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What Factors Influence the Success of Soft Story Retrofit Programs? The Example of San Francisco's Program

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What Factors Influence the Success of Soft Story Retrofit Programs?

The Example of San Francisco's Program

by

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A Thesis Quality Research Paper
Submitted in Partial Fulfillment of the
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In

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INTRODUCTION

In the event of an earthquake, one of the types of structures that is most susceptible to collapse is soft-story buildings (Association of Bay Area Governments [ABAG], 2016). Built before current regulation and codes were enacted, a soft-story residential building is a building that has commercial space or open parking on the first floor, with units built above it (ABAG, 2016). The first floor has a weak structure and the units above the first floor weigh heavily on it (Arroyo, 2019). Due to their building structure, these properties may sway or collapse during an earthquake, ultimately causing fatalities and damage (ABAG, 2016). To prevent this from occurring, many cities have established programs to require property owners to retrofit their soft-story buildings (ABAG, 2016). The timing and intensity of the next earthquake are unpredictable, but to prepare for the next event, the City of San Francisco has created the Mandatory Soft Story Program to retrofit the city's soft-story buildings. The following research question guides this study: *In San Francisco, what factors influence owners' decisions to retrofit their buildings? How can this knowledge help other cities to develop effective retrofit programs?*

BACKGROUND

Loma Prieta Earthquake

During the 1989 Loma Prieta earthquake, some soft-story buildings collapsed due to their design (Stark, 2019). The 6.9 magnitude earthquake resulted in 63 fatalities, 3,757 injuries, and considerable damage to many buildings (Collins, 2017). This violent earthquake caused particularly great damage to soft-story buildings in the Marina District, making it obvious how fragile these buildings with weak first stories were. The earthquake brought to light the vulnerability of wood-framed buildings, which initially had been viewed by engineers as earthquake-resistant and strong. It was quickly learned that wood-framed buildings can still collapse under certain circumstances (Pino & Enright, 2019). These wood light-frame structures collapsed, or came to the brink of collapse, because of their weak first stories. Some of the contributing factors responsible for the collapse of the larger wood-light frame buildings include a lack of bracing walls, liquefaction, and the use of obsolete materials. The majority of the damaged buildings had been built between the 1890s and 1930s (Cobeen, Maffei, & Osteraas, 2019). For the past 30 years, urban planners have encouraged property owners to fix the soft-story building structures in case of another violent earthquake (Stark, 2019).

Property owners and city governments in the Bay Area have spent \$1.2 billion on retrofits since the Loma Prieta earthquake. Although there are better building codes now than there were in the past, there are still older buildings that do not meet the standards of the new building codes and are vulnerable to collapse. Some cities have identified the buildings that are at risk, but they are still having problems retrofitting them, with cost being the primary impediment. There are cities in the Bay Area that have not passed ordinances to require retrofits. For instance, San Jose has yet to create a list of homes that

are at risk, but the city has estimated that there are about 1,500 soft-story properties.

Although the City of San Jose has not required the property owners to retrofit their buildings, officials are looking into cost-effective incentives that would motivate them to do so (Stark, 2019).

Developing a Soft-Story Retrofit Policy

Almost half of the houses that were damaged due to the Loma Prieta earthquake were soft-story buildings. Because soft-story buildings have been identified as a significant housing issue, some Bay Area jurisdictions “have already developed and adopted policies to take inventory, assess and retrofit these buildings” (ABAG, 2016, p. 6). To plan for a soft-story retrofit, there are five steps that a jurisdiction must follow. Figure 1 illustrates the steps that need to be taken to establish a soft-story retrofit program (ABAG, 2016).

Figure 1: Five Steps to Plan for a Soft-Story Retrofit Program



Source: ABAG, 2016

Soft story retrofit policies typically incur resistance from the general public and stakeholders because they affect private buildings and make building owners responsible for the costs. For such policies to garner political and public support, it is important that the first two steps—addressing the problem and building consensus—are completed carefully to address the

critical need for a soft-story retrofit, and to ensure cooperation from those involved on any potential problems. The third step, which is drafting a policy, requires clarifying the buildings that would be affected by the proposed retrofit policy, to list the buildings' expected performance requirements after an earthquake, and to prioritize the order in which the buildings should be retrofitted. After the fourth step of adopting the policy comes the fifth step, which is implementing the program. During this step, jurisdictions are responsible for providing support to building owners, design professionals, and contractors to ensure that the program is being implemented as intended (ABAG, 2016).

Potential Issues and Consideration

There are some potential issues to consider in establishing a soft-story retrofit program. One of them is determining who incurs the costs of the retrofit: the building owner or the tenants. A retrofit program may attract more political support if the program is supportive of the building owners and determines ways to avoid burdening them with the whole cost. Building owners may argue that the cost of upgrading the buildings itself should be considered as an amenity to the tenants, to keep their buildings profitable. Therefore, financial assistance programs for building owners may be beneficial and lead to more support from elected officials and the public.

However, if the costs of the retrofit are passed on to the tenants, tenants and tenant rights groups may resist these financial assistance programs for building owners. They may argue that ensuring safety should be expected, and that the burden of retrofitting the buildings should not be passed on to them. Low-income residents may feel a burden from an increase in rent, and may have to live in less safe areas or move out (ABAG, 2016).

Financial programs that allow a tenant retrofit cost pass through are usually one of the major political challenges to passing a soft-story retrofit policy. As mentioned previously, there

is resistance on both sides when deciding who should be burdened with the costs. For example, in Los Angeles, the city council took more than a year to pass a cost-sharing policy for seismic retrofits. Furthermore, it would be difficult to pass a retrofit policy if rent control did not exist in the jurisdiction. Each jurisdiction decides how much of the cost can be passed through to the tenants, so it is advisable to include the local rent board in these discussions. In San Francisco, 100% of the costs are allowed to be passed through to tenants so long as there is no more than a \$30.00 or 10% increase to each tenant's annual base rent (whichever is greater), while in Los Angeles, only 50% of the costs are allowed to be passed through to tenants, with no more than a \$38 per month increase in rent per tenant (ABAG, 2016).

In addition, a soft-story retrofit may affect the structure of the building's ground story, as it may require bulky structures to be built. This may cause a reduction in the number of parking spots available during and after construction. Therefore, tenants should be provided details about their rights should they lose their parking spaces due to the soft-story retrofit. The building owners could be provided accommodations in zoning ordinances for parking requirements (ABAG, 2016).

