2016 SAFER CITIES SURVEY

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SEA
SOUTHERN CALIFORNIA

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SAFER CITIES SURVEY

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Evaluating current approaches to retrofitting seismically vulnerable buildings in Southern California

A partnership between

STRUCTURAL ENGINEERS ASSOCIATION SEA SOUTHERN CALIFORNIA

seaosc.org

and

The Dr. Lucy Jones Center for Science and Society

drlucyjonescenter.org

Disclaimer

This Safer Cities Survey has been prepared by the Dr. Lucy Jones Center for Science and Society (DLJCSS) for the Structural Engineers Association of Southern California (SEAOSC), and is published as part of our association's educational program. While the information presented in the document is believed to be correct at the time of publication, the materials, practices, and understanding of the matters discussed are sometimes subject to differences of opinion and approach, and are constantly evolving. As such, neither SEAOSC nor its Board, committees, writers, editors, firms, or individuals who have contributed to this survey make any warranty, expressed or implied, or assume any legal liability or responsibility for the use, application of, and/or reference to opinions, findings, conclusions, or recommendations expressed herein. This survey should not be used or relied upon for any specific application without competent examination and verification of its accuracy, suitability, and applicability by qualified professionals. This survey is not intended to amount to minimum standards for any purpose. Users of this survey assume all liability arising from such use.

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Structural Engineers Association of Southern California

SEAOSC PRESIDENT'S MESSAGE

DEAR SOUTHERN CALIFORNIANS,

We live in an age of unparalleled global interconnectedness and access to information with 24/7 news channels and mobile technology with near constant social media availability. As a result, we are exposed to major natural disasters in real time. Even in the fortunate event where the death toll is low, affected communities can lose many buildings which may have an extreme detrimental economic impact and require decades of recovery time. The news exposure to recent events has increased the public's knowledge of natural disaster risk and building performance and has driven public discussions on how we can increase the safety and resilience of our communities. Thankfully, technology, tools and methodologies to evaluate and communicate natural disaster risk are available. Coupled with continued advancement in building performance determination, the public and policymakers are afforded a better understanding of risk and potential solutions and are provided with a better way to understand and communicate the cost of doing nothing versus taking action.

SEAOSC Past President Michelle Kam-Biron, Dr. Lucy Jones, and SEAOSC President Jeff Ellis.

In order to develop an effective strategy to improve the safety and resilience of our communities, it is critical to benchmark building performance policies currently in place. For Southern California, this benchmarking includes recognizing which building types are most vulnerable to collapse in earthquakes, and understanding whether or not there are programs in place to decrease risk and improve recovery time. In light of this, the Structural Engineers Association of Southern California (SEAOSC) partnered with the Dr. Lucy Jones Center for Science and Society (DLJCSS) to perform a survey of the cities in Southern California with the goal of providing a snapshot of current strategies to strengthen the built environment in our region.

This Safer Cities Survey is designed to be used as a tool to help identify vulnerable building types, show where we are in addressing these buildings through retrofit ordinances, and provide a lens to better see where to focus our attention to reduce our vulnerabilities. Structural engineers have long recognized the need to strengthen existing buildings, but policy changes required to achieve this require input from many stakeholders and the skill and adeptness of our local leaders to advance common goals. As the discussion continues, SEAOSC will update the information in this report to measure progress, which is something we can only achieve with the stakeholders working together toward a common goal for safer and more resilient cities.

SEAOSC is a one of the oldest structural engineering associations in the world. We strive to advance the state-of-the-art in structural engineering and to provide the public with safe structures. SEAOSC stands ready to help jurisdictions develop strategies to mitigate risk and increase resilience by decreasing recovery time. Improved performance of our community's and region's built environment is critically important to saving lives as well as important to protecting its economy, character and fabric. One of the first steps in developing a mitigation strategy includes consulting with practicing professional engineers so they may establish an inventory of vulnerable buildings within a city, assist in the development of draft retrofit ordinances, and provide input toward the creation of a back-to-business program. SEAOSC can provide an objective, third party review and offer advice on the developed ordinances and programs. In fact, SEAOSC has already provided this advisory service for jurisdictions in Southern California at their request.

We endeavor to make this Safer City Survey a useful tool in understanding where we are as a region and in the development of prioritized strategies to increase the safety and resilience of our communities. Southern California is an incredible place to live, full of great opportunities with a diverse population and many cultures stretching from the beach to the mountains and desert. Let us continue to work together to sustain these opportunities by ensuring our region does not get knocked out by the next natural disaster but is able to roll with the punches and quickly recover.

Yours for a safer and more resilient southern California,

JEFF ELLIS
PRESIDENT, SEAOSC

SUMMARY

Studies show many types of buildings in California built under earlier versions of the building code are now known to be very vulnerable to earthquake damage and will be responsible for the majority of deaths in future earthquakes. Ordinances to encourage or mandate the retrofit of these buildings for improved seismic safety are the main tool available for local jurisdictions to reduce this risk. This Safer Cities Survey report (referred to as Survey in this report) provides an overview of the seismic ordinances that have been enacted or are under consideration in the jurisdictions of Southern California.

INTRODUCTION/BACKGROUND

SOUTHERN CALIFORNIA HAS THE HIGHEST RISK OF EARTHQUAKE DAMAGE IN THE UNITED STATES.

Straddling the plate boundary between the Pacific Ocean and North American plates, southern California has over a hundred faults crisscrossing the region with almost 20 million inhabitants. The combination of many faults and dense population means that between one third and one half of the nation's estimated $4.5 billion/year seismic losses are expected to occur in the region (Jaiswal et al., 2015).

Several scenarios have been created for possible big earthquakes in the region to better understand the most likely causes of major loss and the triggering of regional depression (examples include Jones, 2015; Wein and Rose, 2011; Jones et al, 2008; EERI, 2011). The two biggest factors are the loss of buildings for residential and commercial use and the disruption to basic infrastructure. The deadliest type of building loss is in the older structures that do not meet current building code standards for life safety.

No building code is retroactive; a building is as strong as the building code that was in place when the building was built. When an earthquake in one location exposes a weakness in a type of building, the code is changed to prevent further construction of buildings with that weakness, but it does not make those buildings in other locations disappear. For example, in Los Angeles, the strongest earthquake shaking has only been experienced in the northern parts of the San Fernando Valley in 1971 and 1994 (Jones, 2015). In San Bernardino, a city near the intersection of the two most active faults in southern California where some of the strongest shaking is expected, the last time strong shaking was experienced was in 1899. Most buildings in southern California have only experienced relatively low levels of shaking and many hidden (and not so hidden) vulnerabilities await discovery in the next earthquake.

The prevalence of the older, seismically vulnerable buildings varies across southern California. Some new communities, incorporated in the last twenty years, may have no vulnerable buildings at all. Much of Los Angeles County and the central areas of the other counties may have very old buildings in their original downtown that could be very dangerous in an earthquake, surrounded by other seismically vulnerable buildings constructed in the building booms of the 1950s and 1960s.

