RESILIENCE POLICY GUIDANCE DOCUMENT

# SOFT STORY RETROFIT

PROGRAM DEVELOPMENT

Association of Bay Area Governments

# Association of Bay Area Governments
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# Credits


This guidance document was produced with support from the United States Geological Survey and FEMA.

Our special thanks to David Bonowitz, Laurence Kornfield, Jenny McNulty of City of Berkeley, Patrick Otellini of City and County of San Francisco, Sharyl Rabinovici, Laura Samant, and Marko Schotanus of Rutherford + Chekene for their careful review of all or parts of this document.

ABAG Publication #**P15001PRO**

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# INTRODUCTION

Introduction

# Soft Story Retrofit: Residential Resilience for the Bay Area

This document provides information gathered from local experience, and recommended practices, for how to develop programs to reduce the earthquake risks of existing “soft story” buildings. While the information presented here is based on extensive earthquake engineering knowledge, this guide is intended to be used by a non-technical audience, including jurisdiction staff and elected officials to help guide policy development, adoption and implementation.

The term "soft story" as used throughout this report refers specifically to older, wood-frame multi-story buildings with an especially weak, flexible, or otherwise vulnerable ground story. Often (but not always), the soft story deficiency is indicated by large openings in the ground story walls, typically due to garage doors, open parking stalls, or large storefront windows. These buildings, built before current building codes, have ground stories that have a tendency to collapse when shaken hard enough.

Approximately 140,000 units in 18,000 of these buildings exist in the Bay Area. [1] ABAG (2003) estimates that soft story buildings will account for approximately two-thirds of uninhabitable buildings in a major Hayward fault earthquake, and they represented almost half of the housing lost in the 1989 Loma Prieta earthquake.

While they are not the only fragile building type, for some Bay Area jurisdictions, soft story buildings comprise a significant percentage of the residential units. This puts residents, primarily renters, at risk. Protecting soft story buildings from collapse through retrofit saves lives and can prevent community devastation.

Some Bay Area jurisdictions have begun to recognize soft story buildings as a problem and have already developed and adopted policies to inventory, assess, and retrofit these buildings. These regional leaders can help inform other Bay Area jurisdictions by sharing lessons learned, what works and what doesn't.

The approach we lay out here follows the basic steps that a jurisdiction would take to implement any new policy, with specific guidance and lessons learned around topic areas specific to soft story retrofit. Specifically, retrofit policies generally receive skepticism from the general public and stakeholders because they impose public policy on private buildings and impose costs to building owners. The first two steps, therefore, are critical for ensuring that policy adequately addresses public concerns and gains political and public support. The five steps, illustrated in Figure 1 and laid out in the structure of this document, are:

- Assess the problem - figure out if soft story retrofit is apppropriate for the jurisdiction, and how retrofitting soft story buildings helps the jurisdiction meet goals for residential performance in the event of a major earthquake
- Build consensus - using information gathered from the assess step, jurisdictions need to craft a compelling story about why soft story retrofit is necessary, and work with the public and stakeholders to work through potential issues and gain support for

*1 Information compiled from various city building inventories, available here: http://resilience.abag.ca.gov/housing/softstory/*

**TABLE 1 Prevalence of Particular Best Practices in "Soft Story Leadership Communities"**

| City | Number of Soft Story Buildings* | Building Inventory | Notified Owners | Notified Tenants | Mandated Screening form | Mandated Engineering Evaluation** | Mandated Retrofit |
|---|---|---|---|---|---|---|---|
| **San Francisco** | 6,700 | √ | √ | | √ | √ | √ |
| **Oakland** | 1,479 | √ | √ | √ | √ | | |
| **Berkeley** | 400 | √ | √ | √ | | √ | √ |
| **Alameda** | 70 | √ | √ | √ | | √ | |
| **Fremont** | 22 | √ | √ | √ | | √ | √ |
| **Santa Clara County** | 2,630 | √ | | | | | |
| **San Leandro** | 350 | √ | | | | | |
| **Sebastopol** | 55 | √ | | | | | |

** Identified in initial inventory. The number of buildings actually subject to retrofit may be less.*
*** This inidicates that an engineering report was a formal deliverable. San Francisco did not require an engineering evaluation to be submitted, but it is implicit that a building owner would have an engineering evaluation performed prior to submitting plans for permit.*

the program. Without this step, the policy is likely to fail or be held up during the drafting and adoption phases.

- Draft a policy - decide the specifics of the program. What buildings will be subject to the policy? To what degree will they have to perform after an earthquake? Are some buildings a higher priority than others?
- Adopt the policy
- Implement the program - jurisdictions will have to provide significant support for building owners, design professionals, and contractors to ensure that the program is implemented according to expectations.

The information presented in this guide is based on the collective efforts of a community of engineers, policy makers, jurisdiction staff, and researchers to collect and distill best practices for developing and implementing soft story programs. Table 1 (page 6) shows a summary of the jurisdictions who have completed at least some component of a soft story retrofit, whose lessons learned are incorporated into all of the recommendations made in this document.

## Safer Homes Make Stronger Communities

This document is part of a wider discussion about protecting housing and residents in their own communities. In the Bay Area, retaining housing is crucial to expediting and ensuring effective disaster recovery. Limiting catastrophic housing damage and allowing residents to stay in their homes not only helps people who may lack the resources to quickly recover from a disaster, but keeps communities intact. In the aftermath of natural disasters, the recovery of the region's economy is interdependent with the recovery of the region's housing. If residents can stay in their homes, they will be better able to participate in the rebuilding of their neighborhoods and cities, go to work and support local business, and improve the recovery trajectory of the entire region.

Housing, in turn, is only one component of a jurisdiction's overall resilience. Communities seek to protect residents from devastating personal loss, but also to ensure that residents are cared for through the continued provision

**FIGURE 1 Soft Story Retrofit Policy & Program Development Steps**

**TABLE 2 Commonly-found Fragile Housing Types in the Bay Area**

| Fragile Housing Type | Definition | Notes |
|---|---|---|
| Hillside | Located in a "zone of required investigation" for earthquake-induced landslide. | Hillside homes may also have structural damage due to ground shaking |
| Single family cripple wall | Contains a crawl space and/or stairs leading up to the front door. | Commonly found in bedroom communities, rare in city centers and dense suburbs. Common in older, more established regions such as San Francisco and Alameda counties. |
| Single family house over garage | Garage with living space above it that lacks interior walls and may be unable to support the living space above it. | Commonly found in dense pre-1950's suburbs like San Francisco, or post 1950's suburbs with attached multicar garages. Highly prevalent in more recently urbanized areas such as Santa Clara and Contra Costa counties. |
| Unreinforced masonry | Masonry buildings that lack any structural support aside from mortar. | 1% of total regional housing stock, most significant in San Francisco and Alameda counties. Mandated to be inventoried by state law. |
| Multi-family cripple wall | Contains a crawl space and/or stairs leading up to the front door. | Commonly found in pre-1920's neighborhoods. |
| Multi-family soft story | Contains large openings on the first floor, typically for parking or commercial space, with residential units on the upper floors. | Pre-1950: mixed or high density suburban neighborhoods. Significant in older cities – over 10% in San Francisco.<br>Post-1950: Fairly prevalent, especially in San Mateo County. Also found in large subdivision developments (Fremont, Hayward). |
| Multi-family non-ductile concrete | Concrete structures lacking steel reinforcement to add ductility, or the ability to bend without breaking. | Commonly found in high-density suburban neighborhoods. |

of infrastructure services. Continuity of services, including water, wastewater, power, police, fire, education, health care, and businesses enable residents to meet their daily needs and retain their jobs. Citywide resilience should be considered holistically and addressed by jurisdictions in a multifaceted way, cutting across departments, addressing multiple hazards, and planning for both short-term and long-term solutions.

## Setting Citywide Resilience Goals

Citywide resilience goals should start with a comprehensive understanding of the particular mix of building uses and seismic deficiencies and how the performance of a specific housing type (such as soft story buildings) impacts overall housing recovery objectives. Goals should also be set to articulate expected performance across other sectors such as infrastructure, natural resources, community planning, economy, and health and social services.[2]

From there, jurisdictions can set goals for performance and recovery to help set a policy agenda that supports an efficient and expedited recovery.[3] Performance goals can be partially achieved through retrofit of existing structures, but jurisdictions should also consider where and how future growth affects the performance of a jurisdiction after a disaster. Building in high risk areas can lead to higher levels of damage; additionally, raising building codes and standards for new construction beyond a life safety standard can help ensure that residents are able to remain in their homes and reduces the need for repair and reconstruction during recovery.

*2 For more information on resilience in each of these sectors, refer to FEMA's National Disaster Recovery Framework, available at http://www.fema.gov/media-library-data/20130726-1820-25045-5325/508_ndrf.pdf*

*3 SPUR's 2009 publication The Resilient City: Defining What San Francisco Needs from its Seismic Mitigation Policies, contains discussion on goal-setting and performance expectations. It is available at http://www.spur.org/sites/default/files/publications_pdfs/SPUR_Seismic_Mitigation_Policies.pdf*

# FRAGILE APARTMENT BUILDINGS

## THE SOFT STORY PROBLEM

1

Section 1

# Fragile Apartment Buildings: The Soft Story Problem

Soft story wood frame buildings pose a significant risk to residents and the residential building stock in the Bay Area during an earthquake. They are wood-frame buildings, built before current building codes, whose ground floors have a tendency to collapse when shaken hard enough. Soft story buildings are typically found in older cities and suburbs and can represent a disproportionate share of the regional risk for significant impacts on these jurisdictions.

**FIGURE 1.1 Typical pre-1920's soft story building with parking garages on the ground story**

**FIGURE 1.2 Typical 1950's-60's soft story building with open parking on the ground floor ("tuck-under parking")**

The term "soft story" refers specifically to a multi-story wood frame building with an especially weak, flexible, or otherwise vulnerable first story. Often (but not always), the soft story deficiency is indicated by large openings in the ground story walls, typically due to garage doors, open parking stalls, or large storefront windows. These buildings can display a number of structural inadequacies that can cause damage or collapse, including inadequately stiff walls, weak walls, open wall lines, and unbalanced wall layouts. These are collectively referred to as "soft, weak, or open front" (SWOF) conditions. Throughout this document, we use the term "soft story" to refer specifically to multi-family, wood-frame buildings that exhibit structurally vulnerable first story conditions.

This type of soft story building was most typically built prior to the adoption of the 1978 building code, when code changes began to better address this specific structural deficiency. Approximately 140,000 units in 18,000 of these buildings exist in the Bay Area.[1] While they are not the only fragile building type found in older Bay Area jurisdictions, they do represent a disproportionate risk for significant impacts on a jurisdiction's residential building stock. ABAG (2003) estimates that soft story buildings could account for approximately two-thirds of uninhabitable buildings following a major Hayward fault earthquake; almost half of the housing lost in the Loma Prieta earthquake was soft story construction.

Soft story buildings are typically found in older cities and suburbs. Among soft story buildings, two subsets account for the majority of buildings. These two subsets tend to display distinctly different building technologies.

