- **Private K-12 schools and private colleges**

  Most people assume that school buildings are safe, but most private schools are probably no safer than the general building stock. Many of San Francisco's private school buildings were constructed when building standards were much less stringent than today. Nearly one third of school children—more than 23,000—attend private schools in San Francisco, the highest rate in the entire state[10]. The City must ensure that all of San Francisco's children and other students attend school in buildings that meet standards equivalent to the standards for public schools[11].

- **Assisted Living facilities**

  The City's elderly and other disabled persons should be in facilities that are expected to be safe and functional after future earthquakes. Relocation after an earthquake would be hardest on these residents. The City must provide assistance to those facilities serving low-income residents.

- **Houses of worship**

  Churches, temples, mosques and other religious buildings have large occupancies during services, and often in times of emergency. Many provide critical services to the broader community. These buildings often have earthquake vulnerabilities due to their size, configuration, age and falling hazards. During earthquakes they pose serious threats to the safety of occupants, and the resulting damage would limit their ability to provide services to the community. Many of the most vulnerable houses of worship have limited resources, warranting long lead times before mandates to allow for planning.

- **Concrete non-residential buildings built before 1980**

  Like concrete residential buildings, older reinforced concrete buildings used for other purposes can experience dramatic and deadly collapses during earthquakes. Such collapses are responsible for many of the casualties in earthquakes around the world. There are many older reinforced concrete buildings in San Francisco being used as office buildings and warehouses. Thousands of people use these buildings daily. Retrofit of these buildings may be expensive, but is important due to the risks they pose to the City. It may make sense to retrofit these buildings to a "collapse prevention" standard, recognizing that, even after retrofit, many of them may not be repairable after an earthquake.

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[10] California Department of Education, 2009.

[11] The CAPSS project did not consider public schools, which serve about 55,000 students in San Francisco. Public schools built to state standards are among the most earthquake resistant buildings in California. However, like other buildings, some were constructed to older standards and some of the buildings constructed before the state standards were adopted in 1933 were retrofitted, but do not provide the performance expected from modern school buildings. In 2002, the Department of Conservation, Division of the State Architect, developed a list of public school buildings, *Seismic Safety Inventory of California Public Schools* (Department of General Services, 2002), to identify non wood-frame school buildings built before July 1, 1978 that should be evaluated because of their age and building type. There are 72 buildings belonging to the San Francisco Unified School District on this list.

- **Hotels and motels**

  Hotels and motels of all structural types must be safe during future earthquakes and readily reoccupiable. Hotels play a key role during post-earthquake recovery by housing emergency workers, including those brought to the City to restore utilities. They also provide potential temporary housing for displaced residents. Moreover, because tourism is a key part of the City's economy, improving the performance of visitor-serving buildings is critical for the City's earthquake recovery.

- **Critical retail stores and suppliers**

  Certain businesses are critical to helping the City recover quickly and it is desirable to have them operational as soon as possible. San Franciscans need pharmacies, grocery stores, and similar retail establishments that provide the items required for daily living. Some of these important businesses may be located in weak buildings that would not be usable after a large earthquake. Many of these businesses may rent the space they use, and retrofit timelines should allow time to renegotiate leases as part of this process.

- **Buildings used by large audiences**

  Theaters and other buildings that are used to gather many people need to be safe, considering hazards due to occupants due to damage to the building and falling hazards. Although many of these buildings are occupied only a few hours each week, when they are occupied there is the chance of a large number of casualties. A reasonable threshold for the size of buildings in this category is an occupant load of 300 persons.

- **Historic buildings, significant and contributory buildings in historic districts, and other resources that may be historic**

  Historic resource buildings should be repairable after future earthquakes so the City may maintain its heritage. This could include many older masonry buildings previously upgraded to standards only intended to reduce casualties, but not to assure reparability.

- **Concrete tilt-up buildings**

  These buildings have heavy precast concrete panels that are raised in place to form the building walls. If the walls are not adequately connected to each other and to the roof, they can separate when shaken by an earthquake, causing the roof and wall sections to collapse on the occupants and contents of the building. This structure type is often used for industrial purposes, but also may be used for grocery stores or other commercial purposes. There are an estimated 200 of these in San Francisco. These buildings are relatively simple and inexpensive to retrofit, compared to other structure types, and a number of communities have enacted retrofit programs for this type of building. Standards for retrofitting are readily available for adoption into the San Francisco Building Code.

- **Large buildings with welded steel moment frames built before 1994.**

  Many office buildings and workplaces were constructed with welded steel moment frames with details that were found vulnerable in the 1994 Northridge earthquake in southern California. Welding procedures and connection details were changed in 1994 to improve the performance of buildings built since then.