Building codes do have provisions to require upgrading of the building structure when a building undergoes a significant alteration or when the use of it changes significantly (e.g., a warehouse gets converted to office or living space). Seismic upgrades can require changes to the fundamental structure of the building. Significantly for a city, many buildings never undergo a change that would trigger an upgrade. Consequently, known vulnerable buildings exist in many cities, waiting to kill or injure citizens, pose risks to neighboring buildings, and increase recovery time when a nearby earthquake strikes.

The main tool available to cities to reduce this risk are ordinances to recommend or mandate strengthening of buildings through seismic retrofitting. Most retrofit ordinances are at the complete discretion of an individual jurisdiction and have passed when the community members, structural engineers, elected officials and building departments work together because of a shared commitment to safety. This report reviews the different earthquake building vulnerabilities that can be addressed through seismic retrofit ordinances, the approaches being taken in cities across southern California and the status of progress.

METHODOLOGY

The DLJCSS surveyed seismic safety ordinances enacted and under consideration in the 191 cities and 6 counties of Southern California that are shown in Figure 1.

The primary data was obtained through telephone calls and emails to the Building Officials of each jurisdiction, supplemented with searches of city codes available online and discussions with active members of the building code community.

DLJCSS asked about retrofit ordinances addressing the most common types of dangerous buildings as well as business resumption programs that have been used in California jurisdictions to reduce earthquake losses.

Figure 1. Area of California considered in this study.

TYPES OF VULNERABLE BUILDINGS

THE THREE MOST DAMAGING EARTHQUAKES TO STRIKE SOUTHERN CALIFORNIA, the 1933 Long Beach M6.4, 1971 San Fernando M6.7, and 1994 Northridge M6.7 earthquakes, each exposed significant weaknesses in existing buildings and led to changes in the building codes for new structures. For example, following earthquakes, unreinforced masonry buildings were outlawed, concrete construction was required to be more flexible (ductile), soft-story construction was restricted, requirements for tilt-up construction were strengthened, and welded steel moment frame connections underwent a massive testing program. It is the buildings built before these earthquakes, and before subsequent changes to the code, that represent a major risk to the safety of the occupants. Below are descriptions of each significant type and what is needed to make them safer.

Unreinforced Masonry (URM)

The 1933 Long Beach earthquake was a moderate earthquake, magnitude 6.4 that caused a high level of damage because the fault ran through the populated areas of Long Beach where vulnerable buildings were built in loose, saturated soils. Most of the damage occurred in brick and masonry buildings without any internal steel reinforcement. When the mortar between the bricks and stones lost strength in the shaking, the bricks holding up the roof fell, causing the roof to collapse. Because the bricks and roof are often very heavy, collapse of these buildings is particularly deadly. These risks to life can be significantly reduced with targeted retrofitting.

Front wall of the John Muir School, Pacific Avenue, Long Beach, California, downed by the March 11, 1933 earthquake. Photo credit: W.L. Huber, earthquake.usgs.gov

In 1986, the state of California passed the unreinforced masonry (URM) law that required all jurisdictions in high seismic activity areas (identified as Seismic Zone 4 in the Uniform Building Code) to catalog their URM buildings and develop a program to address the risk but left it to each jurisdiction to determine what form the program would take. Seismic Zones are no longer a part of the building code, which now uses the National Seismic Hazard Map from the US Geological Survey. Much of the southern California region is in what was Seismic Zone 4, with the exception of the eastern parts of Riverside and San Bernardino Counties. Because of the State URM Law, most jurisdictions have some law enacted.

Wood-Frame Buildings

In general, properly built, wood-frame buildings, such as the average single-family home, are some of the safest buildings in California during earthquakes. Wood is light and flexible, both admirable characteristics under earthquake shaking. The 1933 earthquake showed that when a building slides off its foundation, it may not kill people, but it can be a complete financial loss. The 1935 Uniform Building Code required that buildings be bolted to their foundation. The 1971 earthquake showed this was not enough for buildings with raised foundations and cripple walls. A cripple wall, a wood stud wall between the foundation and the first floor, creates a crawl space and is typically made of spaced 2x lumber that can topple like dominoes when pushed sideways in an earthquake. Therefore, since 1976, these buildings are required to be bolted to the foundation and have wood structural panels to brace the 2x framing within the cripple wall.

No jurisdiction has imposed mandatory requirements on single-family homes. Some have adopted voluntary programs to encourage retrofitting and the California Earthquake Authority (www.earthquakeauthority.com) partners with some jurisdictions to provide funding to encourage improvements.

Wood-frame building in Long Beach, California, destroyed by the March 11, 1933 earthquake. Photo credit: earthquake.usgs.gov

Tilt-Up Concrete Buildings

These are buildings where concrete walls and columns are created on site in horizontal position on the building slab and then tilted up to be tied together and connected to the roof structure. Many of these failed in the 1971 earthquake because the connections between walls and roof were not adequate enough. The standards have been improved and post-1976 tilt ups have performed better. Several jurisdictions adopted programs to upgrade older buildings after the 1994 Northridge earthquake.

Tilt-up concrete building damaged in the 1994 Northridge earthquake. Photo credit: George Sakkestad.

Non-Ductile Reinforced Concrete Buildings

Concrete is a "non-ductile" material, meaning it cracks and breaks during strong earthquake shaking if there are not enough steel reinforcing bars to hold the concrete together. The partial collapse of the then-recently built Olive View Hospital in the 1971 San Fernando earthquake was shocking and led to major changes in the 1976 building code requirements for concrete buildings. These buildings were common, representing many of the commercial buildings built in southern California. Like for tilt-up buildings (which are really a subset of the non-ductile reinforced concrete type), the 1976 code required a different approach to connecting the walls and roof. The collapse of more of the buildings of the older type in the 1994 Northridge earthquake as well as many other earthquakes in other parts of the world have demonstrated that these are some of the deadliest vulnerable buildings during earthquakes (e.g., Otani, 1999). After the 1994 earthquake, the California Seismic Safety Commission recommended retrofit be required for these buildings (CSSC, 1995).

Partial collapse of the Olive View Hospital in the 1971 San Fernando earthquake. Photo credit: NOAA/NGDC, E.V. Leyendecker, U.S. Geological Survey.

Soft First-Story Buildings

The 1989 Loma Prieta earthquake in the San Francisco Bay area and the 1994 Northridge earthquake together brought home the problems presented by soft first story construction practices. A "soft first-story" building is one where a big opening in the first floor walls, such as a for carport or retail windows, makes the first story much weaker than the stories above. This concentrates the shaking into the first story during the earthquake and makes it more likely to collapse at the first story endangering the inhabitants.

Collapse of the Northridge Meadows apartment building in the 1994 Northridge earthquake. Photo credit: NOAA/NGDC, M. Celebi, U.S. Geological Survey.

Because many of the buildings are residential, they represent a particularly critical threat to lives and a major loss to a community after the earthquake. The retrofit is also relatively economical and non-invasive, involving just a strengthening of the first story. This has meant that several jurisdictions have started considering ordinances to address the problem.