- 1920's: A residential building boom in the Bay Area around the 1920's resulted in many soft story buildings, typically with garages and commercial and few or no residential units on the ground floor. These buildings also all tend to exhibit similar massing and materials that contribute to their structural issues, based on common building technologies available at the time. These buildings represent one of the most iconic Bay Area architecture styles, especially in San Francisco and older, dense suburbs. Though the majority of this subset of soft story buildings were constructed in the 1920's, some buildings of this style may be older or newer, but are distinct from the second subset.

- 1960's: Another residential building boom occurred in the 1960's, resulting in a second type of soft story building, typically with open parking on the ground floor ("tuck-under" parking) and second floors supported along the open front by pipe columns (as opposed to framed wall sections). This sub-type also is more likely to have residential units on the ground floor. Similar 1960's buildings might have concrete or reinforced masonry walls in the first story; while these

*1 ABAG (1996). Shaken Awake! Estimates of uninhabitable dwelling units and peak shelter populations in future earthquakes affecting the San Francisco Bay Area.*

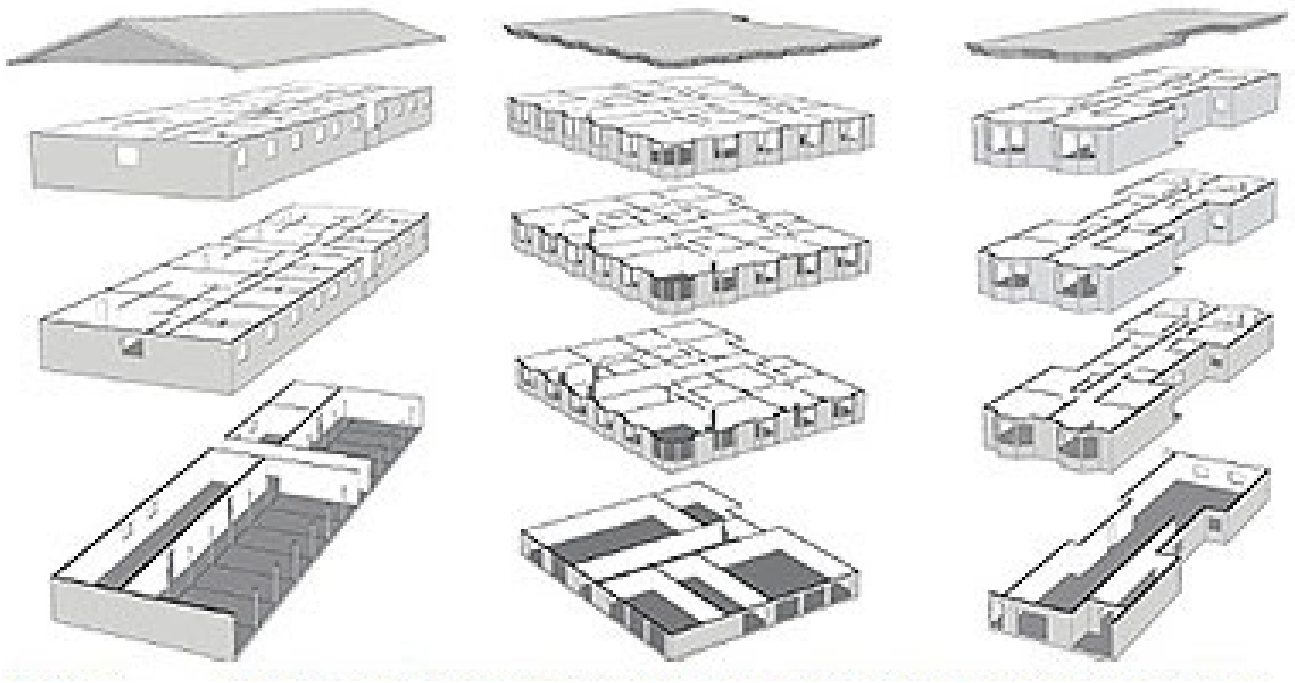

**FIGURE 1.3 Exploded views of three common multi-unit wood frame residential building stypes (roof system, top row; first story, bottom row). The left building is characteristic of 1950's or 1960's buildings with tuck-under parking accessible through a long open side. The middle building is a 1920's era corner building with garage doors lining large portions of both street-facing sides. The right building is a midblock configuration with typically few first-story transverse walls. In all cases, note the relatively high density of walls and partitions above the first story.**

*Source: FEMA P-807, Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings with Weak First Stories, 2012*

buildings may display open front conditions, they are not subject to typical soft story programs, which target wood frame ground stories. Again, while the majority of these buildings were built in the 1960's, some buildings of this style may be newer or older, but are all built before 1978.

Soft story buildings are typically thought to be easily identifiable with characteristic open ground story fronts. While visual surveys can identify potential hazards, actual SWOF deficiencies may not always correlate to these visual cues. True deficiencies are associated with insufficient absolute strength in the ground story, with structurally inadequate bracing or few walls.[2]

Soft story buildings are typically more vulnerable on the ground story, because upper stories usually have more interior walls between rooms and units. The ground story tends to fail more catastrophically than upper stories, so loss of life is less of a hazard than with some other building types, but it is still possible. Retrofit measures aim to prevent soft story building collapse and thus enhance safety in earthquakes. However, loss of life is not the only impact of soft story housing collapse; loss of housing units can devastate a community after a major disaster. Post-disaster housing losses require more government services in a community and often force residents to relocate, significantly altering community demographics and slowing recovery.

Because they are, by definition, multi-unit, soft story buildings may house many families who are primarily renters. Because renters do not control the physical vulnerability of the building in which they live, renters may be highly vulnerable to disaster impacts. Renters

*2 Bonowitz and Rabinovici, 2012, and FEMA P-807, Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings with Weak First Stories, 2012*

may also be more likely to be lower income or young adults, often with fewer financial assets necessary to easily recover after an earthquake if their homes are significantly damaged.[3] Retrofitting multi-family, rental housing, especially in low and moderate income areas, is critical for keeping residents in their homes and communities and for protecting those most vulnerable residents.

Lastly, many soft story buildings, especially the older ones, contribute unique and desirable architectural character to a community. Losing these buildings due to collapse would significantly change the character of a community, including loss of historically significant buildings.

*3 For more information on social vulnerability, ABAG and BDCD developed an analysis of housing and social vulnerability factors in the Bay Area entitled Stronger Housing, Safer Communities: Strategies for Seismic and Flood Risks. It is available online here: http://resilience.abag.ca.gov/projects/stronger_housing_safer_communities_2015/*

# PREPARING A RETROFIT PROGRAM

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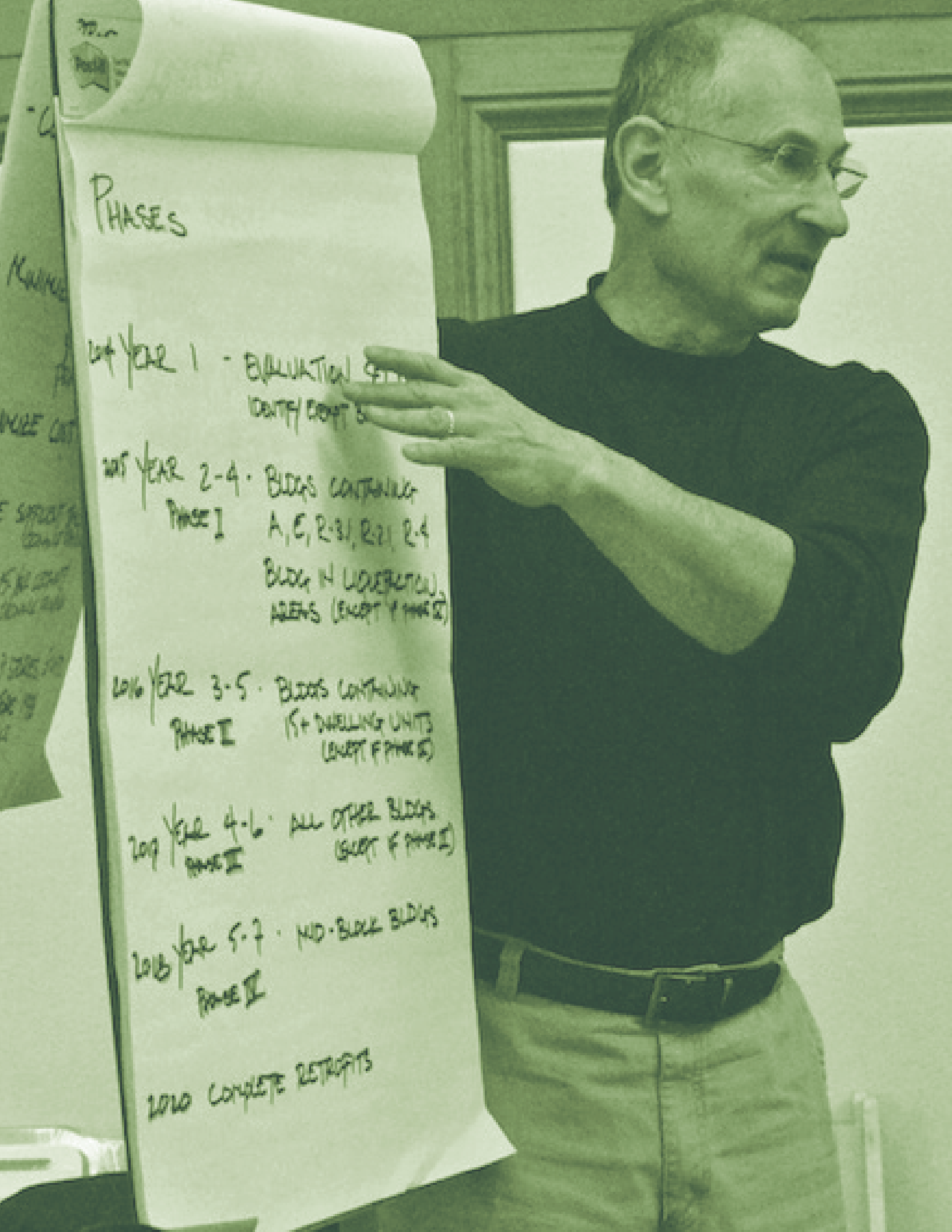
PHASES
2014 YEAR 1 - EVALUATION
2015 YEAR 2-4 · BLDGS CONTINUING
PHASE I
A, E, R-3, R-2, R-4
2016 YEAR 3-5 · BLDGS CONTINUING
PHASE II
2019 YEAR 4-6 · ALL OTHER BLDGS
PHASE III
2018 YEAR 5-7 · MID-BLOCK BLDGS
PHASE IV
2020 COMPLETE RETROFITS

Section 2

# Preparing a Retrofit Program

Before policy is adopted and retrofits begin, jurisdictions need to build consensus around the need for the policy and exactly what the policy requires. Support from the community and from local decision-makers is critical. Much of the same advocacy and consensus-building work needed for any city policy is also needed for soft story retrofits, but the specific issues and audiences may differ. The following chapter contains some recommendations for the pre-policy phase with specific lessons from jurisdictions who have successfully adopted soft story policies.

