repairs, local governments may require seismic evaluations or retrofits as conditions for construction permits.

If a community relies on building owners to manage their own risks, the owners who are more conscientious, that have long-term interests in their community, and are aware of earthquake risks may eventually replace or retrofit their vulnerable buildings when they find it convenient. But risk reduction progress is expensive and will typically be slow and uneven. In the meantime, those who occupy collapse prone buildings and rely on streets and sidewalks nearby are exposed to their risks and the prospect of years of disruption after earthquakes.

The public policy questions that warrant consideration by government agencies, building owners and the public are:

1) How effective are current policies regarding earthquake safety?

2) How many years will policies take to significantly reduce collapse risks in the community?

3) What other earthquake risk management alternatives merit consideration?

Invariably, the public incorrectly assumes that government agencies require existing buildings to be earthquake resistant. But many buildings are poorly-maintained, built before seismic requirements, and quite vulnerable. Many people are surprised to learn that the latest earthquake safety regulations do not apply to existing buildings unless they undergo major alterations, additions, or repairs.

Communities assume that their government officials will take initiatives in long-term planning and place earthquake safety priorities into context with other competing priorities. And California has many examples of government agencies that have undertaken earthquake risk management initiatives. This guide summarizes three steps and seven common options:

Success Story

Fremont's Soft Story Apartment Building Program

In 2007, Fremont required owners of 30 apartment complexes to retrofit. The City designed their ordinance to result in no occupants being relocated from their units during construction. Fremont also reimbursed owners for all plan check and permit fees once the retrofits were completed. Owners could apply for time extensions due to financial hardship. Fremont demonstrated remarkable success, albeit for a relatively small portion of their apartment building stock.

Step 1: Create Opportunities for Education, Dialogue and Public/Private Participation in Decisions about Buildings

Recommend Building Officials, Emergency Managers, City Councils and Boards of Supervisors, and the private sector actively engage and inform the public about issues related to collapse-prone buildings and alternatives for managing their risks. Consider keeping stakeholders informed about who makes decisions, when, and how they can participate and influence policymaking.

Step 2: Estimate the Size and Nature of the Risks Posed by Collapse-Prone Buildings

Inventories can provide insights into a community's vulnerability by picking from several approaches ranging from:

- Surveys by walking or driving through neighborhoods that have concentrations of older buildings (See Step 3, Option 2 below)
- Individual seismic evaluations of all vulnerable or representative buildings (See Step 3 and Options 2 to 5 below)
- Compare efforts in other similar communities that may have already conducted such studies that might provide benchmarks for inferences and contrast

Learning about the ages of buildings, their occupancies, sizes, locations and states of repair will help quantify the potential for deaths, injuries, downtime, economic and social losses from damaging earthquakes. Reviewing long-term plans for economic improvement, historic preservation, transportation, and redevelopment will help identify opportunities and constraints for reducing earthquake risks while accomplishing other objectives. Inventories will also help identify buildings that have already been retrofitted or replaced and the rate at which changes are already taking place. Even if nothing further is contemplated, community leaders, emergency managers, and building officials will gain a better sense of what to expect and how to respond to future earthquakes.

Success Story

Los Angeles' Unreinforced Masonry Building Retrofit Program

The City of Los Angeles spent over a decade requiring owners to retrofit or replace over 8,000 unreinforced masonry buildings. At the time of the Northridge Earthquake in 1994, over 6,000 had been retrofitted and 2,000 replaced. Fortunately, no one was killed in these buildings during the earthquake. While not all retrofits were entirely successful and lives could have been lost if the earthquake had occurred at another time of the day, the city's recovery efforts were accelerated by reduced damage and disruption in these buildings.

Step 3: Develop & Consider Options for Identifying and Mitigating Collapse Risks

Seven options to manage collapse risks range from implementing existing regulations to enacting mandatory retrofit programs as well as several options in-between. They are ranked below from lowest to highest according to their difficulty to implement and their potential for resistance from building owners:

- **<u>Option 1</u>: Rely on Current Triggers for Alterations in the Building Code:**

  Chapter 34 of the California Building Code requires owners to consider seismic safety in existing buildings when major alterations, additions, and repairs are contemplated. However, these regulations tend to discourage owners due to uncertainties and other triggered costs like fire safety and accessibility upgrades -a "Pandora's Box". The cumulative effects of prior alterations are required to be considered when altering or constructing additions to existing buildings. Voluntary seismic improvements are encouraged by the building code, which allows owners discretion when proposing improvements.

  State laws require disclosures of typical earthquake weaknesses at the time of sale for certain dwellings and encourage disclosures for certain commercial buildings. These disclosures can trigger voluntary retrofits.