When buildings are subjected to a soft-story retrofit ordinance, the ordinance should clarify that owners are responsible for maintaining safe buildings in the event of a disaster. After an earthquake, those who have experienced injuries may blame building owners for being negligent in keeping their buildings up to code. Jurisdictions have the ability to impact owners' liability in the wake of a future earthquake by identifying affected buildings and setting retrofit standards and compliance deadlines (ABAG, 2016).

Phasing and Deadlines

Many programs have established tiered systems that permit more time for the retrofitting of certain types of buildings than they do for others. Those buildings assigned to the highest priority level must be retrofitted more quickly than other buildings. In the case of San Francisco, the city government developed a tiered system that stipulated that buildings that had many occupants, or that housed high-risk populations, had to be retrofitted sooner than others. Thus, Tier 1 buildings are educational, assembly, or residential care facilities. Tier 2 buildings are buildings with 15 or more dwelling units. Tier 3 buildings are those buildings that do not fall within another tier. Tier 4 buildings are those with the most recent compliance date, and that have ground-floor commercial use, or are in a liquefaction zone. Tier 4 building owners are given more time to retrofit their buildings due to the buildings' more complex nature. Tenants may be displaced during the process of a Tier 4 retrofit, or the building may be in a liquefaction zone. Additionally, these tiers were established to prevent the city from receiving an overwhelming number of permit requests and plans at the same time (ABAG, 2016).

San Francisco's Mandatory Soft Story Program

In 2013, San Francisco passed the Soft Story Seismic Retrofit Ordinance, which requires a mandatory seismic retrofit of wood-framed soft-story properties (Pino & Enright, 2019). This ordinance was created by Mayor Ed Lee and the city's Earthquake Safety Implementation Program (ESIP) (San Francisco Department of Building Inspection [SFDBI], n.d.-a). ESIP is a 30-year plan that aims to improve San Francisco's resilience and strength in the face of earthquakes (SFDBI, n.d.-a). Because soft-story buildings were identified as the city's biggest risk, the Mandatory Seismic Retrofit Program was established (SFDBI, n.d.-a). The program mandated retrofits for multi-family and wood-

framed buildings that are “three-stories or taller, or two-story buildings over a basement or crawl space, with five or more dwelling units” (Pino & Enright, 2019, para. 4) and whose permits are dated before January 1, 1978 (SFDBI, n.d.-e). The Mandatory Soft Story Retrofit Program (MSSP) is led by the ESIP, while the San Francisco Department of Building Inspection (SFDBI) is responsible for enforcing compliance. Only the target story that is considered weak or soft needs to be retrofitted in the building. The target story is considered soft if it has a vastly different wall structure or number of walls in comparison to the stories above it (Pino & Enright, 2019). According to a 2016 report by the Association of Bay Area Governments (ABAG), San Francisco has 6,700 soft-story buildings, the highest number of soft-story buildings in the region. The ultimate goal is to have 100% of the soft-story buildings retrofitted (Stark, 2019).

The ordinance provided a list of buildings categorized into four tiers: (1) Tier 1 buildings are special, institutional, and educational buildings; (2) Tier 2 buildings are buildings with 15 or more units; (3) Tier 3 buildings are buildings with 5 to 14 units, and (4) Tier 4 buildings are buildings with ground-floor commercial spaces (Pino & Enright, 2019). Table 1 shows each tier’s building owners’ deadlines for submitting permit applications and for completing the retrofitting of their buildings.

Table 1: Deadlines for Retrofitting Wood-Framed Buildings in Mandatory Seismic Retrofit Program

Compliance Tier	Submittal of Permit Application with Plans for Seismic Retrofit Work	Completion of Work and Issuance of Certificate of Final Completion
1	September 15, 2015	September 15, 2017
2	September 15, 2016	September 15, 2018
3	September 15, 2017	September 15, 2019
4	September 15, 2018	September 15, 2020

Source: Pino & Enright, 2019

Advertisement of the Mandatory Seismic Retrofit Program (Ordinance No. 66-13)

The City of San Francisco conducted a community outreach campaign that included sending out repeated notices to the property owners of buildings that fit the requirements of the ordinance and using the media to spread the word (Pino & Enright, 2019). Property owners received notices starting in September 2013 and were required to send in their screening forms to the SFDBI by September 15, 2014.

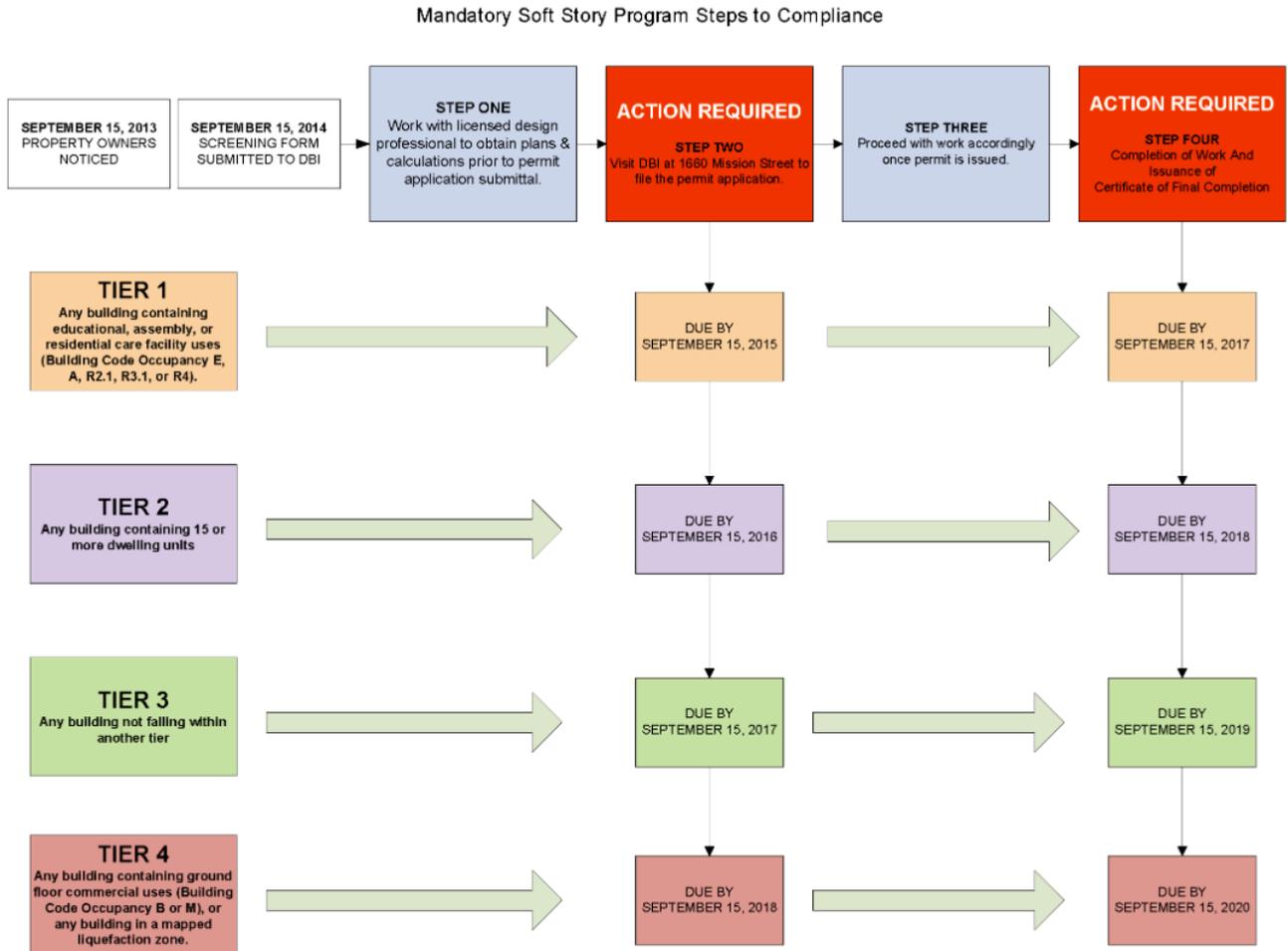
The city’s Office of Resilience and Recovery team created and held financing workshops, and yearly earthquake retrofit fairs. Government officials also worked with the SFDBI and the San Francisco Rent Board staff and experts on these projects to host public meetings. During these meetings, citizens were allowed to ask questions and raise concerns, and property owners were provided with education and information (Pino & Enright, 2019).