# Assessing the Problem

## Collecting Data to Scope the Problem

Many jurisdictions are unsure of the magnitude of the housing problem they may have after a disaster, or unsure of where pockets of fragile housing are concentrated. In this case, they may want to conduct an exploratory inventory by collecting data on their housing stock to understand if they have enough of a fragile housing problem to warrant a retrofit program, and to decide which housing types should be retrofitted to meet community residential performance goals. This may also be necessary to educate elected officials or other decision-makers on the issue, or to craft a comprehensive story about the magnitude of the problem and its potential impacts to get community members support for a retrofit program.

Developing an inventory requires resources – either money to hire a team to conduct the inventory, or significant investments of time by staff or volunteers. An inventory requires informed and educated staff or consultants to analyze data on existing building stock to identify and flag commonly-known fragile building types (including soft story, cripple wall, non-ductile concrete, unreinforced masonry, and concrete tilt-up) and get an estimate of the number and location of each of these types within the jurisdiction. However, this information should not be used to create an address-by-address list of fragile housing in a jurisdiction; it should only be used to approximate the magnitude of potentially fragile housing types in order to guide policy development.

ABAG has developed criteria for identifying buildings that may belong to one of seven fragile building types using readily available building data such as number of units, number of stories, and age.[1] These criteria can be used by jurisdictions to approximate the presence of these fragile building types within their community.

Once initial estimates are done, jurisdictions can conduct sidewalk surveys to visually confirm that the estimates are within an acceptable range. Sidewalk surveys are most useful only to confirm that the buildings meet the criteria that may indicate that they have a seismic structural deficiency; visual surveys alone cannot confirm structural deficiencies.

Another option to determine the magnitude of fragile residential buildings is to calculate specific loss estimates of damage that could occur to a community's fragile buildings. This may be done through a loss-calculation program such as Hazus-MH, a FEMA-designed tool that calculates economic loss from damages to the built environment. This type of calculation would likely require the assistance of a consultant, but community-specific loss estimates, when presented in ways that are specific to a community's concerns about damages, can be a powerful motivator to help galvanize support for a program among officials and the public. Though they cost money to hire a consultant at the outset, they can be effectively utilized if the program receives significant political pushback.[2] Again, this type of assessment should not be used to create lists of fragile buildings, but instead should be used to approximate the magnitude of potential economic damage in order to guide policy development.

## Developing Goals

A program will be most successful if a jurisdiction articulates a clear vision for what a residential retrofit program should accomplish. Requiring building owners to retrofit soft story buildings to a life safety standard is important. But retrofit programs can also be used to meet larger community-wide performance goals after a disaster, such as keeping residents in place or protecting more vulnerable residents by targeting specific deficient housing types and/or particular at-risk neighborhoods or communities, and specifying the level of performance and speed of recovery that the community should expect from its housing stock. Programs designed to meet these goals should also include tracking and analyzing results to see if goals are being met.

Goals should address the following questions:

- What level of performance does the community

*1 Stronger Housing, Safer Communities: Strategies for Seismic and Flood Risks (Technical Report). (2015) http://resilience.abag.ca.gov/wp-content/documents/housing/Final%20Report/StrongerHousingSaferCommunities_TechnicalReport.pdf*

*2 For more technical information, see ATC report 52-3A, Appendix 4. The City of San Francisco's CAPSS program developed soft story fragility functions that can be used for a technical loss estimate model.*

expect from its housing stock in a disaster? What level does it want?[3]

- How does this expected performance impact the ability of residents to stay in their home or rapidly return to buildings, short-term shelter needs, keep communities and neighborhoods intact, and needs for services to residents after a disaster?
- How does a residential retrofit program serve a larger performance goal for the community overall, including public and commercial buildings? What gaps remain after a retrofit program is successful?

For a community to achieve an acceptable level of building performance after a disaster, understanding the role that housing plays in that performance is critical. For example, if a goal is to allow the majority of residents to be able to stay in their homes after a disaster, it is important to prioritize fragile housing types that house the largest numbers of residents, and to specify that the expected performance level (for the housing stock overall, if not for individual buildings) should be habitability, not just safety. This means deciding which housing types should be retrofitted first, and what role incentives or mandates will need to play in those retrofit programs. If a jurisdiction has only a small number of soft story buildings, but they house a large number of people or a particularly vulnerable population, a retrofit program geared towards soft story buildings may make sense. Conversely, depending on specific needs and goals, it may make more sense to focus on single family homes and encourage cripple wall retrofit instead, which can be low cost and high impact.

Collecting data on your housing stock and the population that lives in it can help with understanding the magnitude and scope of the degree that housing contributes to a jurisdiction's vulnerability.

*3 "Level of performance" refers to the habitability after a disaster. This can range from immediate occupancy after a disaster, safe and repairable (life safety), to not safe due to possible collapse, falling hazards, fire, or hazardous materials release. For more information about performance standards and expectations in residential homes, see SPUR's Safe Enough to Stay report (http://www.spur.org/sites/default/files/publications_pdfs/SPUR_Safe_Enough_to_Stay.pdf)*

*For more information about community performance expectations for all building types, see SPUR's The Dilemma of Existing Buildings report (http://www.spur.org/sites/default/files/migrated/anchors/SPUR_The_Dilemma_of_Existing_Buildings.pdf)*

# Advocacy and Consensus-Building

## Assemble Policy Development Team

Developing a retrofit program, like any other initiative, requires commitments of time and resources from a jurisdiction, both prior to policy adoption and while the program is being implemented. Jurisdictions will need to assemble a team to develop policy and to secure political support from local policy makers and the public. The process of developing and adopting a program can work more efficiently and quickly with an enthusiastic and organized project lead, and a well-selected team that includes both internal staff and external stakeholders. This helps to develop consensus and support, limiting opposition and disagreements that can easily derail even a well-planned effort. Seismic retrofit can be controversial, so this is critically important. In Bay Area jurisdictions who have adopted soft story retrofit policies, lack of consistent leadership, lack of maintaining soft story as a priority, and disagreements among political players or with the community have blocked or delayed policy for months or even years.

Jurisdictions are already familiar with the political process of developing policy. Soft story retrofit policy, in many ways, follows the same process, but the challenges that it will face may be unique and require the engagement of different local stakeholders. These potential challenges and key stakeholders will be discussed in the next section.

The project lead for developing the policy will need to be able to knowledgeably navigate the jurisdiction's decision-making and policy adoption process and be able to communicate clearly and persuasively about why the program is important for community safety. This person will therefore likely be from a high-level department, such as the City Administrator's Office, City Manager's Office, or Mayor's office. This person must also be motivated to see the project through to implementation, despite the inevitable setbacks; in some jurisdictions, the policy lead was someone who cared passionately about seismic safety, and in others motivation came from strong political pressure or focused leadership. After the policy is adopted and the program transitions to implementation, the project lead role may transition to a more technical

program manager, such as someone from the Building or Planning department.

The lead will need a project team of staff, stakeholders, and possibly consultants to develop the policy and shape the implementation of the program. The project team will likely not be housed in typical departments that work on housing issues, but may need to be cross-departmental or part of a new initiative. The team may be a task force, a working group, or a new department. San Francisco began their process with an interdepartmental task force which evolved into the Community Action Plan for Seismic Safety (CAPSS). CAPSS undertook an extensive analysis to understand, describe, and mitigate the risk the city faced from earthquakes. The recommendations that came out of the study resulted in the development of an Earthquake Safety Implementation Committee (ESIC), which created the Earthquake Safety Implementation Program (ESIP). Their soft story retrofit program is a result of the ESIP work plan and the groundwork laid by CAPSS and the ESIC. The San Francisco CAPSS effort took over a decade, and the emphasis on soft story emerged through research and discussion. Jurisdictions don't need to follow the same timeline, especially if the soft story focus is already known. However, the structure that CAPSS used, a task force to study and develop the ESIP program, can be replicated.

To draft appropriate and responsive policy, the team needs a working knowledge of earthquake hazards, how much of a problem they pose to the community, and basic knowledge of possible solutions. At least the policy lead must be able to knowledgeably convey the program "story" to stakeholders as well as know when to solicit technical input and expertise. While internal technical expertise isn't crucial, the team has to seek appropriate expertise and be able to place technical work into local context and policy experience. It is also important that any staff that may not be on the planning team, but will be interacting with the public for the program, such as building department staff, be generally informed on the program. This may require significant communication and outreach to city staff by the project team.

Political proficiency and social influence is critical, not necessarily for the development of the program, but to get the program adopted and implemented. The policy lead and his or her staff must be able to craft a persuasive and compelling story about soft story conditions within the jurisdiction and the importance of taking action to protect residents, and know how to influence to affect decision-makers and stakeholders in support of the program. In addition to staff, having high-level champions who have the authority to make decisions, such as the City Administrator or a City Council members is important.

## Involve the Community

In addition to getting political support from local staff and elected officials, a retrofit program will more likely succeed if the general public is informed about the issues, supports the program, and trusts the team. The general public may not initially support such programs because of concerns about cost of retrofits, impacts on housing costs, and the potential displacement of tenants. Informing the public, or their representative organizations such as tenant groups, can significantly help a program's implementation. Support from public interest groups can influence elected officials who want to serve their constituents, can make city council meetings or other meetings with the public go smoothly, and can support a higher degree of compliance once the program is implemented.

Many routes can be utilized for community education, outreach, and consensus-building. Jurisdictions can hold open houses, town hall meetings, city council meetings, and provide information materials via websites or mailings. While individual education is important, the project team should meet with community organizations such as tenant rights groups, building owners associations, or other relevant groups in the community, as these groups can have significant influence over local policy and can represent the interests of their members. Community outreach can be an opportunity to solicit feedback on the program and help identify issues and concerns specific to the community and to resolve conflicts and points of contention before they escalate politically.

# Potential Issues and Considerations

## Cost and Affordability for Owners and Tenants

One of the biggest issues raised by requiring residential

**TABLE 2.1** Pass Through Provisions for Two Cities

| City | Percent of cost of improvement allowed to be passed through to tenant | Maximum increase limits for tenants | Amortization period allowed |
|---|---|---|---|
| San Francisco | 100% | $30.00 or 10% of the tenant's petition base rent annually, whichever is greater | 20 years |
| Los Angeles | 50% | $38 per month | 10 years |

retrofit is who is responsible for the cost. The City of Berkeley found that the average soft story retofit cost was approximately $50,000 per building ($5,000 per unit).[4] Soft story retrofit programs will likely garner more political support if the jurisdiction understands the interests of building owners and assists them in meeting the requirements without placing undue burden on them. Financial assistance programs can engender stronger support from both elected officials and the public. Even modest assistance can make a difference in how the program is received and how supported building owners feel throughout the process.

Building owners whose buildings are occupied by tenants will likely want to pass through as much of the retrofit cost to the tenants as possible in order to maintain the profitability of their building. They may argue that the expense of retrofit places an undue burden on them and that retrofitting the building provides an additional amenity to the tenant that the tenant should pay for. On the other hand, tenants and tenant rights groups may argue that tenants deserve life safety improvements as a condition of their lease, and should not be burdened with any of the cost. Increasing rents due to retrofit costs may also place undue burden on low-income residents and exacerbate existing housing affordability problems and displace the most vulnerable low-income residents into unsafe housing, other parts of the region, or into homelessness.