Pre-1994 Steel Moment Frame Buildings

After the failure of the concrete buildings in the 1971 San Fernando earthquake, many turned to steel as a better building material for seismic safety. Because steel is "ductile" (bends rather than cracking when pushed beyond its strength), it seemed a safer way to build buildings. Even if the strength of the building is exceeded, it was thought that the ductility of the steel would prevent collapse and people could get out alive. The 1994 Northridge earthquake exposed flaws in this construction. In some buildings, the welding of beams to columns changed the material properties of the steel and cracks formed in the welds. In a bigger earthquake than Northridge where ground shaking will last for a longer duration, engineers now know there is a real risk of collapse in these older, steel moment frame buildings.

A steel frame building in Kobe, Japan where cracks through columns led to collapse of one floor in the 1995 M6.9 earthquake. Photo credit: Chuo Ward.

APPROACHES FOR MITIGATION

Jurisdictions have taken a variety of approaches to increase their community's earthquake resilience that include retrofitting ordinances that seek to reduce the risk before the earthquake happens and programs that will improve the ability of the community to recover. The retrofit ordinances are, in general, specific to the type of building and may be either mandatory or voluntary. In the Survey results, there are the following possible categories:

- **Mandatory**: An enacted ordinance that requires retrofitting
- **Mandatory but incomplete:** This is used only for the URM laws that have been in place for several decades. It is an enacted mandatory ordinance with incomplete enforcement so that less than 50% of the buildings have been retrofitted or demolished.
- **Voluntary:** An ordinance that encourages retrofitting and provides technical standards without requiring the action.
- **In development:** Survey response was that ordinances are being actively developed.
- **In discussion:** Survey response was that city personnel are beginning to discuss the options and explore possibilities.
- **Not Applicable:** Many jurisdictions have no URMs so there would be no point in having a URM law. The data is available through the State URM law (State of California, 1986).
- **None:** No ordinance in place or in discussion. Unlike for URMs, there is no data to determine if each jurisdiction has any of the other building types, such as tilt-up concrete or steel moment frame. Several building officials told us their city is young and they do not believe they have problem buildings. This should be considered when looking at the data.

Unreinforced Masonry (URM)

RESULTS

Because the 1986 California URM law requiring all jurisdictions in the earlier Seismic Zone 4 per the Uniform Building Code to develop a retrofit program, these programs are widespread (see Figure 2). These buildings were prohibited from being constructed after 1935, so 58 jurisdictions surveyed had no URMs and therefore no need for a program. The majority of the remaining jurisdictions have programs that mandate retrofit of URMs although not all have been successful in retrofitting or demolishing all of their URM buildings. Twelve jurisdictions have mandatory programs that achieved less than 50% compliance. Imperial and Los Angeles Counties have the highest rate of mandatory programs while San Bernardino County has the lowest.

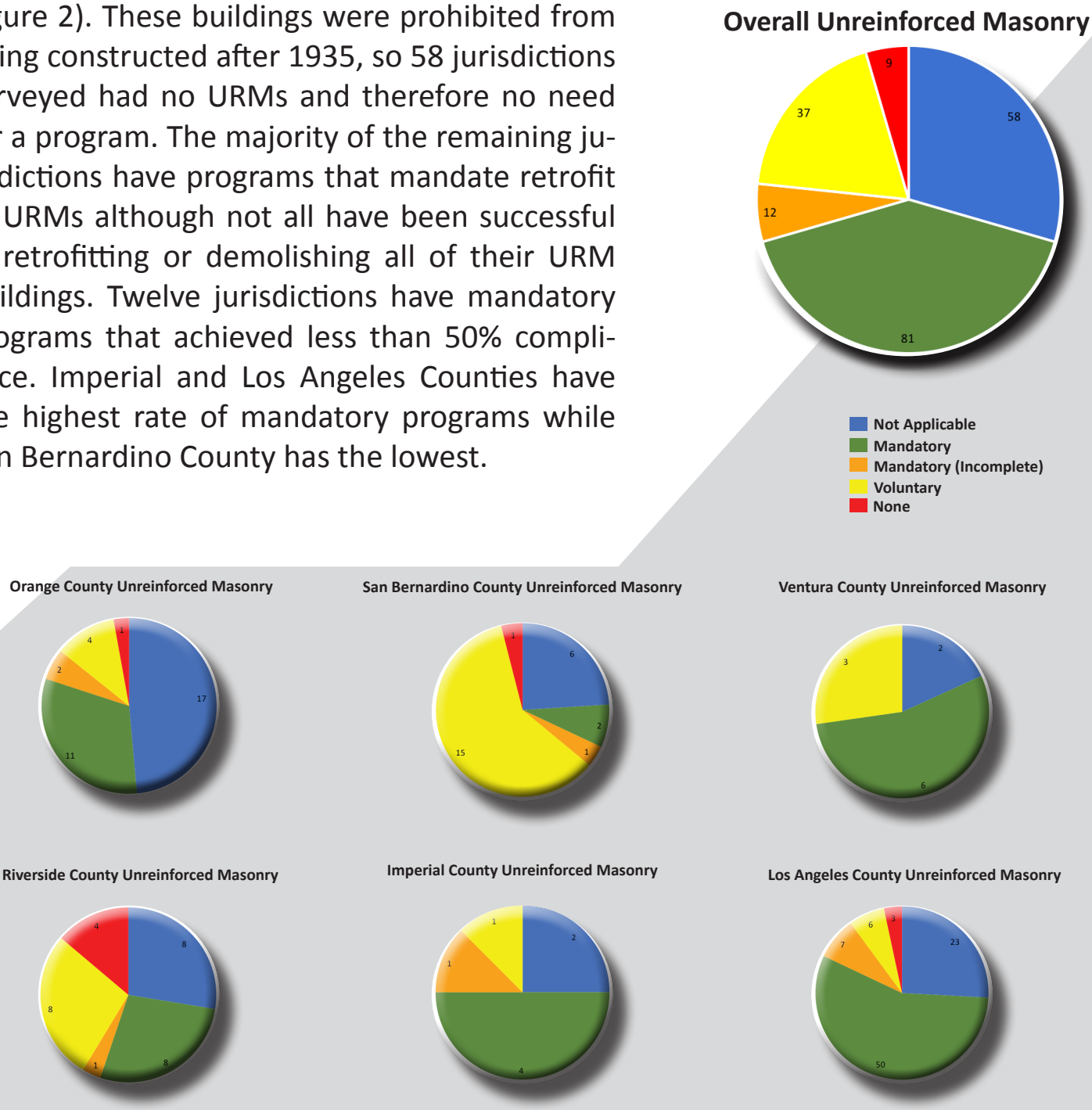


Figure 2. Ordinances to address Unreinforced Masonry for all six counties and by county.

Other Vulnerable Building Types

For the remaining types of vulnerable buildings (wood-frame, tilt-up, non-ductile concrete, pre-1994 steel moment frame, soft first-story), very few jurisdictions are considering any action at this time. No jurisdictions in San Bernardino or Riverside Counties have any program to address the other five building types. Imperial County has one jurisdiction with a mandatory tilt-up concrete retrofit program but no other programs. Six other jurisdictions have tilt-up concrete retrofit requirements, one in Orange County and five in Los Angeles.