Procedures for Property Owners

The SFDBI mandated that each affected property owner turn in a screening application by September 15, 2014 (SFDBI, n.d.-c). Those who did not turn in this form were considered in

violation of the San Francisco Building Code (SFDBI, n.d.-c). After the screenings were completed, the property owners were assigned two tasks: (1) to obtain a construction permit and (2) to complete the retrofit work, with deadlines depending on the tier of building that they owned or managed (SFDBI, n.d.-c). These deadlines are ongoing. Prior to submitting their permit applications, property owners in each tier must collaborate with licensed design professionals to create plans and perform calculations (SFDBI, n.d.-c). After they have worked with the licensed design professionals, they must go to the SFDBI to submit their permit applications. Once these applications have been submitted, retrofit work is allowed to be performed (SFDBI, n.d.-c). During this stage, required inspections must be accounted for and the district inspector must be contacted (SFDBI, n.d.-c). All special inspections must be performed and signed off on before the final inspection is allowed to take place (SFDBI, n.d.-c). During the final inspection, when the building inspector has signed off on the job card, the property owner must request a certificate of final completion (CFC; SFDBI, n.d.-c). The CFC is a document that declares that a building is safe and sound for people to occupy (SFDBI, n.d.-d). The building owner has to send the CFC to the MSSP via email or take it to Window #8 on the first floor of 1660 Mission Street in San Francisco (SFDBI, n.d.-g). The CFC confirms that they are in compliance with the MSSP (SFDBI, n.d.-g). Figure 2 details the steps that property owners must take, as described above.

Figure 2: Workflow of Procedures for Property Owners



Source: SFDBI, n.d.-g

Financing the Retrofit

The estimated cost to retrofit a building, depending on its size, hazard level, and needed seismic retrofit work, is between \$60,000 and \$200,000 (Hui, 2017). The City of San Francisco has made public financing available to building owners through the Alliance NRG/Counterpointe Sustainable Real Estate Program. The NRG financing program provides business owners with a loan that covers 100% of the retrofit costs, and the costs are permitted to be passed on to tenants for rent-controlled properties (Pino & Enright, 2019). The majority of buildings in San Francisco are rent-controlled (Pino & Enright, 2019). The benefits of retrofitting the buildings include

increased protection for tenants and properties (Collins, 2017). Thus, the San Francisco Rent Board allows 100% of costs of the seismic work required by law to be passed through to the tenants, so long as there is no more than a 10% increase to each tenant's annual rent (San Francisco Rent Board, n.d.). If the cost of the passthrough exceeds the 10% increase, the rest of the cost of the passthrough can be added to the rent the following year(s) (Collins, 2017). However, tenants who are facing financial hardship have the option to submit a hardship appeal application for passthroughs (SFDBI, n.d.-b). If the property owner decides to pay for the costs of the retrofit or seek a loan from a bank, they face restrictions on the kinds of costs that can be transferred to the tenants (Pino & Enright, 2019).

Notices of Violation

To enforce and advertise compliance, placards were posted and notices of violation (NOVs) were sent to building owners who were non-compliant with the MSSP (SFDBI, n.d.-f). These placards, which featured the words "Earthquake Warning!" in big, bold and red letters, warned residents, property owners, and the public that the property owner(s) were not in compliance with the Mandatory Soft Story Retrofit Program (Pino & Enright, 2019). Those who were considered in violation were those property owners who had unsuccessfully completed the screening process, who had not completed the retrofit of their buildings in accordance with the compliance tier timeline dates, or who had not applied for a permit by the deadline (SFDBI, n.d.-f). If the property owners failed to resolve their NOVs, they were required to attend a director's hearing to explain the reasons for non-compliance (SFDBI, n.d.-f). Additional costs were also applied to the property, including the cost of the time that inspectors spent urging the property owners to comply with the program (SFDBI, n.d.-f).

LITERATURE REVIEW

Soft-Story Ordinance in Los Angeles

In December 2014, the City of Los Angeles established the Resilience by Design initiative to strengthen the city's built environment against earthquake vulnerabilities, as well as to protect the economy and lives of citizens by preparing the city to recover efficiently from future earthquakes. In response to this initiative, Ordinance No. 183983 was signed into law in October 2015; it was amended in January 2016, creating Ordinance No. 184081. Ordinance No. 183983 and Ordinance No. 184081 require buildings with soft, weak, and open-front wall lines and building permits issued before 1978 to be retrofitted. According to the Los Angeles Department of Building and Safety, there are about 13,500 affected buildings in total. The property owners are responsible for the costs of the retrofit, but if the retrofit is completed by the specified timeline, they can apply for the city's Seismic Retrofit Program (Kang, Yi, & Burton, 2019). The Seismic Retrofit Work Cost Recovery Program allows the property owners to temporarily increase the rent equally among all rental units so they can recover up to 50% of the retrofit cost (Los Angeles Housing Community Investment Department, n.d.).