## Rent Control

Conversations around tenant pass through will likely present one of the most significant political hurdles to getting a policy passed. Even if actual rent increases will be minimal, the pushback will likely come from disagreements on who should shoulder the burden, and politicians want to support their constituents' interests. In Los Angeles, whose City Council recently approved a cost-sharing policy for seismic retrofits, the issue was debated in council for over a year before an agreement was made and passed.[5] It is important that jurisdictions allow sufficient time and support, and prepare local leaders sufficiently, for this conversation to avoid significant delays in getting an ordinance passed.

In many jurisdictions with rent control, building owners are allowed to pass through capital improvement costs to tenants above and beyond allowed annual rent increases, while other costs are considered routine maintenance to maintain a habitable building and the building owner cannot pass them through. Seismic improvements are not considered by the State of California to be included in basic habitability standards, but are considered capital improvements and therefore eligible for pass through. But unless a jurisdiction has rent control provisions in place already, it will be very difficult to regulate pass through costs. Few cities in California have rent control, however, some Bay Area jurisdictions do.

Every jurisdiction has different guidelines for passing through costs to tenants, including the percentage of the cost that can be passed along and the timeframe over which the cost must be amortized to limit cost increases to tenants. Jurisdictions with rent control, or who know they will have to make decisions about rent pass through, should include their local Rent Board in conversations about the program as early as possible.

Delving into this issue of who pays for improvements may trigger the need to update or adopt pass-through ordinances. The City of San Francisco updated their pass-through guidelines to include seismic improvements as capital improvements, and also updated their hardship appeal procedures (Ordinance No. 203-13). The City of

*4 Email correspondence with Jenny McNulty, City of Berkeley, dated 2/2/2016*

*5 http://www.latimes.com/local/lanow/la-me-ln-retrofit-20160113-story.html*

Oakland is currently considering a separate pass through provision for seismic work than for capital improvements pass through. In many cases, pass-through results in very little additional rent if amortized over a long period of time, and the percentage of costs allowed to be passed through may also make little difference in the monthly rent increases for tenants. If a jurisdiction is considering controlling rent increases through pass-through provisions, a financial analysis should be done so that all stakeholders understand exactly how much additional rent will likely be passed through to tenants.

## Public Assistance

There may also be a role for public financing in paying for retrofits. In some jurisdictions, especially those with many low income residents and no rent control or pass-through protections, retrofit may not be feasible without severely negatively impacting residents and building owners. Similar to financing affordable housing, jurisdictions may decide that there's a place for public assistance to ensure that low income residents have access to safe housing. Low income residents are already more likely to be less resilient after a major disaster, because they have fewer resources, both financial and social, to be able to effectively prepare for, respond to, and recover from disasters. Keeping the most vulnerable residents in fragile housing exacerbates their existing vulnerability. Jurisdictions have successfully used CDBG funds to retrofit housing for low-income owners, and FEMA Hazard Mitigation Grant Program (HMGP) funds are eligible to use for retrofits as well. The role of public money in private buildings is something that each jurisdiction should determine individually, based on local goals and demographics.

## Non-Financial Impacts to Tenants

Some soft story retrofits may require bulky structures in parking areas or ground floor commercial or residential units that affect the use of the ground story, for instance by reducing the number of parking spots available to tenants or the rentable are. Additionally, parking or other common area services may be temporarily unavailable as the retrofit is under construction. Many cities, including Alameda, include language in their ordinances that detail what rights tenants have if they lose parking due to a retrofit, and also accommodations in zoning for minimum and maximum parking for building owners if they lose parking. The City of San Francisco prepared a separate ordinance (Ordinance No. 173-14) to outline procedures and requirements for landlords to compensate tenants for temporary loss of services, including parking.

## Real Estate Transfer Disclosures

Existing state real estate disclosure laws do not require building owners to disclose specific known seismic deficiencies when a building of five units or more is sold, but do require that the buyers are informed of seismic safety provisions through the California Seismic Safety Commission brochure. This brochure, entitled Commercial Property Owner's Guide to Earthquake Safety, includes a section on the risks of soft story buildings. Aside from local mitigation efforts such as mandatory soft story programs, sellers are also not required to evaluate the vulnerability of their building or to strengthen any known weaknesses.

Jurisdictions could note information about a building's program status as part of its tax assessor/official record. This could be the certificate of occupancy issued after retrofit is complete (this would mean including language in the ordinance requiring a new certificate of occupancy after retrofit) or documentation of whether the building is on a list of buildings subject to the ordinance. This would allow potential buyers to determine the compliance status of properties through a title search, including whether the building is subject to an existing mandate and whether or not it has complied.

## Owner Awareness of Potential Hazards to Occupants

Owners have a responsibility to maintain their properties in a safe condition. Following earthquakes, those who are harmed might believe the owner is responsible for damages. Owner notification programs such as those taking place in Berkeley, Oakland, and Alameda are part of a broader societal trend recognizing the seismic hazards of soft-story buildings that will make it harder for owners to avoid liability in the future. However, it must be noted that retrofit programs may only raise selective awareness; for example, soft story retrofit programs typically target wood-frame multi-family buildings with five units or more, but this does not mean that a similar 4-unit building

across the street has a lesser obligation to the public to maintain life safety in the event of an earthquake.

Owners of buildings a building that conform to older building codes and are subject to a retrofit ordinance and fail to comply may be liable for the consequences of noncompliance. A jury in a recent court case awarded damages against a property owner for bodily injury caused by their unreinforced masonry building (URM) during an earthquake.[6] The jury concluded that because the building was subject to a risk reduction ordinance, the building owner was negligent in failing to perform a seismic retrofit that could have prevented these deaths. By establishing criteria for identifying vulnerable buildings, clear retrofit standards and compliance deadlines, jurisdictions could affect owners' liability in the event of an earthquake. Those who comply are more likely to be found as having acted reasonably than those who have not. Clarifying liability in this fashion might encourage those who are concerned about liability and might encourage liability insurers to exert pressure on owners to retrofit.

*6 Myrick v. Mastagni (2nd Dist. 2010) 185 Cal. App. 4th 1082; 111 Cal. Rptr 3d 165*

STOP

# RETROFIT PROGRAM AND POLICY ELEMENTS

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Section 3

# Developing Retrofit Program and Policy Elements

Though every soft story retrofit program has similar elements, some decisions will need to be made to fit the program to a particular jurisdiction. Specifically, which buildings within the criteria will be subject to the ordinance, which retrofit standards will be accepted as adequate to meet the jurisdiction's performance goals, how the program will be phased, how building owners comply with the requirements of each phase, how building owners can exempt themselves or comply in ways aside from retrofit, and how to handle noncompliance. These issues must be laid out clearly within the policy itself and incorporated into a jurisdiction's code. The following sections outline recommended best practices and considerations for each policy element.

# Determining Which Buildings are Subject to the Program

Prior to notifying building owners that they may be subject to a retrofit program, jurisdictions need to decide how to determine which buildings are included in the program. Typically, the following characteristics go into developing inventory data:

## Age

Age is a useful proxy for the adequacy of a building's structural design. As the engineering and building community has learned more about earthquakes and their effects on typical construction types, codes have become more stringent, so newer buildings are built to better withstand earthquake forces. California Health and Safety Code Section 19161(a)(2) sets January 1, 1978 as a date that jurisdictions may use to distinguish, broadly, potential soft story buildings. Buildings permitted prior to this date are more likely be insufficient to withstand likely earthquakes, so all buildings permitted prior to this date should be evaluated and considered for retrofit. However, some cities have chosen more recent, and therefore more stringent, building codes (for example, Oakland chose 1990, or buildings built to the 1988 Uniform Building Code). While this may capture more buildings that may experience significant damage in an earthquake, it also affects more building owners.

## Number of Units

Most existing programs target multifamily buildings with five or more residential units. This is partly because a focus on larger buildings achieves a greater effect with fewer retrofit projects, but also because five is the cutoff at which residential buildings are considered commercial properties eligible for commercial loans. Five units is a useful cutoff for many practical reasons, but it is not based in risk. If policy makers in a jurisdiction that has many 4-unit soft story buildings believe that including them will significantly serve retrofit goals, they may decide to adjust this cutoff.

## Number of Stories

Soft story buildings, by definition, have two or more stories. The soft story condition occurs when a lower story is too weak or flexible to support the stories above it when the building is shaken by an earthquake. Therefore, buildings with only one story are not soft story buildings and are not subject to a soft story program. While it may seem intuitive that more stories would exacerbate the soft story condition, Bonowitz and Rabinovici (2012) found that certain two-story buildings may actually be more vulnerable due to typical materials used, so it is important to include two-story buildings in a program. Single-story buildings may still be fragile, but should be considered separately from a soft story retrofit program. Buildings on sloped sites can be multi-level, with two or more stories in some sections and only one story in others. These types of buildings should also be included in the program.