The City of Downey is an interesting case. In 1985, the Downey City Council passed a law (amended in 1995) that all buildings built before 1957 of all types had to be evaluated for their seismic resilience and brought up to code if they were found to be deficient. This law addresses many of the issues discussed here but not completely as all buildings designed prior to the 1971 earthquake are possibly vulnerable. In the data analysis, it was considered a mandatory code for all building types, but note that the critical 1957-1975 period has not been addressed.

The most common mandatory code other than the required action on Unreinforced Masonry is for concrete tilt-up buildings (see Figure 3). Most of these laws were enacted after the 1994 Northridge earthquake.

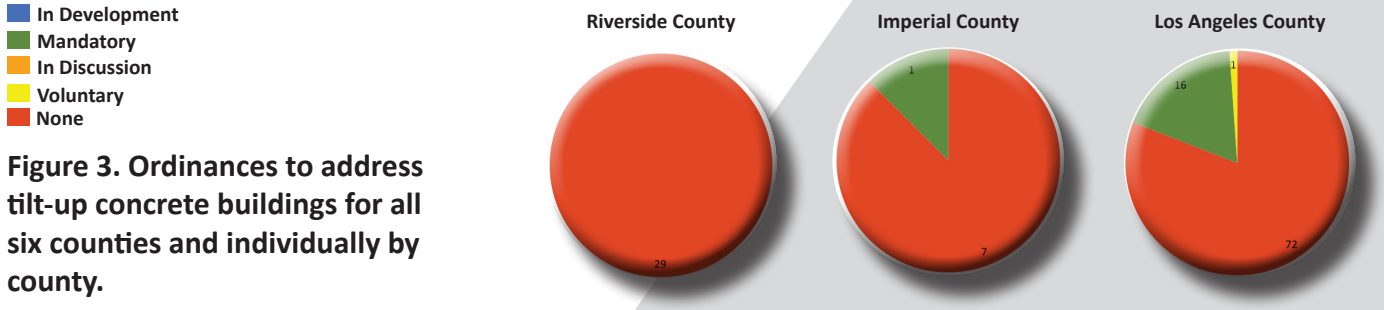


Figure 3. Ordinances to address tilt-up concrete buildings for all six counties and individually by county.

The most common interest currently is in retrofitting soft first-story buildings (see Figure 4). Seven of the 191 cities are considering or have taken action, including one city in Ventura County and six in Los Angeles County. Two cities have enacted mandatory programs, two have voluntary programs, and three are in discussion or working on developing a proposed program. In addition, Los Angeles County is working on a voluntary program and, if it is included in the county building code, it will apply to its contract cities. Because this is not yet clear, DLJCSS marked the contract cities as being in discussion.

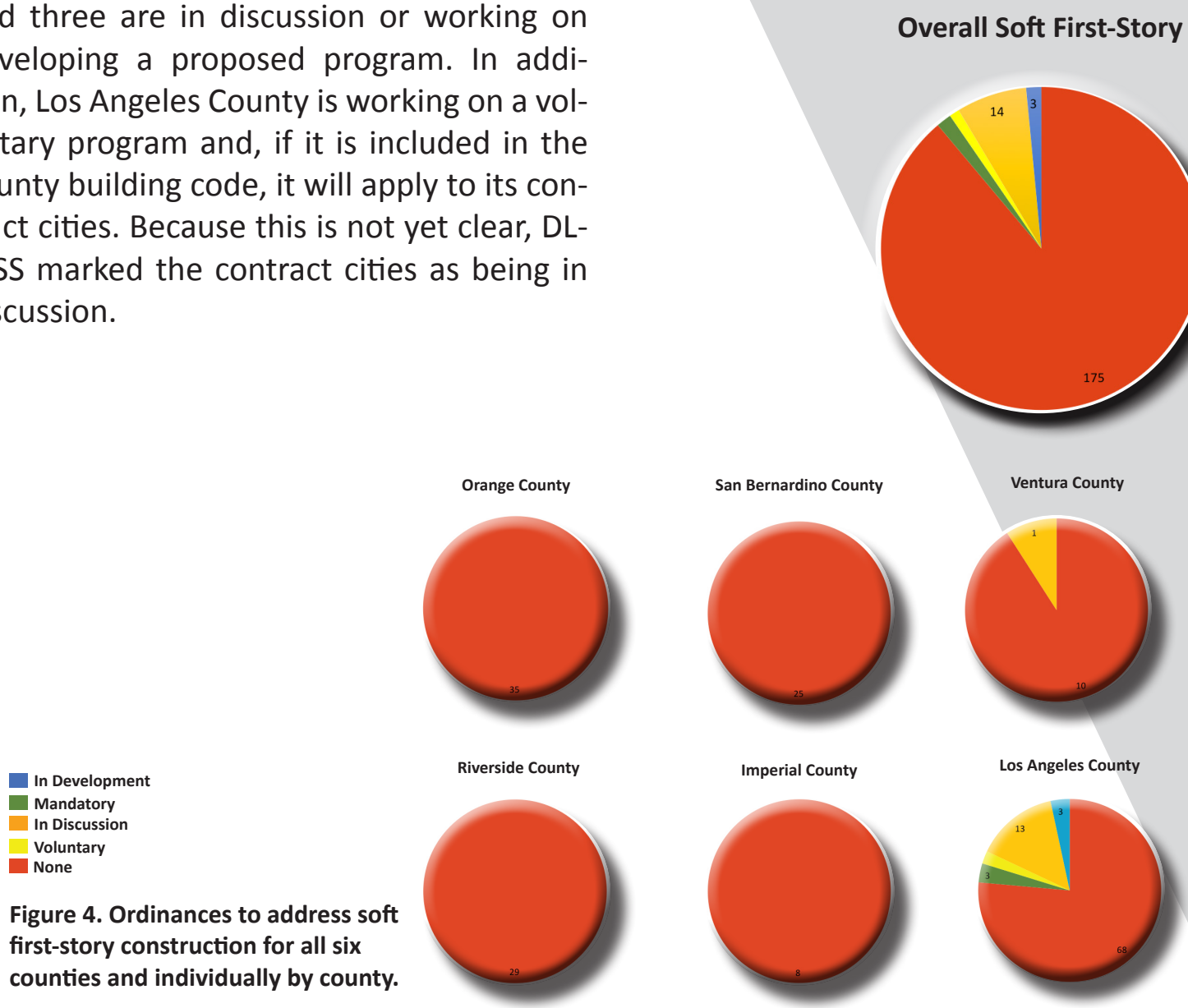


Figure 4. Ordinances to address soft first-story construction for all six counties and individually by county.