Kang et al. (2019) explored the post-earthquake recovery-related benefits of the city's soft-story ordinance in five particular neighborhoods: Koreatown, Westlake, Pico Union, Lomita, and East Hollywood. There are about 8,000 soft-story buildings in these five neighborhoods. Kang et al. (2019) found that the ordinance would reduce the initial post-earthquake mean loss of occupancy by about 25%. However, if the considered recovery performance metric were set to restoring 90% occupancy, there would be a 64% reduction as a result of the ordinance retrofit. The researchers came to these numbers by completing a scenario-based damage assessment and using a specific model to illustrate

post-earthquake recovery. Another particular area of study was the effect of the city's ordinance on post-earthquake recovery trajectories. In comparison to the other four neighborhoods, Koreatown had the highest percentage of soft, weak, and open-front buildings at 28%. Kang et al. (2019) also found that the retrofit was projected to "reduce the initial loss of occupancy in Koreatown by 45% compared to 25% when considering all neighborhoods" (p. 181). The soft-story ordinance in Los Angeles is expected to have a significant impact on the loss of occupancy after an earthquake.

Berkeley's Soft-Story Retrofits

When the 1996 Northridge earthquake occurred in the Los Angeles area, the soft first story of the Northridge Meadows apartment building failed and killed 16 people who resided in first-floor apartments while they slept. This caused California cities to inventory their soft first-story buildings to understand the community's risk from such structures (Comerio, 1998). The ground level of a building is much weaker and more flexible than other levels, putting it at greater risk of collapse (Lindt et al., 2014). Samant et al. (2009) stated that in the event of a large earthquake, the ground-level walls of soft-story buildings would be unable to support the stories above the ground floors of the buildings. The ground-level walls would sway back and forth or shift sideways, potentially resulting in building collapse, with the ground floors demolished.

Although many residential buildings are built using a woodframe construction, the partial or entire first stories of such buildings are oftentimes used for parking. The first story of such a building accordingly has fewer walls and partitions in comparison to the stories above. In some areas of California, such as Los Angeles and San Francisco, two- to five-story wood-framed buildings are typically used for multifamily dwellings. The upper stories are occupied by residents (Burton, Rad, Yi, Gutierrez, & Ojuri, 2019). Among those that inventoried their

building stock, the City of Berkeley discovered that there were 321 wood-framed soft-story buildings that contained over 3,200 housing units. As a result, in 2005, the city established an ordinance that mandated that owners of soft-story buildings identify the weaknesses in the buildings and propose possible solutions. They were required to post signs to alert tenants that the buildings were seismically at risk. Signed into law on January 4, 2014, a new ordinance required the rest of the soft-story buildings to be retrofitted, and included wood-framed buildings built before 1978 (City of Berkeley, n.d.). By the end of 2016, owners of these soft-story buildings were required to apply for building permits and were given two years to complete the retrofits. As of October 2, 2015, there were 124 buildings that had yet to be retrofitted.

Public Policy and Mitigating Earthquake Risks

Based on a nine-year, \$1 million-dollar study conducted by the Community Action Plan for Seismic Safety (CAPSS), “43 to 80 percent of multi-story wood frame buildings in San Francisco will be deemed unsafe after a magnitude 7.2 earthquake” (Lindt et al., 2014). Comerio (2004) reviewed data collected from a variety of large earthquakes and stated that building damage is the primary type of damage that occurs. Soft-story buildings are one of the biggest threats to a city in the event of an earthquake (Porter & Cobeen, 2012). Earthquakes can be viewed as a housing disaster, since they not only damage homes but also require victims to be rehoused and require building owners to shoulder the costs of repairing and rebuilding the buildings. The Loma Prieta earthquake heavily affected single-room occupancy hotels in San Francisco, Oakland, and Santa Cruz and caused residents to become homeless (Comerio, 2004). In response, the SFDBI established CAPSS to develop a plan to decrease the risk of earthquakes in the city (Porter & Cobeen, 2012). CAPSS also developed repair plans and guidelines that would help with recovery after an earthquake (Samant et al., 2009). Participants in CAPSS

argued that seismic risk was a community issue that was far more significant than the individual concerns of building owners who may have the retrofit costs imposed on them. The CAPSS advisory committee met numerous times and came to the consensus that there was a need for an ordinance requiring the retrofit of high-occupancy, soft-story wood-framed buildings (Porter & Cobeen, 2012).

Moreover, building owners were oftentimes uninsured, so the public was left to manage the housing crisis. An example of the government implementing policies in order to mitigate potential losses in the aftermath of disasters is when California funded the retrofit of state-owned buildings that had poor seismic structures. This type of policy/program aimed to protect a portion of the public building stock, but it was difficult to encourage owners of private buildings to explore implementing similar pre-earthquake mitigation efforts (Comerio, 2004).

According to Comerio (2004), one of the basic policy approaches to reduce the impact of disasters and encourage safe development is implementing policies that include preparedness information, building codes, and insurance. It is obvious that establishing building codes prevents potential damage from earthquakes and other natural disasters, but building codes are generally focused on new buildings. In fact, the high rate of deaths from earthquakes is generally due to a lack of enforcement of building regulations. In the United States, building codes and practices differ between urban and rural areas and among states.

In fact, CAPSS conducted a study to analyze the potential consequences for multi-unit, soft-story wood-framed dwellings in the event of several moderate to large earthquakes. If several moderate to large earthquakes were to occur, an estimated tens of thousands of people who live in these affected homes would be displaced. A mandatory retrofit would significantly decrease this risk (Samant et al., 2009).

Many states provide information on how to make buildings more disaster-resistant but do not make it mandatory for owners to perform the upgrades. Oftentimes, it can be difficult to compel owners to provide these basic safety measures. For instance, after Hurricane Andrew, Florida attempted to enforce a state-wide building code, but rural jurisdictions opposed it. As a result, Florida developed a state building code that brought codes to areas that did not have any, while having the unintended consequence of weakening the hurricane safety requirements in other areas that already had codes. The City of Berkeley has been successful in enforcing earthquake mitigation for public and private buildings. The government offered homeowners an incentive, indicating that if the homeowners performed structural retrofitting of their houses, the city would offer them a real estate transfer tax rebate. Due to this incentive, 38% of houses in Berkeley have been seismically retrofitted. Berkeley was also successful in adding seismic improvements to its city hall (Comerio, 2004).