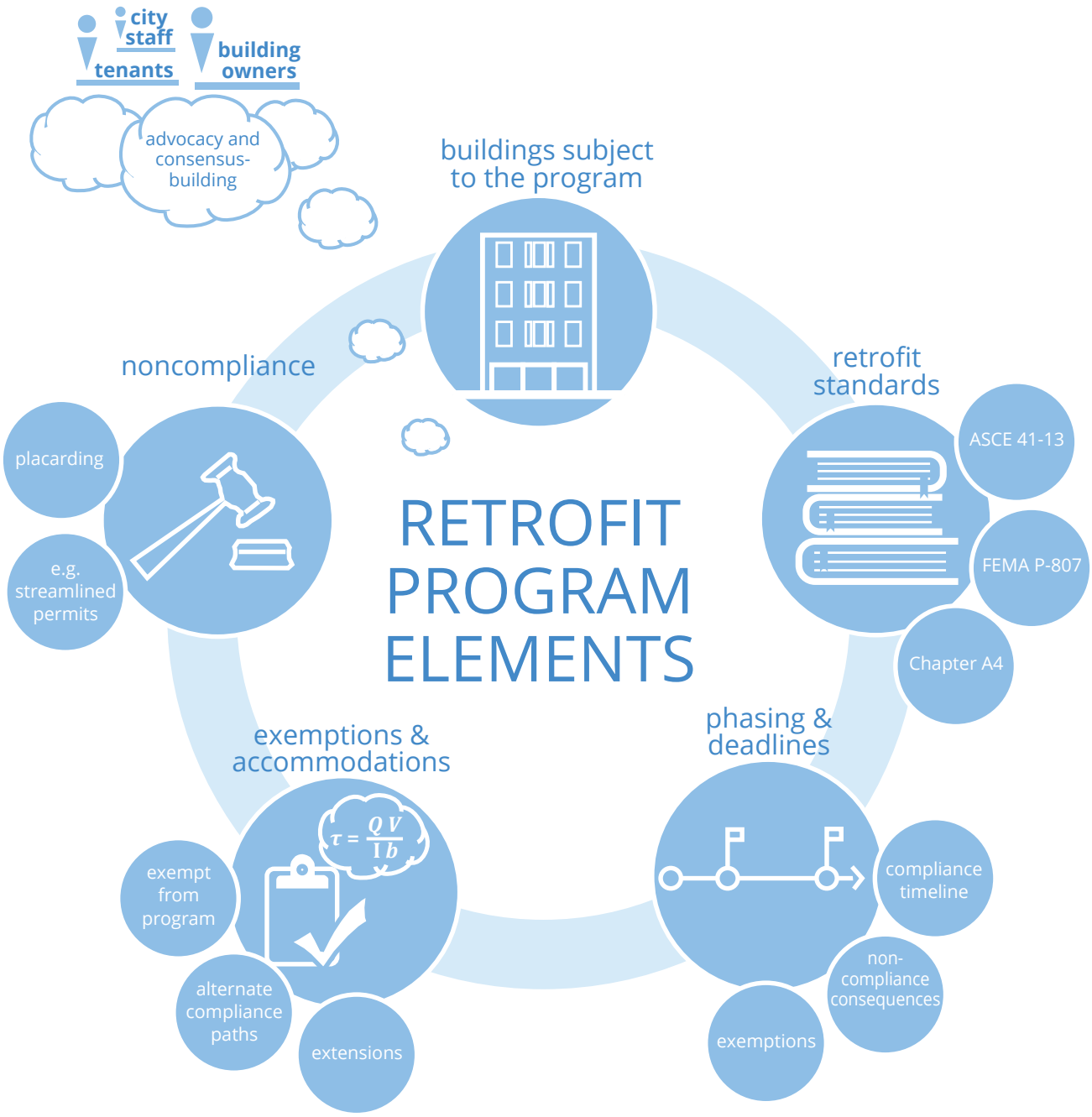
## Structure Type

Multi-unit, multi-story residential buildings can be of almost any structural material and system. Typical soft story programs, however, target older wood frame buildings with soft or weak first stories because of their history of poor earthquake performance. Other construction types, including archaic concrete and masonry systems, can exhibit structural weaknesses as well. However, it makes sense to begin a retrofit program with wood frame buildings, given the poor historic performance of these particular wood frame buildings in past earthquakes, and the relatively easy and inexpensive retrofit for wood frame soft story buildings as compared to other structure types.

## Ground Level Use

Soft story buildings are characterized by large open areas in the ground floor or crawl space. These are typically associated with uses other than residential dwelling units, such as parking, commercial spaces, or unfinished storage areas. Open areas lack the walls that provide strength and stiffness within dwelling units. These conditions make the ground level significantly weaker than the stories above. Additionally, some ground floor uses pose higher hazards than others. Collapse of a parking level will likely affect far fewer people than collapse of a level that contains commercial spaces such as bars or restaurants with lots

FIGURE 3.1 Retrofit Program Elements - Key Considerations



of people in them. While not all buildings with parking or retail on the ground story will be found to be structurally weak, these ground story uses are likely to contribute to soft story conditions. Some soft story buildings, especially those built in the 50's and 60's, may also have some residential uses on the ground story, but will primarily have the other uses described here.

# Retrofit Standards

Jurisdictions will have to decide what technical standards are acceptable for evaluating buildings and performing retrofits. Multiple standards have been developed by the engineering community that are generally accepted as the current state of practice. However, with the development of new methods, questions have arisen about the consistency between new and old approaches and about the costs and benefits of each approach to the building owner. This discussion can be left between the owner and his or her engineer, or the jurisdiction can work with a consultant or the Structural Engineers Association of North America (SEAONC)[1] to help clarify the differences. Unless a jurisdiction has special circumstances that would require unique engineering criteria, it is safe to assume that the standards cited by the current San Francisco program are sufficient for use. However, some standards require customization (setting performance objectives), which can vary based on program goals and expected ground shaking.

To ensure consistent use of standards across all buildings being evaluated, it is recommended to provide some sort of guidance for how to use the accepted standards. San Francisco's Building Department issued Administrative Bulletins[2] to provide guidance on how to interpret their retrofit standards, and Berkeley developed a Framework to guide engineers.[3] Both cities have made modifications to the standards to help clarify their use and to make the results of different standards more consistent with each other.[4] Proper application of engineering criteria not only ensures that buildings are retrofitted to the expected standard, but ensures that the soft story building stock will perform as expected.

Additionally, if soft story buildings are spread over a wide geographical area, it can be assumed that earthquake ground shaking will vary based on location and that some buildings will perform better than others based simply on the degree of shaking they experience. Therefore, it may be acceptable to set a more moderate performance objective and still have acceptable performance of the building stock as a whole.[5]

It should be noted that public expectations of performance may not align with standard technical goals. Even new buildings are built to a nominal safety standard, meaning that while they are not likely to be damaged in an earthquake to the extent that they lead to loss of life, they may still be significantly damaged, requiring extensive repairs or even demolition. If performance goals expect buildings to be habitable after a disaster, this needs to be incorporated into retrofit standards. This is especially important when asking building owners to spend considerable amounts of time and money to upgrade their buildings – if they retrofit but still need to do extensive repairs after an earthquake because they retrofitted to a safety standard, they may be upset and feel as though the time and money invested were wasted. At the same time, it may not be reasonable to require higher performance standards for retrofitted buildings than for new construction (ie, shelter-in-place standard versus life safety). It may also be more difficult to work with older building technologies to achieve a significantly higher level of performance simply because older building materials and technologies may not be practical to significantly upgrade without extensive, and possibly expensive, alterations.

However, meeting higher standards – or even attempting to match the performance expected of a new code-designed building – is more costly and may require retrofitting upper stories as well. Because soft story

*1 http://www.seaonc.org/*

*2 AB-106 and AB-107, http://sfdbi.org/sites/sfdbi.org/files/AB-106%20updated%20010114%20signed.pdf and http://sfdbi.org/sites/sfdbi.org/files/AB-107.pdf*

*3 http://www.ci.berkeley.ca.us/uploadedFiles/Planning_and_Development/Level_3_-_Building_and_Safety/ss%20Guidelines%20Framework%20for%20engineeers.pdf*

*4 Based on case study analysis of the three retrofit guidelines on the same building, ASCE 41-13 requires the most extensive retrofit, followed by IEBC A4 and FEMA P-807. IEBC A4 and ASCE 41-13 retrofits were significantly stronger than those from P-807, because they add in additional measurements that require additional strengthening. However, all of the standards result in a greatly reduced collapse risk of retrofitted buildings (Buckalew, et al, unpublished draft).*

*5 FEMA P-807, Appendix B*

conditions in the ground story represent the most severe structural deficiency and are most likely to cause catastrophic failure in an older building, nearly all soft story retrofit programs only address and require the strengthening of the first story. Indeed, the political feasibility of these programs relies in large part on the agreement to limit the work to these most critical deficiencies. First story only retrofits are less invasive and costly, and take less time.

Nonetheless, higher performance standards that address whole-building deficiencies, not just the soft story conditions on the first story, may be desirable depending on performance goals. First story only retrofits may not allow a building to meet an owner's more ambitious performance objectives. Similarly, first story only retrofits by themselves might not be enough to allow a jurisdiction to meet its overall performance objectives. In almost all cases, a resilient community will need to supplement a soft story retrofit program with risk reduction for other existing building types and with higher criteria for its new buildings as well.

The following are the most commonly used standards for evaluating and retrofitting soft story buildings.

## ASCE 41-13, Seismic Evaluation and Rehabilitation of Existing Buildings

ASCE 41-13 is a comprehensive technical standard used to evaluate and retrofit existing structures. It is intended to be used for all building sizes and types, not just soft story buildings. Though it is not as targeted toward soft story buildings, it does capture a wide range of variables in terms of building construction, materials, and site conditions, so it can cover most buildings.

ASCE 41-13 requires the user to select a desired performance level and to pair it with a presumed earthquake. Additionally, since ASCE-41-13 is not geared specifically toward soft story buildings, its provisions mostly assume evaluation or retrofit of the whole building, not just the weak first story. If ASCE 41-13 is used for a first story only retrofit program, modification will be needed to clarify the intended scope of work and the limited benefits.

ASCE 41-13 combines and supersedes previous ASCE standards used on other Bay Area retrofit programs: ASCE 31-03 and ASCE 41-06. A further update is expected to be published by ASCE in 2017.

## FEMA P-807, Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings with Weak First Stories

FEMA P-807 is a new evaluation and retrofit guideline that utilizes an innovative approach intended to provide the benefits of sophisticated "nonlinear" analysis with only a fraction of the engineering effort. P-807 is geared toward evaluating and addressing the soft story conditions on the first floor and does not provide guidance for retrofitting other potential structural deficiencies. It also is designed to limit over-strengthening of the first story, which can, in some cases, lead to costly and inconvenient damage in upper stories. To define the performance objective, users have to identify (1) the earthquake hazard of interest, (2) the desired performance level, and (3) the acceptable probability of failure.

Because P-807 is based on statistical results from "typical" buildings, its use is limited to buildings that meet specific eligibility criteria. Buildings taller than four stories and some built into sloped sites might not be eligible for evaluation using P-807 (but can be retrofitted using ASCE 41-13 or IEBC Chapter A4).

P-807 also offers proprietary software, the Weak Story Tool, to assist engineers in evaluation and retrofit design.[6]

## Chapter A4 of most recent edition of International Existing Building Code (IEBC)

IEBC A4 is a prescriptive retrofit code created specifically for wood frame structures with a soft, weak, or open front condition. It is updated and published triennially as part of the IEBC; the most recent edition is from 2015. Because A4 does not account for older building materials that are likely present in existing soft story buildings, A4 is not appropriate for evaluation of existing buildings , but is a useful and straightforward, if somewhat conservative, guide for retrofit. Chapter A4 provides a prescriptive retrofit based on 75% of current code forces for new construction. The 75 percent allowance is a traditional

*6 This tool is available to the public, for free, at https://www.fema.gov/media-library/assets/documents/32681*

**TABLE 3.1** **Evaluation and Retrofit Standards Comparison**

| City | Accepted Standards | Evaluation or Retrofit | Performance Objectives |
|---|---|---|---|
| Berkeley | ASCE 41-06, Seismic Rehabilitation of Existing Buildings[a] | Retrofit only | S-5 (collapse prevention) in BSE-C[b] earthquake |
| | ASCE 41-13, Seismic Evaluation and Rehabilitation of Existing Buildings | Retrofit only | S-5 (collapse prevention) in BSE-2E[b] earthquake |
| | FEMA P-807, Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings with Weak First Stories | Retrofit only | Pre-approved "substantially equivalent standard" under procedures of CBC Section 104.11 for Alternative Materials, Design and Methods of Construction, and with a retrofit objective as established by the Building Official |
| | Chapter A4 of 2012 IEBC | Evaluation or retrofit[c] | None |
| San Francisco | ASCE 31-03, Seismic Evaluation of Existing Buildings | Evaluation only | Life safety |
| | ASCE 41-06, Seismic Rehabilitation of Existing Buildings[a] | Evaluation or retrofit | Structural Life Safety in BSE-1 earthquake with earthquake loads multiplied by 75% |
| | ASCE 41-13, Seismic Evaluation and Rehabilitation of Existing Buildings | Evaluation or retrofit | Structural life safety in BSE-1E[d] earthquake |
| | FEMA P-807, Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings with Weak First Stories | Evaluation or retrofit | 50 percent maximum probability of exceedance of Onset of Strength Loss drift limits with a spectral demand equal to 0.50 SMS (as detailed in Administrative Bulletin) |
| | Chapter A4 of 2012 IEBC | Retrofit only | None |
| | Alternative criteria | Retrofit only | Satisfies the intent of FEMA P-807, Section 6.4.2 with a maximum acceptable Onset of Strength Loss drift limit probability of exceedance of 70% |
| Alameda | Chapter A4 of 2006 IEBC | Evaluation or retrofit | None |
| Fremont | Building Code sections 7-10302 and 7-10304[e] | Evaluation or retrofit | See building code |