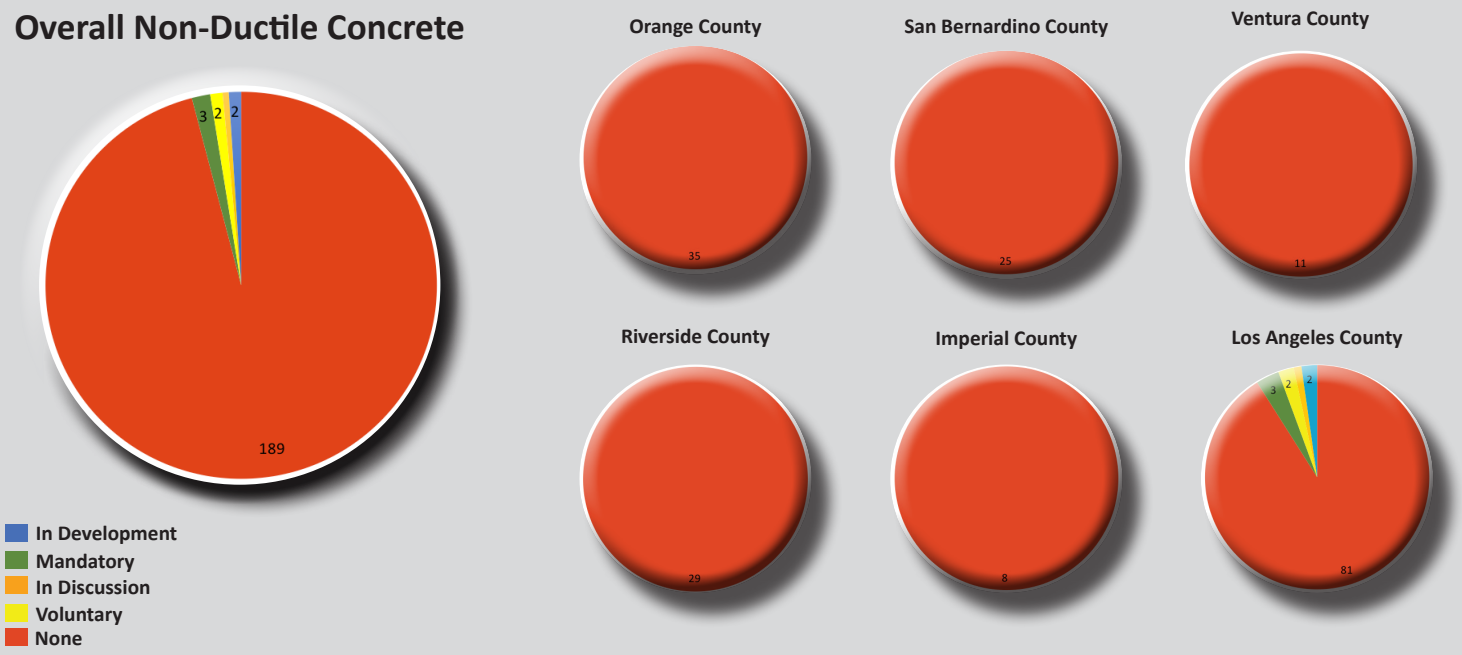
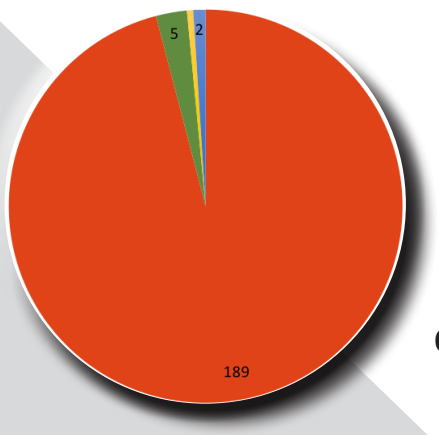


Figure 5. Ordinances to address non-ductile concrete buildings for all six counties and individually by county.

Only two mandatory programs have been enacted for non-ductile concrete buildings (see Figure 5). Santa Monica enacted a mandatory program after the Northridge earthquake but has not achieved significant enforcement and is discussing moving forward with a new law to close that gap. The 2015 law in Los Angeles is the only recent action and requires retrofitting within 25 years. Downey's pre-1957 building law shows up here. Long Beach and Burbank have voluntary programs from the 1990s, and West Hollywood and Beverly Hills are in discussion about enacting new programs.

Progress is also noted in addressing issues seen in pre-1994 steel moment frames. The problem with cracks in steel moment frame buildings was discovered in the 1994 Northridge earthquake, and most of the programs date from the 1990s (see Figure 6). Both Los Angeles City and Los Angeles County established programs mandating inspections and repairs of connections in buildings with cracked welds in areas of high seismic shaking in the Northridge earthquake. This did not include downtown Los Angeles. Santa Monica and Burbank established mandatory programs covering all steel moment frame buildings in their cities. West Hollywood and Beverly Hills are working now on several building types including steel moment frame.



Overall Steel Moment Frame

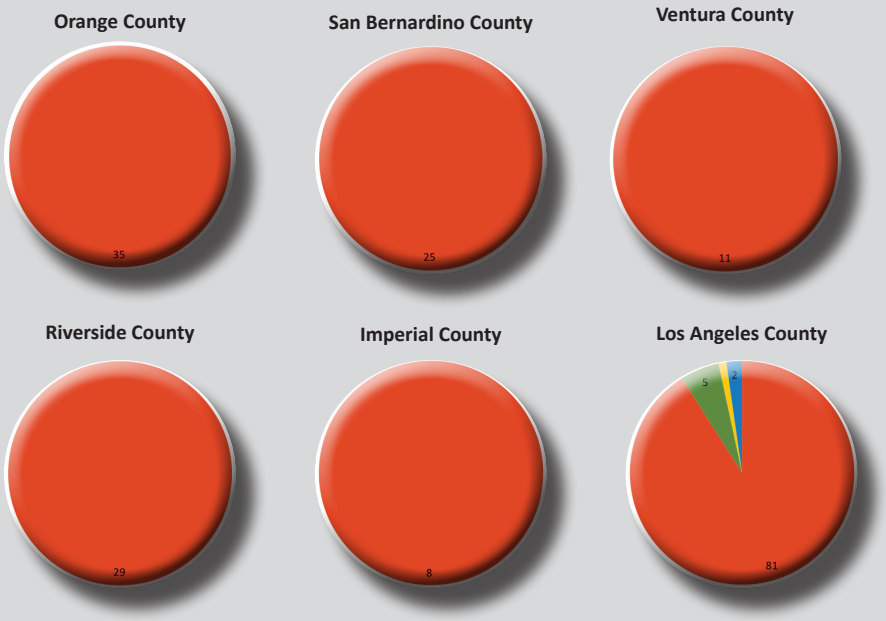


Figure 6. Ordinances to address steel moment frame buildings for all six counties and individually by county.

Back-to-Business Programs

A Back-to-Business or Building Occupancy Resumption Program (BORP) program speeds business resumption after an earthquake by having private structural engineers work with building owners and jurisdictions to develop a program for expedited building inspections after an earthquake. Results include:

- Yes. A program is in place.
- No. Nothing has been discussed.
- In development.

Five jurisdictions have established such programs (see Figure 7). The programs have been enacted in four cities in three counties.