In addition, because of past experiences with a lack of availability of commercial hazard insurance, the Federal Emergency Management Agency (FEMA) has encouraged local governments to make buildings and infrastructure disaster-resistant, thus helping to avoid damage that may necessitate insurance payouts. Since bridges and buildings that have been retrofitted have suffered less damage from disasters than they would have without the retrofitting, it is apparent that encouraging earthquake and hazard mitigation improvements would result in lower federal and personal recovery costs from future events. Although it has been proven that mitigation efforts can prevent further losses, the real estate market does not provide incentives for building owners to complete seismic retrofits, such as allowing them to collect increased rent or increasing the value of their building (Comerio, 2000).

Comerio (2004) stated that the ABAG conducted a study in 1999 that found that Berkeley residents' high income and education levels combined with the local government's outreach and information campaign efforts could have played a role in the city's success in earthquake mitigation. Governments should create initiatives and policies with incentives such as tax credits and established relationships with lenders to associate disaster mitigation with beneficial loan rates. Lindt et al. (2014) suggested that a policy that accommodates residents and building owners fosters public support, and such support hastens the implementation of the policy. Additionally, Comerio (2004) mentioned that successful mitigation policies are those that are not restrictive and that explore ideas for how individuals, businesses, and public institutions can establish basic safety requirements for buildings. If cities do not allow building owners to increase rent, the cities struggle to mandate property owners to seismically retrofit their properties due to the expensive costs. Thus, enforcing mitigation is difficult without providing incentives (Comerio, 2000). Liou and Kapucu (2014) determined that effective disaster recovery programs require a stronger framework for accountability. Their research showed "the weakness of general policies and guidelines and the need for specific standards to assure the quality in policy implementation and performance outcome" (p. 455).

METHODOLOGY

Design

The research is based on a program evaluation of the San Francisco MSSP. According to Sylvia and Sylvia (2012), a program evaluation is conducted to determine whether a given program is achieving its goal: in this case, of ensuring that the identified buildings are retrofitted. A survey was distributed to owners of Tier 2 and Tier 3 residential buildings. Only those building owners who had received CFCs were contacted, since they had already completed all necessary work related to retrofitting their building. Building owners from Tier 4 were not contacted because their CFCs are not due until September 15, 2020.

The program evaluation methodology has four phases: problem identification, solution development, implementation, and feedback evaluation.

Table 2: Program Evaluation

Program Evaluation			
Problem Identification	Solution Development	Implementation	Feedback Evaluation
Soft-story buildings are San Francisco’s greatest risk when it comes to determining the city’s overall resilience to earthquakes and other disasters.	Establish a mandatory soft-story program that requires the retrofitting of multi-family, wood-framed buildings that are identified as soft story.	Affected buildings in Tiers 1–4 are legally required to be retrofitted and have CFCs by September 15, 2020. Notices of violation are given to those building owners who are non-compliant.	Evaluate public data and survey results. Analyze the feedback to answer the question, “What factors influence owners’ decisions to retrofit their buildings?”

A mixed-methods analysis was performed by drawing on the survey results and extracting public data regarding the identified properties’ statuses. For the first step, public data on existing soft-story buildings in San Francisco (Data SF, n.d.) was analyzed to compile

statistical information on the properties that have been retrofitted. The researcher used data from the week of April 4, 2020. Part I of this study involved analyzing quantitative data extracted from the city's public data. The researcher counted how many Tier 2 and Tier 3 building retrofits have been completed and were issued CFCs, and compared the number to the retrofit rate. In addition, the average median income of each of the supervisorial districts of the target buildings was identified, and the retrofit rates of the districts were compared.

Part II of this study involved analyzing qualitative data from the survey results. For the second step, in order to find out the common factors that motivated the building owners' decisions to retrofit, a survey was created. The distribution of responses to the survey indicates common factors that may have played a role in owners' decisions to retrofit. Finally, the researcher identified the common factors that are correlated with the highest retrofit rate; this information is useful for other current or future soft story programs to consider. The researcher investigated how to improve retrofit programs for other cities, using San Francisco as a model for finding out which factors influence building owners' decisions about whether to retrofit.

Data

The researcher researched each of the 2,963 Tier 2 and Tier 3 properties that had been retrofitted to find the property owner's or property manager's contact information, whether their phone number or email address. If the property owner's contact information was not available, the researcher attempted to identify the property manager's contact information. The survey data was collected through phone calls, emails, and Qualtrics, an online survey tool. If the researcher was only able to find an owner's or manager's phone number, the researcher called them. Each time the researcher called an identified phone number, the researcher asked to speak to the

building owner or property manager, introduced herself, explained the research and the commitment to confidentiality, and requested the person’s consent to ask the survey questions.

If the researcher only found their email address, the researcher sent them an email. If the researcher found both their phone number and email address, the researcher attempted to contact them using both methods. The email invited the owner or manager to respond to the survey by directly emailing the researcher back, setting up a phone call, or filling out the survey with the Qualtrics link that was provided in the email. The email also contained an introduction, explanation of the research, and a statement of confidentiality, and asked for consent to proceed with the survey. Upon receiving consent, the researcher proceeded with the questions. The survey asked the following questions:

1. In 2013, Mayor Ed Lee signed legislation that requires all of San Francisco’s “multi-unit soft-story buildings” to be retrofitted. In addition to the legal requirement, what was the most important reason to retrofit your building?
 - a. To maintain and protect the housing stock
 - b. To enhance and increase the property’s value
 - c. The ability to pass through 100% of the cost of seismic retrofit work to the tenants
 - d. Other. Please explain:

2. Is the building rent controlled?
 - a. Yes
 - b. No
 - c. Decline to state

3. What is the monthly average unit rent price?
 - a. \$0-\$1000
 - b. \$1000-\$2000
 - c. \$2000-\$3000
 - d. More than \$3000
4. What is your length of ownership?
 - a. Under 5 years
 - b. Over 5 years
5. Is the building renter occupied or owner occupied?
 - a. All renters
 - b. Owner and renters
 - c. Decline to state

Of the 2,963 Tier 2 and Tier 3 properties that were retrofitted and issued CFCs, 678 had contact information available to the researcher. Of the 678 property owners and managers contacted, 101 filled out the survey, which is about a 15% response rate. Thirty-four responded by phone, 45 responded by email, and 22 responded via Qualtrics.

FINDINGS

This section presents the results of the research, including the quantitative data (number of properties retrofitted and the retrofit rate per district) and the response breakdown for each question in the survey. Public information was obtained from the city's website. Although the public data is updated weekly, the research is based on the public data updated on April 4, 2020. To shed light on common factors that influence owners' decisions to retrofit, the results include qualitative data from the survey. The participants were informed that the survey was voluntary and that no information directly tied to them would be shared. The participants were able to opt out of any question that they did not want to answer. The survey was administered from June to September, 2020. Responses were collected via phone, email, and Qualtrics.