[a] *This standard has been replaced by ASCE 41-13 and should not be use for new retrofit programs*

[b] *Corresponds to an earthquake with a 5% probability of occurring in a 50 year period*

[c] *Though not recommended for evaluation, as explained in footnote on previous page*

[d] *Corresponds to an earthquake with a 20% probability of occurring in a 50 year period*

[e] *These standards have not been reviewed in detail for this document, but we recommend using more widely available and known standards*

**TABLE 3.2 Compliance Timelines for Five Bay Area Retrofit Programs**

| City | Deadline for Non-Engineered Screening* | Deadline for Engineered Evaluation* | Deadline for Permit* | Deadline for Completion* |
|---|---|---|---|---|
| Berkeley | | 2 years (under 2005 soft story ordinance) | 2 years | 4 years |
| San Francisco | 1 year – all tiers | Tier I – 1 years<br>Tier II – 2 years<br>Tier III – 3 years<br>Tier IV – 4 years | Tier I – 2 years<br>Tier II – 3 years<br>Tier III – 4 years<br>Tier IV – 5 years | Tier I – 4 years<br>Tier II – 5 years<br>Tier III – 6 years<br>Tier IV – 7 years |
| Alameda | | 1.5 years | | |
| Fremont | | | Group I – 2 years<br>Group II – 2.5 years | Group I – 4 years<br>Group II – 5 years |
| Oakland (2009)** | 2 years | | | |

** From date of ordinance adoption*

*** Oakland has passed an evaluation ordinance only. A retrofit ordinance is under development.*

approach for building code provisions for existing buildings. As a matter of policy, it has long (if debatable) precedent as a standard for acceptably "safe" structures.

Like P-807, A4 focuses on ground floor retrofits that address the SWOF conditions. Unlike P-807, A4 does not require an explicit check of possible over-strengthening of the ground story. Therefore, both San Francisco and Berkeley have modified A4 for their programs, allowing a "need not exceed" cap on the strength of the A4-designed retrofit. This is expected to address the worst cases of over-strengthening and to make the results of A4 and P-807 retrofits more consistent.

## Historic Buildings

For historic buildings whose exterior may be altered due to seismic retrofit, provisions may be necessary that take into account the California Historical Building Code. Retrofits in historic buildings may be more complicated or expensive than non-historic buildings due to preservation requirements to maintain historic character; additionally, the desire to maintain historic character may also allow less intrusive structural work, resulting in lesser strengthening. San Francisco's Planning Department has developed guidelines for seismic retrofit work for historic buildings which provide alternatives for solving many structural and nonstructural problems while maintaining historic character.[7] While the bulletin is geared towards unreinforced masonry buildings, something similar could be developed for soft story retrofit. The National Park Service also has prepared some guidance for seismically retrofitting historic buildings.[8] Retrofit solutions may need to vary from common structural standards and should be considered on a case-by-case basis. A "technical ombudsman" may be identified within the building department to deal with these types of case-by-case technical issues. However, many of the 1920's soft story buildings may not be subject to historic building requirements, unlike other vulerable types, such as unreinfoced masonry buildings.

# Phasing and Deadlines

Many programs, especially those in cities with large number of soft story buildings, have developed phasing, or tier systems that allow owners of certain types of buildings more time to retrofit, or to ensure that owners of high priority buildings retrofit soonest. Tiers may be utilized to address high-risk populations or buildings with a large number of occupants first, ensuring the most public good in a short time. This is the route San Francisco took, placing educational, assembly, or residential care facilities in the

*7 http://www.sf-planning.org/Modules/ShowDocument.aspx?documentid=5065*
*8 http://www.nps.gov/tps/how-to-preserve/briefs/41-seismic-retrofit.htm*

**TABLE 3.3 Phasing Tiers for Compliance for Two Bay Area Retrofit Programs**

| Tier/Group | San Francisco | Fremont |
|---|---|---|
| 1<br>(earliest compliance date) | Educational, assembly, or residential care facilities | Apartment house with more than 10 units or more than two stories |
| 2 | 15 or more dwelling units | Apartment house with 10 or less units and fewer than three stories high |
| 3 | Not falling within another tier | |
| 4<br>(latest compliance date) | Ground floor commercial uses or in a liquefaction zone | |

first tier and buildings containing 15 or more dwelling units in the second tier. Tiers may also be used to allow more time for more complicated or disruptive retrofits, such as buildings where the ground floor is a commercial use with a tenant that would be displaced during construction, or in liquefaction zones, where retrofit solutions may be more complicated. Additionally, tiers may be used to help manage demands on building departments and other city staff and to avoid an overwhelming influx of plans and permit requests all at once. This may be very different than creating tiers to protect certain populations; for example, in San Francisco, the first tier encompassed a very small number of buildings, while the third tier is very large, leading to a gradually increasing workload for the building department as they develop their program. Table 4.1, above, compares tiering systems.

When considering timelines for compliance, there are a few factors to take into consideration: What is a realistic timeline for building departments to review plans and issue building permits, particularly if additional budget needs to be allocated for additional staff or a consultant? Should this be a new program or department or housed in the existing building department? How long is a reasonable timeline for construction? Are there many buildings that will be retrofitting or just a few? The answers to these questions can help in determining how to phase the program. For example, it may make sense to phase the program into tiers, requiring different timelines for different types of buildings. Additionally, if specific financing tools are being made available, jurisdictions may want to accommodate the timeline for applying for and receiving financing to ensure that the timelines align.

It is important to be explicit with building owners about exactly what they need to submit by the deadlines. For a mandatory retrofit program, this could be as little as a screening form, building permit, and certificate of occupancy. Jurisdictions can post tutorials for compliance on a website, or host seminars or workshops at city hall, to help lead building owners through submittal requirements.

## Exemptions and Accommodations

Inevitably, some building owners will be notified whose buildings are not, in fact, subject to the program. In this case, owners need a mechanism for exempting themselves. In San Francisco, this was done through a screening form. This type of form is designed for building owners to fill out, using the assistance of an engineer. The City of San Francisco developed a screening form for notifying owners with the primary goal of confirming eligibility criteria and identifying exempted properties. A registered design professional was required to fill out and sign the screening form. Depending on the questions asked in the form, this type of screening form can also help building departments gather valuable information on soft story buildings within a jurisdiction. However, it is advised that the building department is well-prepared to accept and respond to screening forms quickly, and that the data is managed and updated in a timely manner. This is especially important if

a list of buildings subject to the program is posted publicly, such as on a website or in a public permit database. While this is an important step to allow the public to track the progress of the program, it is important to acknowledge exemptions and remove buildings from the list quickly.

There also needs to be a mechanism for managing buildings and building owners that either comply through steps aside from retrofit or require additional time. Typically, compliance exemptions or extensions may be granted for financial hardship of the building owner (such as in the City of Berkeley, who offered a one year extension to complete the retrofit) or more complicated building types, such as especially large buildings or buildings in liquefaction zones (in San Francisco, buildings in liquefaction zones are in Tier 4, allowing them the longest time in which to complete their retrofits). Building owners may also comply with the program's performance standards by demolishing the building. Each jurisdiction will need to determine what criteria are eligible for extensions (if any) or exemptions and develop a clear, transparent and user-friendly method for accepting appeals and ruling on them.

Buildings may also comply with desired performance standards if they are already structurally adequate. Building owners who are not exempted through criteria but whose buildings meet the engineering requirements should be able to prove that their buildings are structurally adequate through either an engineering report or proof of acceptable past retrofit. In cases of past retrofit, jurisdictions need to determine if the retrofit is adequate to meet current performance goals. Retrofit guidelines have evolved as the engineering community learns more about the performance of soft story buildings in earthquakes, so past retrofits may not ensure the level of performance desired today. Compliance through past retrofits can depend on a cutoff date (corresponding to a desired building code) or a performance standard, in which case the building owner will likely have to submit engineering drawings from the retrofit to determine if they meet desired standards.

# Noncompliance

Consequences for noncompliance must be well defined and well matche to the enforcement capability of the jurisdiction. Many jurisdictions use existing mechanisms in the building code, including fees, notices, liens, and court action. Jurisdictions may also develop new consequences, such as signage, or different or additional fees. Existing building department staff may not have the capacity to deal with an influx of noncompliance cases, so it is important to consider what capacity exists to enforce noncompliance consequences and choose consequences according to what is manageable and effective in each jurisdiction.

## Placarding

Some jurisdictions have required building owners to publicly display a placard notifying the public of the status of the building within the retrofit program. Placarding can be used for multiple purposes: in Berkeley, placarding was used during the evaluation phase of the program only (it was not required once retrofit became mandatory) as a means to push building owners towards retrofit. In San Francisco, placarding was used after the mandatory retrofit ordinance was passed only when buildings were out of compliance with the ordinance. Requiring jurisdictions to placard when they are in compliance with the program requirements can be seen as an unfair burden, considering that they are doing their best to improve the condition of the building. Placarding should only be used in certain cases where a non-mandatory retrofit program is trying to encourage voluntary retrofits, or in the case of a mandatory retrofit ordinance, placarding should only be used in cases of noncompliance. In a voluntary program, enforcement of placarding can be difficult, and noncompliance may be high, as building owners don't want to dissuade customers or tenants from using their building. However, placarding can be very a very effective tool for noncompliance: in San Francisco, over 300 buildings failed to meet the initial deadline for submitting screening forms. Placarding the out-of-compliance buildings reduced this number to less than five buildings after only a few weeks.

# IMPLEMENTING A RETROFIT PROGRAM

Section 4

# Implementing a Retrofit Program

Once policy is developed and adopted, soft story retrofit transitions from a policy to a program. This section outlines the primary components of running a retrofit program, including managing notifications, plan checking, tracking compliance, and providing resources for building owners to help them complete their retrofits. This section also discusses financing and other incentive programs.

# Assembling a Retrofit Program Team

Implementing a retrofit program requires resources beyond the initial push to get the program adopted. As discussed in Chapter 2, Preparing a Retrofit Program, developing an effective program requires establishing a project lead and pulling staff from various departments to serve as the project team to write the ordinance, facilitate public input, develop supporting materials, and ensure that the program gets adopted. After the initial development and adoption of the program, however, the same project lead, or a different lead, will still need to implement and manage the program, and a different set of city staff will become responsible for the administrative side of the program.

Primarily, administrative staff will need to coordinate notification of owners, build and manage a website with accurate and frequently updated information for building owners and the public, answer or direct questions from the public, and maintain databases that track program compliance and improve data on local buildings. Staff may also be needed to develop maps (GIS expertise) as part of messaging. Public outreach, providing clear guidelines and information, and being able to answer questions quickly and effectively are critical to the smooth administration of the program. Communications and outreach staff may be appropriate to manage this side of the program.