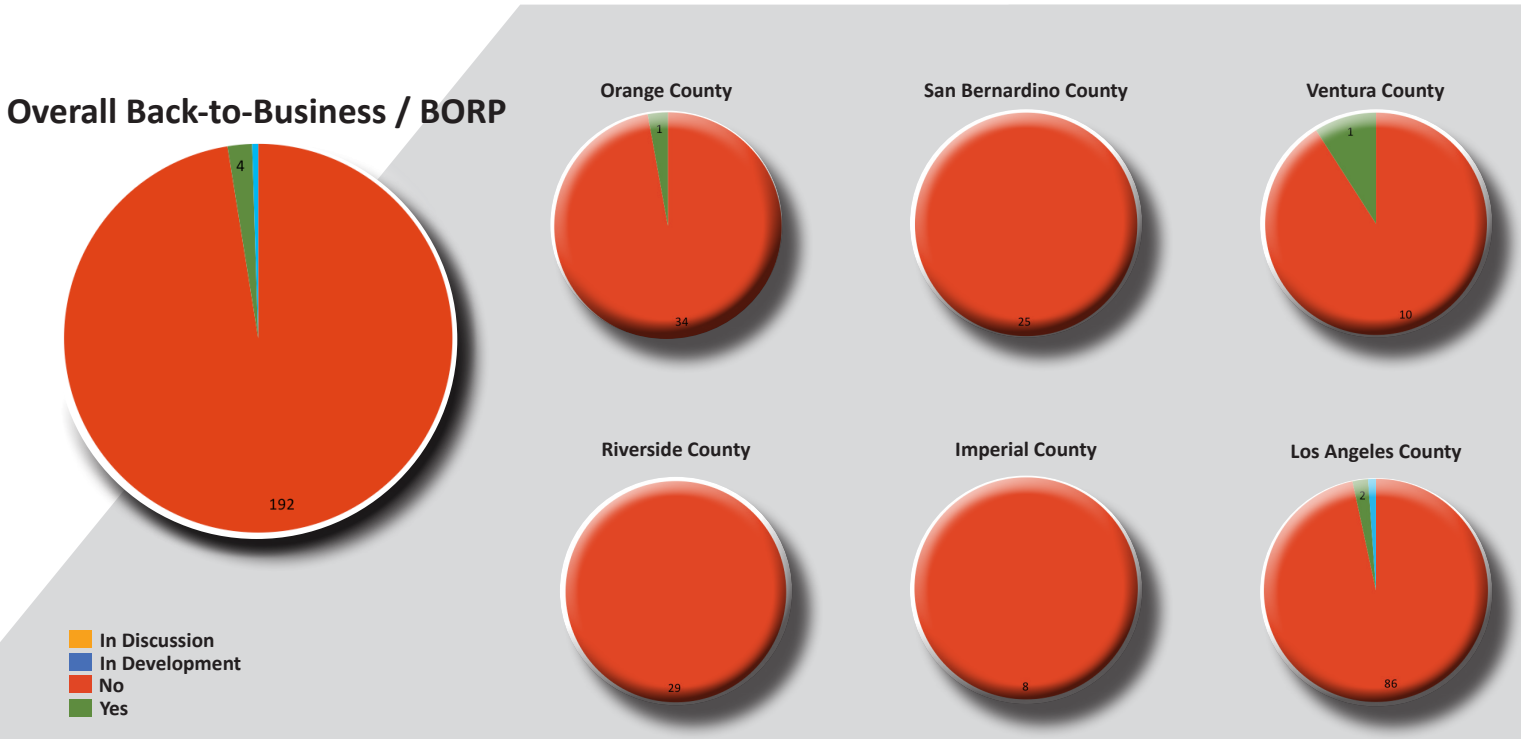


Figure 7. Back-to-Business programs for all six counties and individually by county.

DISCUSSION

The vulnerable buildings considered in this study represent a significant threat to the lives and safety of their inhabitants. These buildings have the potential or even the likelihood of collapse in strong shaking. Communities would need to inventory hazardous buildings and adopt programs to retrofit or remove such buildings to avoid numerous injuries and fatalities in the inevitable future earthquakes of southern California.

As expected in disaster mitigation, most existing programs have been put in place in response to the occurrence of a damaging earthquake. Most of the URM ordinances were enacted in response to a State law that was itself triggered by two deaths in URMs in the 1983 Coalinga earthquake. The Northridge earthquake led to several measures to address soft first-story, non-ductile concrete and steel moment frame buildings. There is a third wave in the last few years that for the first time is not tied to a recent earthquake. Two large cities, San Francisco (http://sfgov.org/esip/capss) and Los Angeles (https://www.lamayor.org/resilience-design-building-stronger-los-angeles), have taken action, successfully adopting mandatory programs with community support, and other jurisdictions have taken notice.