The San Francisco MSSP has four tiers. Tier 1 includes "any building containing educational, assembly, or residential care facility uses (Building Code Occupancy E, A, R2.1, R3.1, or R4)," Tier 2 includes buildings that have 15 or more units, Tier 3 includes buildings that do not fall in any of the other tiers, and Tier 4 includes "any building containing ground floor commercial uses (Building Code Occupancy B or M), or any building in a mapped liquefaction zone" (SFDBI, n.d.-c, para.4). The reported data includes only residential buildings, which are Tier 2 and Tier 3 buildings. Tier 1 is not residential, so it was excluded from the data. Because Tier 4's deadline for the completion of work and issuance of CFCs was September 15, 2020; these buildings were thus excluded from the data.

Number of Properties Retrofitted

Table 3 shows the number of properties whose retrofit work is complete and that were issued CFCs, as well as the retrofit rate of each tier. This table reveals that 83.69% of the total number of Tier 2 properties requiring retrofitting have had the work completed and have had CFCs issued, while 74.84% of the total number of Tier 3 properties requiring retrofitting have had the

work completed and have had CFCs issued. Tier 2 has a higher retrofit rate, but it did not have as many properties that needed to be retrofitted as Tier 3 did.

Table 3: Buildings for Which Work Has Been Completed and CFCs Have Been Issued

Tiers	Number of Properties That had Work Completed & CFC Issued	Total Number of Properties that Needed to be Retrofitted	% Completed, CFC Issued
2	431	515	83.69%
3	2,532	3,383	74.84%

Source: Data SF, n.d.

Median Household Income by Supervisorial District

Table 4 shows the median household income for each of the 11 supervisorial districts in San Francisco. District 6 has the lowest median household income at \$37,431, while District 2 has the highest median household income at \$105,509.

Table 4: 2010 Median Household Income by Supervisorial District

Supervisorial District	Median Household Income
1	\$74,668
2	105,509
3	43,513
4	77,376
5	67,331
6	37,431
7	94,121
8	95,930
9	67,989
10	55,487
11	71,504
Citywide	\$71,416

Source: Budget and Legislative Analyst, 2013, as cited in U.S. Census Bureau, American Community Survey 2006–2010 & Census 2010

Retrofit Rate by District

Table 5 shows that the lowest retrofit rate (54.17%) was found in District 6. As shown in Table 4, District 6 also has the lowest median household income (\$37,431). District 2 has the highest median household income (\$105,509), and it has the third-highest retrofit rate (79.74%). The highest retrofit rate (81.08%) was found in District 4, where the median household income (\$77,376) is the fourth-highest. The citywide median household income is \$71,416, and the citywide retrofit rate (Tier 2 and Tier 3) is 75.99%.

Table 5: Total Retrofit Rate of Each District (Tiers 1 and 4 Excluded)

Supervisory District	Number of Properties That had Work Completed & CFC Issued	Total Number of Properties that Needed to be Retrofitted	% Completed, CFC Issued
1	410	513	79.92%
2	622	780	79.74%
3	433	573	75.57%
4	90	111	81.08%
5	610	817	74.66%
6	26	48	54.17%
7	36	51	70.59%
8	541	712	75.98%
9	139	208	66.83%
10	43	66	65.15%
11	13	20	65.00%
Total	2963	3899	75.99%

Source: Data SF, n.d.

Survey Results

Question 1: *In 2013, Mayor Ed Lee signed legislation that requires all of San Francisco’s “multi-unit soft-story buildings” to be retrofitted. In addition to the legal requirement, what was the most important reason to retrofit your building?*

This question asked participants to disclose the main reason they had retrofitted their buildings, apart from it being required. Responses to the question revealed that 32% of participants chose to retrofit their buildings to maintain and protect the housing stock, 14% of participants chose to retrofit their buildings to enhance and increase their property value, and 5% of participants chose to retrofit their buildings due to the ability to pass through 100% of the costs of the seismic retrofit work to the tenants. The most common answer participants gave when asked about the most important reason why they retrofitted their building was “Other” (49%). The least common answer was the 100% passthrough (5%). One participant was unable to pick just one choice, so his answer is not included in the count.

Table 6: Question 1 Response Breakdown

	Question #1	%	Count
A	To maintain and protect the housing stock	32.00%	32
B	To enhance and increase the property’s value	14.00%	14
C	The ability to pass through 100% of the cost of seismic retrofit work to the tenants	5.00%	5
D	Other. Please explain:	49.00%	49

The following are the 11 highlighted responses under “Other”:

- “Monetary value, insurance reduced” (Participant #2, phone communication)
- “All of the above” (Participant #3, email communication)
- “No other reason other than the legal requirement” (Participant #4, email communication)
- “Protect rent controlled tenants” (Participant #12, email communication)
- “So people don’t die in the building during an earthquake” (Participant #10, email communication)
- “To save lives” (Participant #28, phone communication)
- “Only did it because of the legal requirement” (Participant #29, phone communication)
- “Safety” (Participant #67, Qualtrics)
- “Ability to add accessory dwelling units” (Participant #87, email communication)
- “To meet with legal requirement” (Participant #97, email communication)
- “Enhance the structural integrity of the building” (Participant #101, Qualtrics)

Question 2: *Is the building rent controlled?*

This question reveals that 93% of the participants owned or managed buildings that were rent-controlled and 7% of participants did not. This data shows that the vast majority (93%) of the buildings that have been retrofitted and issued CFCs in the San Francisco MSSP are rent-controlled. One participant did not answer the question because the answers available did not suit the participant.

Table 7: Question 2 Response Breakdown

Question #2		%	Count
A	Yes	93%	93
B	No	7%	7
C	Decline to state	0%	0

Question 3: *What is the monthly average unit rent price?*

This question reveals that 1.23% of the participants collect an average of \$0–\$1,000 in rent per unit per month, 13.58% of the participants collect an average of \$1,000–\$2,000 in rent per unit per month, 71.60% of the participants collect an average of \$2,000–\$3,000 in rent per unit per month, and 13.58% of the participants collect an average of more than \$3,000 in rent per unit per month. The majority of participants indicated that they have properties whose monthly average unit rent is \$2,000–\$3,000.

One participant did not answer because the answers available did not suit the participant. Four participants opted out of the question. Fifteen participants were not included in the count because they stated that their rent amounts vary.

Table 8: Question 3 Response Breakdown

Question #3		%	Count
A	\$0-\$1000	1.23%	1
B	\$1000-\$2000	13.58%	11
C	\$2000-\$3000	71.60%	58
D	More than \$3000	13.58%	11

Question 4: *What is your length of ownership?*

This question reveals that 8.08% of the participants have been owners for fewer than five years and 91.92% of participants have been owners for more than five years. One participant opted out of the question, and one participant was not included in the count because the answers available did not suit the participant.