The connections used before 1994 can be damaged, resulting in buildings that cannot be used and might have to be razed. These large buildings should be retrofitted to reduce the chance of damage and increase the likelihood that the businesses they house will not be displaced and the buildings can be repaired and reoccupied quickly.

- **Early retrofitted buildings**

  Some retrofits conducted decades ago may be inadequate to meet public policy goals. These include early retrofits with thin-wall steel tube braced frames, those meeting very low standards, and those with partial retrofits not meeting an adopted standard. In these early retrofits, tube walls may be too thin, allowing buckling to occur, welded connections might be inadequate, or there may be other vulnerabilities.

- **All other buildings**

  There are other categories of vulnerable buildings and important building uses not included in this list. Buildings with mixed structural systems and parking structures are examples. The City should add additional categories as the need arises as part of the regular evaluation of mitigation programs (Recommendation 17).

Recommended Retrofit Deadlines for Building Categories

This report recommends that San Francisco's buildings go through a three-step strategy over thirty years to improve their seismic resilience—information, evaluation, and retrofit. The recommended timeframe for action for the key categories of buildings is depicted in Table 5.

The first step, providing information and incentives to inform and assist owners, should begin immediately for all building types and continue indefinitely (Recommendations 2, 3, 9, 11 and 12).

The second step (Recommendation 4), requiring evaluation upon sale, should begin for all building types within five years. The five-year timeframe allows the City time to adopt evaluation criteria and procedures and improved retrofit standards before the mandatory evaluations commence. However, after five years the City should establish deadlines and begin requiring evaluations.

The third and final step, mandatory retrofits, should begin immediately for wood-frame buildings with three or more stories and five or more residential units and concrete tilt-up buildings, and should conclude for all building categories in thirty years. This report recommends the City enact mandatory retrofit requirements for the following building categories in the following timeframe:

Ongoing

- Continue to strictly enforce retrofitting buildings as part of significant repairs, alterations, expansions, changes of use, and repair of damage above specified thresholds; and
- Enact retrofitting as a condition to converting multi-unit residential buildings to condominiums.

Begin to require retrofitting immediately and complete within ten years

- Wood-frame residential buildings with three or more stories and five or more units; and
- Concrete tilt-up buildings.

Begin to require retrofitting in five years and complete within fifteen years

- Residential buildings with three and four units;
- Private K-12 schools and private colleges; and
- Assisted Living facilities.

Begin to require retrofitting in ten years and complete within twenty years

- Concrete residential buildings built before 1980;
- Other types of residential buildings with five or more units;
- Hotels and motels ; and
- Critical retail stores and suppliers.

Begin to require retrofitting in twenty years and complete within thirty years

- Single family homes and two unit residences;
- Concrete non-residential buildings built before 1980;
- Houses of worship;
- Preschools and daycare centers;
- Buildings used by large audiences;
- Historic buildings, significant and contributory buildings in historic districts, and other resources that may be historic;
- Large buildings with welded steel moment frames built before 1994; and
- Early retrofitted buildings.

Other Categories

The following use-based building categories are very important to San Francisco's earthquake resilience. However, many of these organizations are nonprofit entities that do not own the buildings they occupy. This report recommends that the City assist these groups to evaluate and retrofit buildings where possible, or relocate, if necessary (Recommendation 6). However, buildings used for these purposes would trigger mandatory retrofit if they also fall under one of the other categories, such as a concrete building built before 1980.

Other categories:

- Non-profit organizations providing important services to vulnerable populations; and
- Clinics and facilities providing medical services.

Table 5 Recommended Timeframe* for Applying the Three-Step Strategy to Key Categories of Buildings

Building Categories	2010-2015	2015-2020	2020-2025	2025-2030	2030-2035	2035-2040
Wood-frame residential buildings with three or more stories and five or more units**						
Concrete tilt-up buildings						
Residential buildings with three and four units						
Private K-12 schools and private universities						
Assisted living facilities						
Concrete residential buildings built before 1980						
Other types of residential buildings with more than five units						
Hotels and motels serving tourists						
Critical retail stores and suppliers						
Single family homes and two unit residences						
Concrete non-residential buildings built before 1980						
Houses of worship						
Preschools and daycare centers						
Buildings used by large audiences						
Historic buildings						
Large buildings with welded steel moment frames built before 1994						
Early retrofitted buildings						
All other building types						

*The mandatory evaluation or retrofit program would begin at the start of the period and be completed by the end of the period.

**See Table 3 for the detailed schedule proposed in the draft ordinance developed by the Mayoral Task Force.

Color key*:**

Step 1: Facilitate a market in which earthquake performance is valued	
Step 2a: Nudge market by requiring evaluation upon sale	
Step 2b: Nudge market by requiring evaluation by a deadline	
Step 3: Implementation period to require retrofit by a deadline	

*** Note: all previous steps remain in effect after advancing to a higher step.