  This option is consistent with policies in most jurisdictions except for unreinforced masonry buildings in regions of high seismicity. A community's Building Official will have more information and a sense of how effectively and at what rate voluntary seismic improvements are taking place.

- **<u>Option 2</u>: Develop Reliable, Detailed Inventories of Collapse-Prone Buildings:**

  Starting from information gathered in Step 2, more-detailed inventories can rely on:

  - Samplings of buildings to infer characteristics of a larger inventory
  - Records of building permits for past seismic evaluations as well as triggered and voluntary seismic retrofits
  - On-line street views and other geographic information systems
  - Sanborn maps that depict construction types
  - Building permit and tax assessor data
  - Archives of Architectural, Civil, and Structural Engineering firms
  - Redevelopment Plans or Transportation Corridor Studies

Success Story

San Luis Obispo's Downtown Revitalization Program

The City of San Luis Obispo requires that all of their 126 unreinforced masonry buildings be retrofitted by 2017. The City provided free downtown parking for contractors, $5000 incentives for each owner that retrofits, grants for up to $25,000 for some owners and permit fee waivers. Most importantly the downtown business community is experiencing a major revitalization with enhanced foot traffic, retail and restaurant activity as a result of the improvements.

- Registers of Historical Buildings and Surveys of Historic Districts, or
- Adopted versions of the Building Code in effect when buildings were originally constructed or retrofitted

These can help determine construction types, sizes, heights, and occupancy classifications and overall vulnerability to earthquakes.

Detailed guidance and checklists for conducting inventories can be found in the Appendices.

- **<u>Option 3</u>: Develop Seismic Performance Options:**

  Governments and other stakeholders can consider a variety of alternatives for describing how buildings can be expected to perform in earthquakes ranging from unknown, to collapse, to partial, basic and enhanced seismic performance objectives for retrofits or replacements. This will enable a dialogue in the community about acceptable levels of risk, recovery costs and duration of social and economic interruption. Discussions can highlight the differences between the expected performance of newer buildings compared with the performance of existing buildings. Typical structural performance objectives are:

  - **Not Considered or Unknown**
  - **Immediately Dangerous –** and not safe to occupy, or
  - **Collapse Prone** – but considered safe enough to occupy, or
  - **Collapse Resistant** – but with little or no margin of safety
  - **Life Safety** – with larger margins of safety beyond collapse although buildings may not be occupiable after damaging earthquakes, or
  - **Immediate Occupancy** – although not necessarily operational, due to damage to building contents, non-structural systems, or lifelines

  Typical performance objectives for nonstructural portions of buildings such as equipment, electrical, plumbing and ventilation systems, ceilings, partitions and cladding are:

Success Story

San Francisco's Earthquake Safety Implementation Program

San Francisco engaged its citizens in collaborative ways to develop a Community Action Plan for Seismic Safety to reduce vulnerabilities with priorities tailored to the City's unique building stock and socio-economic conditions. The plan's recommendations are now being managed through a new 30-year Earthquake Safety Implementation Program. First steps include addressing the most vulnerable soft story apartment buildings. Next in line are older private schools and with plans to address non-ductile concrete buildings later.

- **Not Considered or Unknown**
- **Life Safety** –to avoid death and injury, but not necessarily keep systems in place, or
- **Position Retention** – to keep systems in place, but not necessarily operational, or
- **Operational**

Detailed advice about seismic performance options is in the Appendices.

- **<u>Option 4</u>: Undertake Seismic Screenings:**

  Two techniques for screenings are available:

  - *Rapid Visual Screening of Buildings for Potential Seismic Hazards* (FEMA 154, a national guideline) is a simple procedure that can be accomplished with smart phones from the sidewalk and no access to interiors.
  - *Seismic Evaluation and Retrofit of Existing Buildings – Tier 1 Seismic Screening* (ASCE 41-13, a national standard) is a somewhat more in-depth procedure that can be accomplished in under 1 day for most buildings with interior access.

  The results of these screening techniques can be incorporated into community-specific vulnerability databases for more reliable loss estimates for large cities and counties. Loss estimates can also help generate what-if scenarios for an expected range of earthquakes as well as annualized losses based on screening data unique to each community.

- **<u>Option 5</u>: Require Seismic Evaluations and Ratings of Buildings:**

  Tier 1, 2, or 3 evaluations using ASCE 41-13 of a sampling of representative buildings or all buildings that have a particular type of exceptionally high risk construction will provide comprehensive insights into vulnerabilities. This information can help scope retrofit costs and disruptions to occupants and neighbors. The results of ASCE 41 evaluations can be used

Success Story

San Diego's Downtown Revitalization Program

The City of San Diego includes parapet bracing as a key part of their downtown redevelopment effort. In light of their somewhat lower risk than in other parts of California, they considered the risks posed by other vulnerable aspects of brick buildings to be too costly to address. Bracing was accomplished with historic preservation in mind so that the aesthetics of the brickwork was not adversely impacted by the installation of new wall anchors.

to generate safety ratings and compare them with the performance provided by standards for new construction such as *Minimum Design Loads for Buildings (ASCE 7)*.