Table 9: Question 4 Response Breakdown

Question #4		%	Count
A	Under 5 years	8.08%	8
B	Over 5 years	91.92%	91

Question 5: *Is the building renter-occupied or owner-occupied?*

This question reveals that 92% of properties are occupied exclusively by renters and 8% of properties are occupied by owners and renters. One participant was not included in the count because the answers available did not suit the participant.

Table 10: Question 5 Response Breakdown

Question #5		%	Count
A	All renters	92.00%	92
B	Owners and renters	8.00%	8
C	Decline to state	0%	0

Participant Comments

Some participants provided unprompted thoughts about and reviews of the program. The major trends in comments, along with the value and size of the properties belonging to the participants who made the comments, are described in this section. The value and size of the properties were determined using the website Redfin. The property values are based on estimates for September 2020.

Those who had positive feedback on the San Francisco MSSP managed or owned buildings that had property values ranging from approximately \$2.6 million to \$5.8 million dollars. Those who had negative feedback managed or owned buildings that had property values ranging from approximately \$1.9 million to \$3.7 million dollars. There were three properties that were not included in this breakdown because there was not enough data to generate an accurate estimate and one property that could not be found on Redfin.

Those who had positive feedback managed or owned buildings with property sizes ranging from 4,837 square feet to 9,684 square feet. Those who had negative feedback managed or owned buildings with property sizes ranging from 3,200 square feet to 22,624 square feet.

Pros and Cons of San Francisco MSSP

Table 11 was created based on the comments that the participants provided to explain why they chose “Other” for Question 1, as well as the additional comments listed in Table 12, showing the general pros and cons of the San Francisco MSSP.

Table 11 shows participants’ additional comments along with the property sizes and property values of the respective participants’ buildings.

Table 11: Additional Comments with Property Size and Property Values

Participant	Response Method	Comments	Property Value	Property Size
#2	Phone	"SF required me to be retrofitted by a certain date, but when I had it all ready, the city told me they weren't ready, and it was frustrating"	\$2,291,290	22,624 sq. foot
#6	Phone	"There were other measures that the city could have done. It was very costly, and even with the program, we wouldn't recoup all of the costs. When we asked why the lawmakers signed this law, they didn't have the answers. The retrofit was very costly, about \$300,000 for a	\$2,294,502	7, 145 sq. foot

		building that didn't really need to be retrofitted and for a building wasn't of any use anymore"		
#19	Phone	"It was a good idea to retrofit and to think of long-term solutions"	\$5,470,687	9,684 sq. foot
#20	Phone	"I retrofitted my other property that wasn't required"	\$5,881,094	12,537 sq. foot
#24	Phone	"It was very expensive, didn't make money off of it and because the building is rent controlled, I didn't receive much so can't make up for the cost of the repairs. I didn't think it was necessary"	\$1,912,850	3,200 sq. foot
#40	Email	"Would not have done it but for the requirement"	Not enough data to generate an accurate estimate	4,704 sq. foot
#66	Phone	"It was a wise decision to retrofit in case there is any earthquake hazard. I also own two other buildings that have already been retrofitted before this program passed"	Not enough data to generate an accurate estimate	7,056 sq. foot
#82	Email	"I am hesitant to respond as I do not consider this to be a "Success" when you hold owners hostage to force exorbitant repairs, many property owners had to sell their buildings because with rent controlled rents, they simply could not afford the repair. In answer to your question number 1. The only reason we did the retrofit was because we were forced to. Not like we had a choice. This set back my property owner \$300K. It took a year to refinance the building as my property owners are retired so it was hard to get the financing. The city said they would provide financing which was a joke and did not exist. The only win is we can go back and get 100% in pass through, however since tenants can claim hardship, I doubt we will	\$3,720,915	9,035 sq. foot

		see any of the pass through, especially now with COVID"		
#86	Phone	"The retrofit was necessary to maintain the structure of the building, especially for buildings built in early 1990s for tenant safety. If an earthquake happens, you will run into major issues if you are not in compliance"	\$3,191,703	4,837 sq. foot
#92	Phone	"The program is great, and I did seismic work in other buildings where it was not required. It is a great investment and it's not about if an earthquake will happen, but when. It makes perfect sense to protect tenants"	Not enough data to generate an accurate estimate	9,900 sq. foot
#93	Phone	"It was a wise choice to protect ourselves, to protect tenants and to prevent damage"	\$2,147,637	7,500 sq. foot
#97	Email	"The ONLY reason the vast majority of building owners would do a soft story retrofit on a building is to meet the regulatory requirements of the city". The participant made comments about each of the answer choices in question #1. The comment the participant made to choice A is "How one protects their investment is unique to the property owner, and the situation. San Francisco has been on an earthquake fault since the founding of the city. The majority of the buildings survived 1989 with no issue. Even more if you eliminate those on liquefaction zones". The comment made towards Choice B was "I don't believe this is a viable reason. Other than removing the regulatory risk of a purchase, there is minimal appreciated value to a soft story retrofit building. Because of the regulation requirement, it removes that requirement, without the regulation, I doubt there would be	Unavailable on Redfin	Unavailable on Redfin

		<p>much difference. Similar to how most upgrades do not change the value of a house by any amount close to the cost of doing them unless they are highly desirable or cosmetic". The comment towards choice C is "This is also a poor reason. The 100% pass through is over 20 years and does not include items like impact costs (if you had to remove temporarily services like parking or storage). Furthermore, tenants have the ability to claim economic hardship and completely negate the passthrough. If tenants move out, the passthrough goes away. If rents fall, pass throughs are meaningless (current situation). If a tenant is at, or near, market rent, you would not administer the pass through and risk losing the tenant. Ultimately, the passthrough is a very poor argument". The participant stated they chose D "to meet with legal requirement"</p>		
#99	Email	<p>"State Senator Scott Weiner should be commended for pushing through legislation for the ADU's- additional dwelling units. These units helped soften the financial blow to owners and increased housing at a very affordable cost"</p>	\$2,658,699	4,335 sq. foot

Table 12 shows the overall themes of the pros and cons that were provided in the survey.

Table 12: Overall Pros and Cons of San Francisco MSSP

PROS	CONS
Protects tenants	Cannot recoup the costs
Prevent earthquake damage	Not needed
Protects investment in building	Too expensive
Overall safety	Forced owners to retrofit
Ability to add accessory dwelling units	Difficult to get financing
Maintain structure of the building	100% passthrough is over 20 years
	Tenants can claim economic hardship on the passthrough

Source: Survey

ANALYSIS

The main objective of this study was to identify common factors that influence owners' decisions to retrofit their buildings and analyze common answers. The majority of Tier 2 and Tier 3 buildings that were required to undergo retrofitting and receive CFCs were retrofitted by the set deadlines, as shown in Table 3.