Specially prepared staff from building departments, or an outside plan check consultant, who can perform consistent plan checks and answer and resolve more technical questions about the program are also critical. As the program progresses, especially in the beginning, there will be a "testing" phase as residents and engineers apply the evaluation and retrofit criteria and building department staff learn how the criteria apply to the buildings in their jurisdiction. There may be inconsistencies between how different engineering firms hired by building owners interpret and apply the criteria, so a mechanism for resolving questions and adjusting regulations even during the implementation phase is critical. In Berkeley's program, inconsistent application of the criteria and different assumptions made by different engineering firms led to highly variable results.[1]

As mentioned previously, during a retrofit program, building departments may become inundated with plans as deadlines approach, so jurisdictions must be prepared for this influx of work if there are many buildings impacted by the program. There must also be staff capacity to enforce noncompliance consequences. Some cities, such as Berkeley, hired a consulting engineering firm to perform all plan checks related to their soft story program. While this can take the burden off of city staff, it does create another layer of communication to go through if certain parts of the program are not working as intended.

# Notification, Messaging, and Program Support

Once the program has begun, there are multiple audiences for outreach and support, each with different messaging needs and interests: property owners, design professionals and contractors.

## Notification, Messaging, and Support

Property owners are primarily responsible for the success of the program, as they are the ones performing the retrofit. It is important that the jurisdiction provide significant support to property owners to help them navigate the program and meet program requirements, provide financial and policy incentives, and address their fears and concerns that property owners have about paying for retrofits, liability, and the value of their building.

### *Notification*

Building owners need to be notified that their buildings are potentially within the scope of the program, and why. They should be provided with some basic information about the dangers of soft story buildings, such as statements or photos describing the collapse hazards of buildings similar to their own, and steps they can take to learn more about retrofit. Notifications alert building owners that they may be vulnerable to asset loss and that their buildings may not perform to life safety standards. This alone may spur some building owners to retrofit

*1 Bonowitz and Rabinovici, 2012*

before their compliance deadline. It is suggested that jurisdictions notice all building owners at once, rather than phasing notifications within a certain time frame prior to when they will be required to submit some form of documentation to reduce speculation and put all building owners on an even playing field.

Building owners will need to be clearly notified of the steps they need to take for compliance, such as submitting a screening form or building permit, as well as the timelines for the completion of each step. Be clear about dates for compliance and exactly what needs to be submitted or achieved by what date. Multiple timely notifications can also increase the likelihood of compliance. San Francisco sent multiple postcards, with increasingly firm messages, as deadlines became closer. A clear and concise website with information for both owners and tenants is helpful.

### *Technical Assistance*

Many owners of typical soft story buildings have never hired an engineer, sought permits or engaged a contractor and may find the process daunting. Therefore, jurisdictions may provide publications or other materials about how to work with engineers and contractors for evaluations, design and contracting. Technical assistance could help building owners navigate the complex engineering issues associated with building retrofits. This could include information that will help them ask relevant questions and evaluate proposed costs and activities. Jurisdictions may receive inquiries seeking referrals to engineers and contractors. While jurisdictions cannot promote specific professionals, if a jurisdiction conducts engineering trainings and/or retrofit open houses (see below), they can post lists of the attendees. Jurisdictions can also post guidance on how to select an engineer, such as appropriate questions to ask the engineer and information about proper licensing. SEAONC produces some information on this topic that jurisdictions may find helpful.[2]

City-offered technical review and clarification on compliance may improve the chances that building owners would carry out effective retrofit projects. Staff could be designated for all retrofit activities, including guiding building owners through requirements, working out non-standard evaluations and retrofits, such as for historic buildings or hillside homes, assisting with the city's requirements for plan review and building permit issuance, as well as assisting owners with incentives and financing options. It may also be helpful to make staff available for over-the-counter plan review to avoid the need for resubmittal and multiple plan checks and to flag issues at intake. This can help expedite approvals, especially if expedited approvals are offered as an incentive for the program.

The City of San Francisco offered a soft story retrofit fair shortly after they passed their mandatory retrofit ordinance. The fair brought together engineers, contractors, banks, and other preparedness organizations along with building owners to allow them to ask questions about the policy, find professionals, and learn about the retrofit process. Staff also played videotapes of previous public information sessions to provide basic information about the ordinance. The fair was highly attended and generated benefit not just for the building owners but for design professionals as well.

## Design Professionals and Contractors

Building owners will need to engage design professionals and contractors to evaluate their buildings, develop retrofit plans, and get the retrofit work done. Some engineers may not be very familiar with the specialized standards used for soft story retrofit. Design professionals and contractors need to be aware of how to interpret and implement program standards and requirements consistently. Differences in how design professionals interpreted engineering standards led to significant inconsistency in the City of Berkeley not just in the level to which buildings are retrofitted, but also in deciding which buildings met the program's performance standards, impacting which buildings needed retrofit and which did not.[3]

Jurisdictions could provide training to engineers and contractors in all stages of the retrofit process: building evaluation, retrofit design, and construction. A list with the names of those who complete the training successfully would be made available to building owners.[4] Training could be provided free (FEMA grants could be used), at a

*2 http://seaonc.org/how-select-engineer*

*3 Bonowitz and Rabinovici, 2012*

*4 However, training would not guarantee that those on the list are properly licensed and insured, or engage in good business practices.*

subsidized cost, or at-cost to prospective inspectors, civil engineers, architects, contractors and owners interested in developing a retrofit specialty. Training could be offered through or in partnership with existing local engineering associations, such as Structural Engineers Association of Northern California (SEAONC), or local contractors associations and construction unions. A jurisdiction's awareness literature could promote use of trained individuals.

The City of Berkeley provided training for civil engineers in preparation for its soft story building program, and ABAG has provided training to contractors for retrofitting cripple walls in the past. Smaller jurisdictions can benefit from this training that has already occurred. At a future date, it may make sense for multiple jurisdictions to coordinate for additional or updated training so that each jurisdiction doesn't have to run a training program on its own.

## General Public

Provide transparent and accessible information to the public is important. Most jurisdictions have developed comprehensive websites to provide up-to-date information on the requirements of the program and the status of the program. Contents should include the list of buildings subject to the program (which should be updated frequently as building status changes), the language of the ordinance, evaluation and retrofit standard guidance, and a Q&A section that addresses the most common questions building owners and tenants will have. The following websites may offer some direction:

- Berkeley: http://www.cityofberkeley.info/softstory/
- San Francisco: http://www.sfgov.org/softstory and http://sfdbi.org/softstory
- Alameda: http://alamedaca.gov/community-development/building/seismic-retrofit
- Oakland: http://www2.oaklandnet.com/Government/o/PBN/OurOrganization/BuildingServices/o/Permits/DOWD008964

# Retrofit Assistance Tools

As discussed previously, some building owners may want or need assistance. Jurisdictions can lower financial and administrative hurdles. Although it is assumed by some jurisdictions that incentives are critical, jurisdictions who have offered incentives have found that community consensus-building is more powerful. The following are some tools that jurisdictions have identified or used successfully in the past, as well as some considerations for implementing them.

## Property Assessed Financing

One of the most promising financing mechanisms for seismic retrofits is Property Assessed Clean Energy (PACE). The California Statewide Communities Development Authority (CSCDA), the largest Joint Powers Authority in California, is implementing PACE on behalf of its member cities and counties. PACE is a mechanism for financing renewable energy, energy efficiency, and water efficiency to residential and commercial properties. In 2014, seismic strengthening improvements were added as an eligible PACE activity, creating Open PACE.

PACE programs provide a means of financing improvements by securing loans through a voluntary special tax or assessment on the property. CSCDA finances the property improvements by the issuing bonds, secured by a contractual assessment levied on the owner's property and collected in annual installments through the property tax bill. PACE provides up to 100% financing upfront and allows the cost of improvements to be paid over the course of up to 20 years. Because the loan is attached to the property rather than to an individual, the contractual assessment stays with the property upon sale. Two teams currently operate under the CSCDA umbrella in California: AllianceNRG and Renewable Funding LLC. Additional providers may be added to this platform in the future. CSCDA member cities and counties can opt in to Open PACE by adopting a resolution. Other PACE providers, such as Renovate America, also operate independent PACE programs.

However, PACE is still a relatively new tool for financing and may not prove to be the best financing option for some building owners. Interest rates may vary from traditional loans, and the constraints and rules of the programs may limit application (for example, some programs only finance detached residential properties and may not apply to condo buildings).

## Real Estate Transfer Tax Rebate

The City of Berkeley rebates up to one-third of the 1.5% transfer tax for qualified seismic retrofit on residential properties or mixed use buildings with two or more dwelling units upon sale. Berkeley paid for this rebate by increasing the transfer tax rate. Through these and other efforts, more than 2,500 (12% percent) of single-family homes have been strengthened to various degrees since 2004 (varying because the program does not include strong technical guidelines. Jurisdictions wishing to use this type of program should ensure that technical guidelines are included as a condition for eligibility to ensure retrofits that meet citywide performance goals).[5] These upgrades include both structural and nonstructural mitigation measures.

In 2008, San Francisco voters approved Measure N which increased the transfer tax for properties sold for $5 million or more. Measure N also enabled one-third of transfer taxes (for all properties, not just those over $5 million) to be rebated to property owners for conducting seismic upgrades or installing active solar systems.

## Waiver or Reduction of Building Permit Fees

Building permit fee reductions can be used as a gesture of good will to the owners of subject buildings. Permit fees represent a relatively small portion of the cost of seismic retrofit and so could be paired with other retrofit incentives in order to be more effective. However, reducing or waiving fees also reduces revenue to the building departments at a time when additional capacity is needed to process permits, so this should be taken into consideration. If a jurisdiction chooses to waive a fee, it needs to be clearly communicated to building owners what is waived and what is not waived (for example, plan check fee is waived but inspection fee is not) to avoid confused and disappointed owners.

The Cities of San Francisco, Berkeley, and Alameda have offered flat or waived plan check fees as an incentive for owners to retrofit their buildings. Oakland currently offers a flat permit fee of $250 for owners of qualified single-family residences to perform seismic retrofits.

*5 Information per Building and Safety Division as of March 2012*

Jurisdictions could also consider waiving other fees, like the annual rent control registration fee, as a way of acknowledging the burden being placed on building owners.

## Business Tax Credits

Jurisdictions might waive a portion of a business tax for a number of years to encourage owners to retrofit. This could be beneficial for soft story buildings that are owned by a business entity rather than an individual owner, but it reduces revenue to the city.

## Tax Reduction for Historic Properties

There are two existing incentive programs that could be used to reduce taxes for historic properties that conduct seismic upgrades: the State Mills Act and the creation of a federal historic district.

The Mills Act[6] gives local governments the authority to enter into contracts with owners who restore and maintain historic properties. In exchange, the property owners could get significant property tax savings. However, some jurisdictions have had difficulty using the Mills Act as an incentive for seismic upgrade, since the Mills Act is generally administered by the Planning Department rather than the Building Department. This would require significant coordination between the two departments to use for seismic upgrade.

Creating a National Register Historic District could provide a federal income tax credit for qualifying work on contributing historic properties within the district.