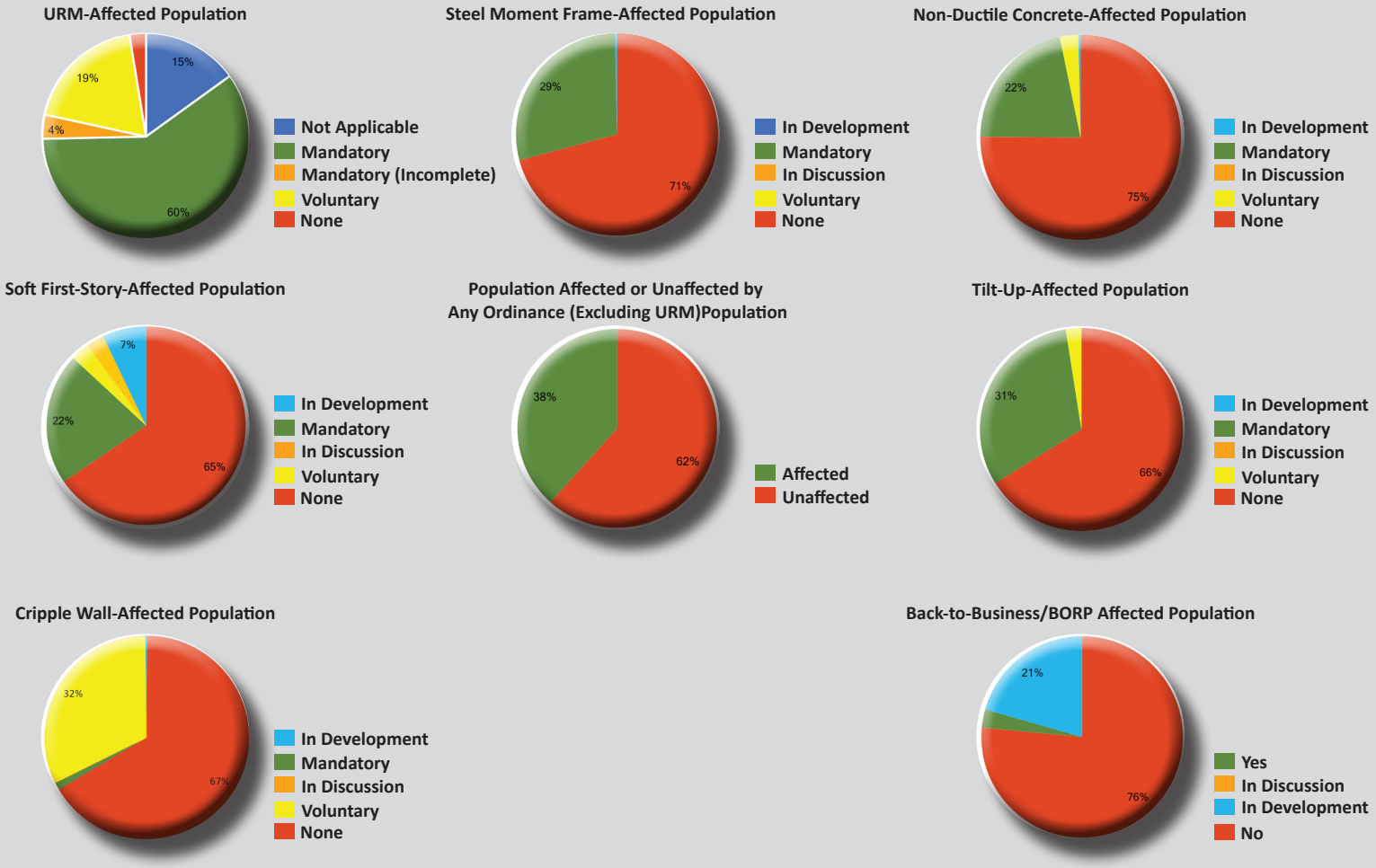


Figure 8

Although the number of jurisdictions addressing many of these problems is small, it still represents a significant fraction of the population (see Figure 8). The actions of these jurisdictions is providing momentum for action. Many of the building officials contacted in this study expressed interest in knowing what other jurisdictions are doing and said they were looking for guidance in how they could address these issues.

ABOUT THE 2016 SAFER CITIES SURVEY

Measuring Safer Cities

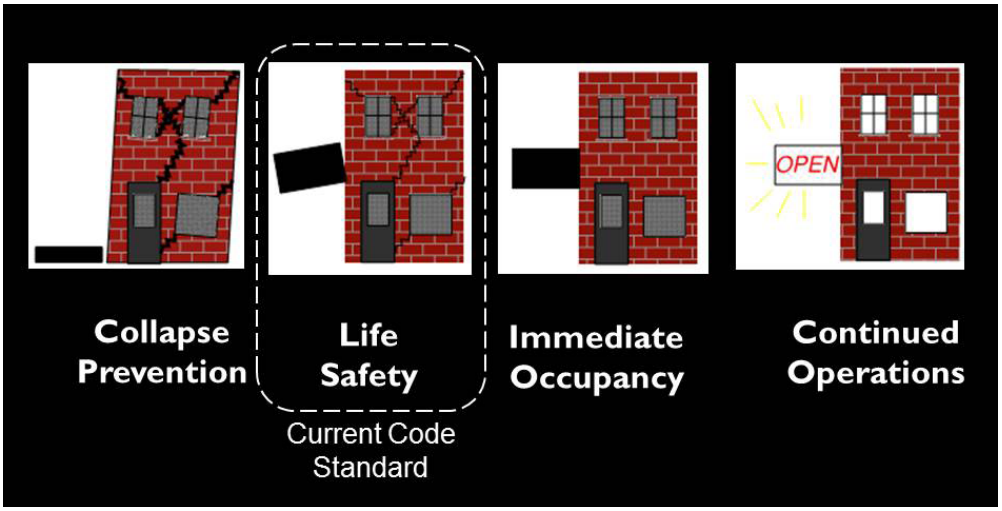
Measuring the safety of cities by the extent to which local governments have enacted ordinances or planned initiatives to address vulnerabilities of existing buildings, the Safer Cities Survey is presented to help frame continued conversations at all levels of engagement with regard to seismic hazards, building performance and community resilience. Prepared by the Dr. Lucy Jones Center for Science and Society (DLJCSS), the Survey has assessed the status of vulnerability determination and implementation of strengthening strategies in place or planned within the survey area. While the safety of cities is a multifaceted topic, the anticipated viability of building structures to sustain occupancy, provide shelter, and support economic stability following a devastating earthquake is a measurable component of a city's ability to limit losses and recovery time.

Mayor Eric Garcetti & Dr. Lucy Jones release "Resilience by Design" program.

Code Performance And Public Expectations

From 1927, when the first consistent statewide building code was adopted, significant strides have been made in increasing the structural performance of buildings during earthquake events. However, nearly every existing building gains little to no benefit from the continued code enhancements because current codes rarely require upgrades to buildings built in compliance with past codes. Instead, owners are most often left to decide how and when to implement upgrades, if any, to their structures. Even when upgrade requirements are triggered by current codes, the building can remain vulnerable, as compared to a new building, due to the fact that portions of the building continue to contain older methods of construction not conforming to current standards. This can be further exacerbated by the need of building owners and retrofit designers to work within fixed budgets focused on enhancing a building's performance while staying just below a threshold that may trigger mandated requirements. The result is a building inventory with non-uniform performance objectives and capabilities. For city officials, policy makers, and emergency planners, this increases the difficulty of prioritizing planning and response programs. For current and future building owners and tenants, this can result in unmatched expectations with regard to long-term value and short-term recovery time of their buildings.

"NEARLY EVERY EXISTING BUILDING GAINS LITTLE TO NO BENEFIT FROM CONTINUED CODE ENHANCEMENTS"



Building performance levels after an earthquake. A typical building designed per the current codes has a "life safety" standard that would prevent loss of life but would result in a damaged building.

Knowing A City's Building Stock

In the aftermath of recent devastating natural disasters, many in the structural engineering and city governing community recognize the need for better discussions regarding the ability, or potential lack thereof, of the built environment to sustain a community beyond life-safety goals established by the minimum standards set forth in current building codes.

Soft story buildings. Photo credit: Simpson Strong-Tie.

In order to further these discussions, SEAOSC's Safer Cities Survey initiative is intended to baseline our communities with regard to the status of active, pending or planned (voluntary or mandatory) regulations addressing the most vulnerable building types. Specifically, the Survey identifies unreinforced masonry, tilt-up concrete wall panel, non-ductile concrete, pre-Northridge steel moment frame, and wood soft-story conditions as building or structure types having the potential for significant losses in future earthquakes. Whether it be understanding the inability of unreinforced masonry to withstand out-of-plane flexure or in-plane shear forces resulting in lost support for elevated floors and roofs; the potential for sudden failure of concrete and steel moment frame connections resulting in excessive and dangerous building drift; the possible loss of anchorage of large concrete wall panels to the roofs of industrial or similar tilt-up buildings and resulting collapse of the wall panels and supported roof; or the potential for excessive drift and collapse of open front wood framed buildings; knowledge of the vulnerable building inventory within a community is a key component to addressing the overall community risk and resilience. With this in mind, the Safer Cities Survey asks Cities if they have an active or planned program to assess the building inventory to gauge the number and locations of potentially vulnerable buildings. This is one of the first steps in developing appropriate and prioritized risk mitigation and resilience strategies.