Comparing Districts and Retrofit Rates

Table 13 shows that the lowest median household income corresponds to the lowest retrofit rate. As the median household income increases, the retrofit rate generally increases with some fluctuations. At a median household income level of \$74,668 or higher, the retrofit rate is between 70% to 81%. The 50% and 60% retrofit rates largely correspond to median household incomes between \$37,431 to \$71,504, with the exception of two districts that have retrofit rates in the 70th percentile. In general, the higher the median household income in the district, the higher the retrofit rate in that district.

Table 13: Median Household Income and Retrofit Rate Comparison

Median Household Income (from lowest to highest)	Supervisory District	Retrofit Rate
\$37,431	6	54.17%
\$43,513	3	75.57%
\$55,487	10	65.15%
\$67,331	5	74.66%
\$67,989	9	66.83%
\$71,504	11	65.00%
\$74,668	1	79.92%
\$77,376	4	81.08%
\$94,121	7	70.59%
\$95,930	8	75.98%
\$105,509	2	79.74%

Question 1. The majority of participants chose “Other” as the main reason why they retrofitted their buildings. As shown in the highlighted comments that property managers and owners provided on the survey regarding the San Francisco MSSP, many retrofitted because they wanted to protect their tenants and the buildings, while others did it only to meet the legal requirement. Table 11 further illustrates why the San Francisco MSSP was an issue for many and may explain why only 5% chose “The ability to pass through 100% of the cost of seismic retrofit work to the tenants” as their answer. Recouping costs is a lengthy process. According to Collins (2017), building owners have to pay the costs out of their own pockets and then must increase tenants’ rent over a period of 20 years to recoup the expenses. Because tenants can claim economic hardship and can apply for an appeal of the rent increase, this may be a major concern, especially during the current coronavirus (COVID-19) pandemic, which is causing economic hardship for many due to shelter-in-place orders and business closures. The long-term impact of COVID is unknown. Moreover, the stipulation that the passthrough cannot result in an increase of more than 10% of the tenant’s base rent a year (ABAG, 2016) may be a disincentive for building owners from retrofitting or implementing the 100% passthrough. The length of the passthrough and the maximum percentage increase of 10% of rent a year may be an explanation for why “The ability to pass through 100% of the cost of seismic retrofit work to tenants” was the least frequently chosen answer. Property owners who do not choose to go through with the 100% passthrough have to cover the costs of the retrofit themselves. Finally, “To maintain and protect the housing stock” was the second most frequently chosen answer and seems to be an incentive for property owners to undertake the retrofit.

Question 2. A common factor among those who retrofitted their buildings was that their buildings were rent controlled. However, rent control may complicate paying for the retrofits because the property owners are limited to a particular percentage increase in rent.

Question 3. The majority of those who retrofitted their buildings and were in compliance had an average monthly unit rent between \$2,000 and \$3,000. The relatively high rental rates may be particularly beneficial for those who choose to do the 100% passthrough, as they can increase each tenant's cost no more than 10% and may recoup the costs faster than those who have monthly average unit rental rates of less than \$1,000. In addition, those who have higher monthly average unit rent prices may profit more from their properties than those who have the majority of their tenants paying less in rent. With the current market rate and economy, some property owners may be making little to no money from their buildings, depending on their average unit rent price.

Question 4. Another common factor among those who retrofitted their buildings was that their individual length of ownership was more than five years. Those who have owned rental properties for that long may have bought the properties as long-term investments. Therefore, retrofitting the buildings may protect their investments in the case of a disastrous earthquake.

Question 5. A common factor among the majority of those who retrofitted their properties was that the properties were occupied by all renters. Those who chose to retrofit may have done so to protect the tenants and avoid having placards placed on their buildings warning the tenants and public that the owners or managers are not in compliance with the program. Non-compliance may deter future tenants or encourage current tenants to move out.

Limitations

A limitation to the study was the amount of data collected. The sample size of the survey was only 101 owners and managers. Although there were 2,963 properties that were retrofitted in Tier 2 and Tier 3, only 678 properties out of the entire retrofitted property list had contact information available online. Some property owners and managers whose contact information was available online were unable to be contacted, as some of the published phone numbers were disconnected. These owners and managers were not considered for the survey. A larger sample size is necessary to provide a more accurate representation of program compliance and common factors, which would be easier to achieve if the contact information for each of the properties was easily accessible.

Second, the number of responses for each question was not equal, as some chose to opt out of answering or the answers did not suit them. The response rate for each question varied.

Third, there may be bias in the survey results. Those who are small landlords may have a harder time affording the retrofit costs than big businesses or bigger landlords. Therefore, those small landlords, also known as “mom and pop” landlords, may be more inclined to view their experiences as negative, because they did not think the risk justified the cost. On the other hand, some of those who indicated that they had had positive experiences may have been able to afford the cost of the retrofit and thus were likely to view their experiences more positively than those who could not afford it.

Lastly, participants were not randomly selected. Only those owners and managers for whom the researcher was able to find contact information were contacted. The findings thus cannot be generalized to the entire population of those who retrofitted their buildings in Tier 2 and Tier 3. In addition, Tier 1 and Tier 4 were not included, meaning that the findings only

represent two tiers. This is not enough information to form a true representation of all the retrofitted properties and those that are currently undergoing retrofitting.

CONCLUSION

The San Francisco MSSP was designed to protect the housing stock and increase the strength and resilience of local buildings to ensure the safety of tenants. This research study helped to identify the common factors influencing decisions among property owners and managers who retrofitted their buildings. The findings reveal a number of benefits to the San Francisco MSSP, such as the ability to protect tenants, add accessory dwelling units, and protect owners and managers' investments in their buildings. In retrospect, there are a number of concerns as well, including the difficulty of the 100% passthrough and the high costs of retrofitting. While the program seems to be beneficial for tenants, and to be designed to prevent damage from future earthquakes, the current parameters of and assistance offered by the program are not perceived by property owners to be helpful to them when they are forced to make these repairs.

Areas for Future Research

This research project focuses on the City of San Francisco. Further research could be done to compare San Francisco to Oakland and Berkeley, nearby cities that also have soft story retrofit programs. Another area of study would be to survey those who did not retrofit their buildings in order to gain a deeper understanding of the reasons why they did not comply with the retrofitting program.

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