The City of St. Helena used both of these tools to assist owners of unreinforced masonry buildings to seismically retrofit. Creating a federal historic district was a successful incentive, giving owners a twenty percent federal tax credit. Many building owners found the Mills Act less appealing because of its cumbersome process.

## Private Loans

Jurisdictions could assist building owners to finance seismic retrofits by:

*6 California Government Code, Article 12, Sections 50280-50290, California Revenue and Taxation Code, article 1.9, Sections 439-439.4*

- Negotiating loan conditions with local banks or credit unions specific to the program,
- Providing loan guarantees,
- Reducing or buying down loan interest rates, or
- Make market-rate loans available to those who might not otherwise qualify for them.

Jurisdictions could provide these loan services or assist building owners to get them from other sources. Loans could be repaid through assessment liens paid along with property taxes. Loan payments could be deferred for a period of time, or until the sale of the property for hardship cases. Small Business Association CDC/504 (Certified Development Corporation) loans may be available for small businesses. The City of San Francisco worked with local banks to try to improve financing for soft story retrofits. While their efforts did not result in significantly improved interest rates, the conversation was new and important, and may lay the groundwork for future agreements with banks for local retrofits. This might work better with locally owned banks or credit unions invested in the local community.

## CDBG Grants

Community Development Block Grant (CDBG) funds could be used to provide grants to cover the cost of a retrofit or building evaluation for moderate or low-income building owners. CDBG funds are given to cities by the U.S. Department of Housing and Urban Development (HUD). CDBG funds have been successfully used in the past by cities to assist with the retrofit of unreinforced masonry buildings. As HUD becomes more involved in disaster mitigation and disaster recovery, CDBG grants may become an important source of funds for protecting low-income residents.

## FEMA Grants

FEMA offers a variety of grants to state and local agencies to reduce the risk from hazards. Pre-Disaster Mitigation (PDM) Grants can provide assistance to homeowners for mitigation activities. Local jurisdictions develop applications on behalf of the homeowners and submit the applications to the State, who can then compete for funds from FEMA.

The Hazard Mitigation Grant Program (HMGP)[7] provides matching grants to implement hazard mitigation measures after a disaster, from a fund established from a percentage of post-disaster repair grants. The amount available depends on the magnitude of grants to the state following disasters declared by the President and the percentages established at the time. These grants could be used by communities not affected by the declared disaster (i.e., Bay Area jurisdictions could apply for grant funds after an earthquake in Los Angeles).

Jurisdictions should include mitigation priorities such as a retrofit program in their Local Hazard Mitigation Plan updates to ensure that they are eligible for HMGP funding.

## Expedited Permits and Reviews

One of the major comments that came from the Berkeley program analysis was that building owners greatly appreciated a smooth and streamlined process (Rabinovici, 2012). Jurisdictions should provide over the counter review consultations whenever possible. Permit reviews for seismic retrofits could be considered for expedited review. Planning Department review for most projects with seismic retrofits could be bypassed, as it was in San Francisco. Jurisdictions could also speed review and permit processes by offering additional assistance and technical advice to owners upon submittal of plans to avoid multiple rounds of plan check. If a jurisdiction chooses to offer expedited plan review, they must make it clear to building owners that only seismic retrofit and associated work would be applicable for expedited review; any ancillary work aside from the soft story retrofit addressed in the program would need to go through normal plan review processes.

## Waiver or Extension of Future Retrofit Requirements

Many building owners, having just gone through an arduous and expensive process, may be nervous that, as standards change, they will be required to meet new standards at a later date. Most jurisdictions who have developed soft story retrofit ordinances have included a provision that guarantees that building owners who successfully complete a retrofit are exempted from any

*7 Section 404 and 406 of the Federal Stafford Act*

future mandates for a period of 15 years. This gives wary building owners peace of mind and makes them more likely to feel as though a retrofit is worth their time and money. However, this should not mean that building owners are exempted forever if new or revised requirements are passed within the grace period, but that they are given additional time to comply with future requirements. This prevents building owners from continually having to comply with more and more stringent requirements, but does allow a window of opportunity in the future if engineering knowledge and standards improve.

## Exempt or Defer Triggered Work

Owners that choose to voluntarily seismically retrofit their buildings might trigger other required work, such as Americans with Disabilities Act (ADA) upgrades, fire resistance upgrades and sprinklers, Title 24 energy analysis and upgrades, or neighborhood notification. The City could exempt owners from some triggered requirement. Note that owners cannot be exempted from triggered ADA upgrades, which can be costly. This is a federal requirement and the courts have determined that seismic strengthening projects should not be exempted from this requirement.

## Exemptions for Nonconforming Conditions

Many older buildings have nonconforming conditions that do not meet current code requirements, such as construction directly on the lot line, inadequate setbacks, or inadequate parking. Jurisdictions should make clear that seismic retrofit work does not trigger retroactive compliance.

## Zoning Incentives

Jurisdictions could exempt owners that retrofit from selected zoning restrictions, such as allowing concessions regarding encroachment into setbacks, increased floor/area ratios, height limits, density bonuses, and onsite parking requirements. These concessions could be more powerful if owners, who elect not to use them, could sell them to others, or transfer them to another location within the jurisdiction (Transfer of Development Rights). An owner might 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.

Palo Alto modified its zoning laws to encourage owners of unreinforced masonry buildings to retrofit. The zoning laws were modified to permit expansion of the floor area of downtown buildings included in the program if the owner performed seismic upgrades. These building were also exempted from onsite parking requirements and fees for offsite parking.

## Density/Intensity Bonuses

Where a number of soft-story buildings contribute to the historical or architectural character of a district or area, a city may want to offer specific increases in the maximum allowable building density or intensity to help offset the added costs of seismic upgrades.

## Transfer of Development Rights (TDR)

Jurisdictions could allow owners to transfer unused development rights to another site. This incentive might be especially valuable for owners of historic properties. The value of the development rights to be transferred should be comparable to the cost of a seismic retrofit.

# Collecting Data and Program Tracking

A mitigation program is also an opportunity to collect data on the building stock that was previously unknown to the city. By recording information on buildings as they are retrofitted, jurisdictions have the opportunity to collect updated information on building occupancy, number of units, construction type, or other relevant data.

Although tracking the compliance and success of a soft story program requires additional effort, a jurisdiction can learn much about its housing stock and its community, including:

- The true expected performance of housing stock, and how retrofit affects it.
- The true extent of relatively vulnerable community

members living in soft story structures.

- Stumbling blocks to retrofit, such as lack of knowledge, lack of seismic awareness, costs, or lack of trust of local government.
- Understanding of how housing stock performance affects other components of a larger recovery and resilience effort in the community, including sheltering needs and demands on infrastructure and city services.

Tracking the performance of buildings and the program over time in pioneering jurisdictions can also provide valuable lessons for other jurisdictions following in their footsteps.

# References and Resources

Websites with resources and information about soft story buildings:

- ABAG Soft Story page: resilience.abag.ca.gov/housing/softstory
- Berkeley: http://www.cityofberkeley.info/softstory/
- San Francisco: http://www.sfgov.org/softstory and http://sfdbi.org/softstory
- Alameda: http://alamedaca.gov/community-development/building/seismic-retrofit
- Oakland: http://www2.oaklandnet.com/Government/o/PBN/OurOrganization/BuildingServices/o/Permits/DOWD008964


ASCE (2014). Seismic Evaluation and Rehabilitation of Existing Buildings (ASCE/SEI 41-13)

Applied Technology Council (2009). Here Today - Here Tomorrow: The Road to Earthquake Resilience in San Francisco. Earthquake Safety for Soft Story Buildings Documentation Appendices (ATC 52-3A). http://www.sfgsa.org/modules/showdocument.aspx?documentid=9759

Applied Technology Council (2009). Here Today - Here Tomorrow: The Road to Earthquake Resilience in San Francisco. Earthquake Safety for Soft Story Buildings (ATC 52-3). http://www.sfgsa.org/modules/showdocument.aspx?documentid=9756

Applied Technology Council (2010. Here Today - Here Tomorrow: The Road to Earthquake Resilience in San Francisco. Post-Earthquake Repair and Retrofit Requirements (ATC 52-4). http://www.sfgsa.org/modules/showdocument.aspx?documentid=9761

Bonowitz, D., and Rabinovici, S. (2013). Soft Story Risk Reduction: Lessons from the Berkeley Data. Earthquake Engineering Research Institute. https://www.eeri.org/products-page/other-special-reports/soft-story-risk-reduction-lessons-from-the-berkeley-data/

Brechwald, D., et al. (2015) Stronger Housing, Safer Communities: Strategies for Seismic and Flood Risks. Association of Bay Area Governments. http://resilience.abag.ca.gov/wp-content/documents/housing/Final%20Report/StrongHousingSaferCommunities_Strategies_3.16.15.pdf

Buckalew, et al, (unpublished draft). Example Case Studies of Soft-Story Retrofits Using the San Francisco Ordinance

California Seismic Safety Commission (2006). Commercial Property Owner's Guide to Earthquake Safety. http://www.seismic.ca.gov/pub/CSSC_2006-02_COG.pdf

FEMA (2012). Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings with Weak First Stories (FEMA P-807) https://www.fema.gov/media-library/assets/documents/32681

International Existing Building Code (IEBC) (2015). Chapter A4: Earthquake Risk Reduction in Wood-Frame Residential Buildings with Soft, Weak or Open Front Walls. International Code Council. http://publicecodes.cyberregs.com/icod/iebc/2012/icod_iebc_2012_appa4_sec001.htm

Maison, B., McDonald, B. McCormick,D., Schotanus,M., and Buckalew, J. (2014). Review of FEMA P-807: Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings with Weak First Stories. A Report to the: Existing Buildings Committee Structural Engineers Association of Northern California. http://seaonc.org/sites/default/files/commiteess/documents/p807_review_feb2014_0.pdf

Mieler, D., (2014). Soft Story Housing Improvement Plan for the City of Oakland. Association of Bay Area Governments. http://resilience.abag.ca.gov/wp-content/documents/OaklandSoftStoryReport_102914.pdf

Perkins, J. (1999, 2003 update)Preventing the Nightmare – Designing a Model Program to Encourage Owners of Homes and Apartments to do Earthquake Retrofits. Association of Bay Area Governments. http://resilience.abag.ca.gov/wp-content/documents/Pubs/

Preventing-the-Nightmare-2003.pdf

Rabinovici, S. (2012) Motivating Private Precaution with Public Programs: Insights from a Local Earthquake Mitigation Ordinance (Doctoral dissertation). https://escholarship.org/uc/item/3bf2t2xs

Samant, Laura and Tom Tobin. Memo to the Advisory Committee, Community Action Plan for Seismic Safety, "Incentives to Encourage Seismic Retrofits: Options for San Francisco". San Francisco, CA. 5 Sept. 2008. http://www.sfcapss.org/PDFs/Incentives_to_Encourage_Seismic_Retrofits.pdf

SPUR, (2008) The Dilemma of Existing Buildings: Private Property, Public Risk. http://www.spur.org/publications/spur-report/2009-02-01/dilemma-existing-buildings

SPUR (2011) Safe Enough to Stay. http://www.spur.org/publications/spur-report/2012-02-01/safe-enough-stay

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