More detailed evaluations using such techniques as the Applied Technology Council's Performance Assessment Calculation Tool (PACT) can be used to assign ratings for repair costs and recovery.

Detailed advice about seismic evaluations are in the Appendix.

- **<u>Option 6</u>: Encourage Voluntary Seismic Retrofits or Replacements:**

  Voluntary retrofits or replacements will be influenced by:

  - Real estate market conditions, including property values, rental and vacancy rates
  - Frequencies of changes in occupancies such as when buildings are sold or leases are started or renewed
  - Code-based triggers of seismic evaluations and retrofits including those for alterations, additions, or repairs
  - Decisions that are altered by awareness of stakeholders when ratings and disclosures become known pursuant to Options 1 or 5
  - Ordinances that may require notification of owners of exceptionally high risk buildings and specify seismic performance objectives for evaluations and retrofits and periodic reporting to the jurisdiction so that retrofit progress can be monitored
  - Redevelopment and intensification of properties
  - Incentives such as reducing building permit fees or reduction of disincentives such as waiving parking requirements

- **<u>Option 7</u>: Consider Requiring Retrofits or Replacements :**

  Mandatory retrofit ordinances will generally require retrofits by owners within time frames of multiple years. Ordinances will typically include:

  - Notification of owners of exceptionally high risk buildings near active earthquake faults
  - Minimum seismic performance objectives and retrofit requirements
  - Financial incentives and removal of disincentives
  - Procedures for regulators to:
    - Record certificates of collapse risk on property deeds

- Ensure effective enforcement of evaluations, retrofits or replacements within prescribed time frames
- Adjust the timeframes for compliance in response to changing economic conditions, construction costs, and delays, and to allow time for buildings to be sold to others willing to retrofit
- Preserve qualified historical resources
- Require demolition of high risk buildings only as a last resort when retrofit alternatives are found not to be feasible
- Monitor and report progress to policymakers.

Step 4: Other Key Management Considerations

Recommend that communities, building owners and government officials also consider:

- Hazards unique to each community from nearby faults, including the expected rates of occurrence of damaging ground motions, landslides, liquefaction, tsunamis, fires and other effects
- Costs, benefits, affordability and the time needed to reduce collapse risks effectively
- Financial, zoning and use incentives that help owners invest in building safety
- Including seismic safety objectives with other planning, zoning, economic, social development, and historic preservation initiatives
- Seismic retrofits can trigger other requirements such as disabled access compliance, fire resistance and repairs that can substantially increase project costs and discourage building owners from taking action.
- Risks to a community's tax base posed by altering the building stock or damaging earthquakes, and
- Post-earthquake recovery times and how they might be reduced by pre-earthquake risk reduction

Since earthquakes are relatively rare, communities will typically have the advantage of many years, possibly decades, before future damaging earthquakes occur. But retrofits and replacements of collapse prone buildings are quite costly, so they can't be readily accomplished in the short term. Therefore, adopting a long-term perspective is typically sound practice and includes:

- Building safety regulatory oversight by well-trained and qualified professional inspectors and plan reviewers, who are generally licensed or certified, to

ensure that new buildings are earthquake resistant and every opportunity is taken to effectively reduce the risks posed by older buildings

- Preparedness, public education, and emergency management measures including barricading, stabilization and repair ordinances are in place to address the anticipated risks that damaged buildings can pose
- Management by metrics using periodic progress reports to keep the public and policymakers abreast of the size and nature of the risks posed by collapse prone buildings, what has been done about them over time, how soon will such risks be significantly reduced to manageable levels, and how the rate of retrofit and replacement progress compares with the expected rate of occurrence of future earthquakes
- Incorporation of retrofit and replacement initiatives into a community's multi-hazard mitigation plans and coordination with other long-term planning and growth objectives, and
- Periodically reevaluating progress and revising priorities and strategies especially after damaging earthquakes

Appendices

The California Seismic Safety Commission draws from the past experiences of hundreds of local governments to generate this Guide and Appendices that can hopefully help carry out the options described above. Advice in the Appendices can be considered a toolbox from which local governments can draw and adapt to their community's unique circumstances. Checklists, success stories, financial incentives, and references for more detailed information might prove useful to local governments when designing initiatives to manage collapse risks.

The Commission is interested in feedback from users of this guide and the Appendices so that it can make periodic improvements and corrections. We welcome your ideas, so please send your comments to: feedback@stateseismic.com