Rapid Business Recovery After An Earthquake

Additionally, the Survey keys into City programs for timely restoration of occupancy to buildings. Some cities have established "Back-to-Business" or "Building Re-Occupancy" programs, creating partnerships between private parties and the City to allow rapid review of buildings in concert with the City safety assessments. While City resources must be initially focused on critical infrastructure and first response facilities, Back-to-Business programs help ensure the economic viability of individual residents, business and ultimately the City itself, by allowing private parties to activate pre-qualified assessment teams, who became familiar with specific buildings to shorten evaluation time, to support city inspections. These key programs help define potential timeframes of recovery and measure "safety and resilience of the city" as it relates to the ability to predict outcomes and plan sustainable community wellbeing.

BORP and B2B Timeline

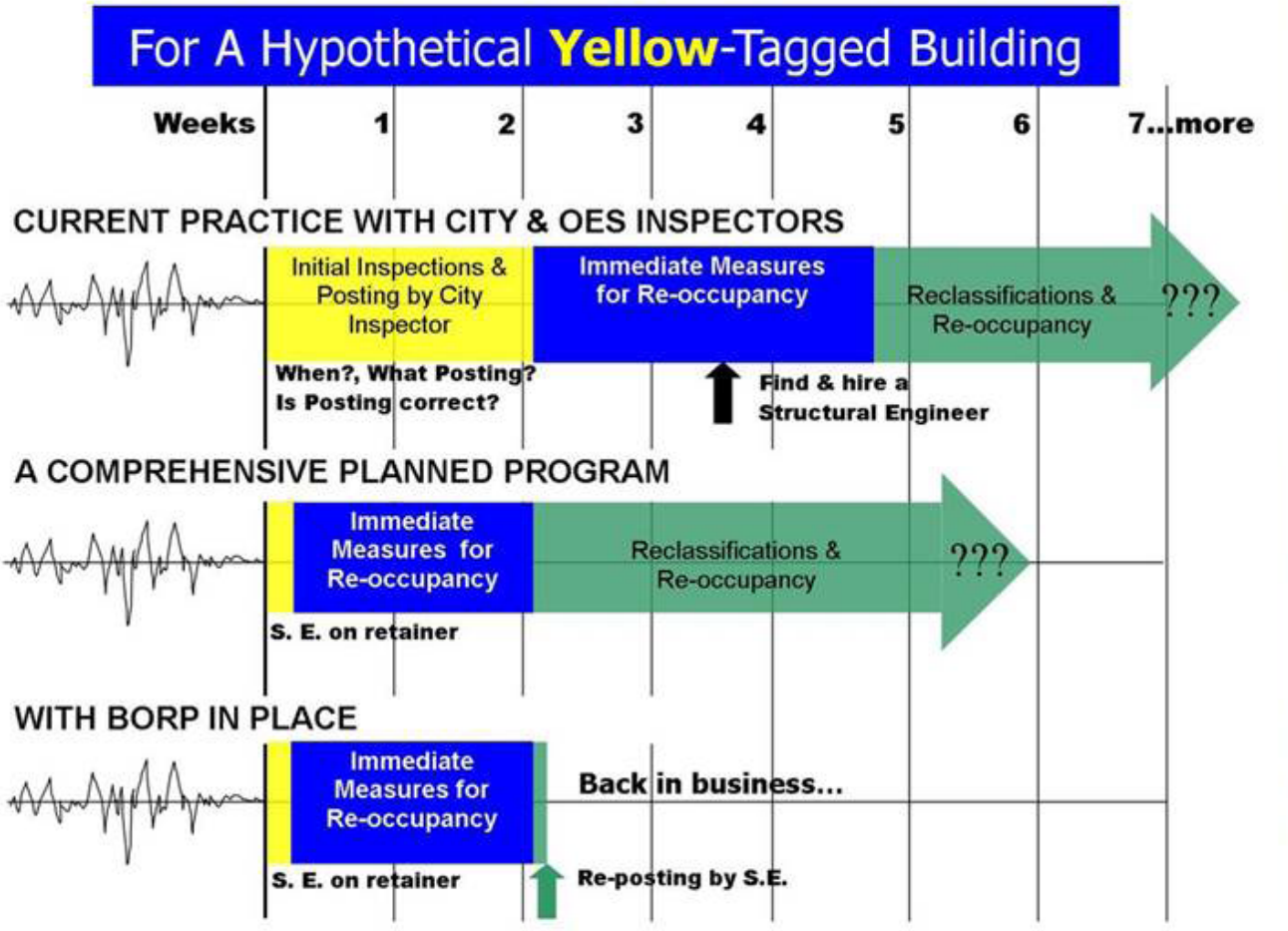


Image courtesy of SAFEq Institute / Structural Focus.

SEAOSC Is A Resource For Owners And Policy Makers

SEAOSC is committed to remain an active participant in the continued conversations on building resilient communities and, to that end, will update this Safer Cities Survey report with additional information as it is gathered. The Association's role is to provide independent technical and non-technical information for decision makers to use in assessing risks and developing risk mitigation and resilience strategies. To leverage this information, policy makers and building officials are encouraged to reach out to SEAOSC for input on ordinances or city programs that can be implemented towards building safer cities through setting effective performance objectives and resilient planning initiatives. Back-to-Business or Occupancy Resumption programs should be reviewed as effective ways to partner with community businesses to alleviate immediate demands on limited city resources resulting in quicker recovery. Building owners and tenants are welcome to visit the Association's website (www.seaosc.org) where they can learn more about specific risks, retrofit measures, and how to reach some of our 1000-plus members to begin the journey toward better performing buildings. The SEAOSC office contact information is shown on the website and they may be contacted for more information. As mentioned in the President's Message, Southern California is a region of great opportunity. SEAOSC and its membership is dedicated to sustaining these opportunities for all by helping local building officials and the general public survive and more quickly recover from tomorrow's earthquake through better building performance and resilient community planning today.

SEAOSC presents resources at the City of Los Angeles Seismic Retrofit Fair on April 7, 2016.

"QUICKLY RECOVER FROM TOMORROW'S EARTHQUAKE THROUGH BETTER BUILDING PERFORMANCE AND RESILIENT COMMUNITY PLANNING TODAY"

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About SEAOSC

The Structural Engineers Association of Southern California (SEAOSC) is the premier professional organization to which local Structural Engineers belong. The organization serves its members in the noble profession of structural engineering by fostering and promoting the contributions of structural engineers to society. SEAOSC is a member-centric organization, where substance and image are equally promoted through fiscally responsible management and optimization of the benefits to the members. SEAOSC leadership and membership will strive to reach the ideals represented by the following five pillars of the association: membership value, image & advocacy, codes & standards, education, and legislative participation. www.seaosc.org.

About the Dr. Lucy Jones Center for Science and Society

The Dr. Lucy Jones Center for Science and Society was created in 2016 with a mission to foster the understanding and application of scientific information in the creation of more resilient communities. Working with both the public and private sectors, The Center will increase communities' ability to adapt and be resilient to the dynamic changes of the world around them, and will help scientists become better communicators of their results and help decision-makers understand how they can partner with scientists and use results of scientific studies to make better informed decisions. www.drlucyjonescenter.org

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