City of Culver City, Survey of Wood SWOF ("Soft Story") Buildings and Recommendations

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Contents

1.0 Introduction

The Northridge earthquake was one of the greatest economic natural disasters in American history, with losses estimated to exceed $25 billion dollars. When compared to California cities, the City of Culver City has high seismic hazards as defined by the California Building Code (see Figure 1). In addition, the city contains hundreds of buildings that have potential soft/weak story deficiencies which is considered to have one of the Highest Risk of significant damage during a large earthquake. This deficiency often occurs in wood buildings with soft, weak, or open front (SWOF) walls. To minimize its seismic risk, the City of Culver City has chosen to be proactive in developing a program to identify, evaluate, and upgrade SWOF wood buildings (also commonly referred to as “Soft Story”).

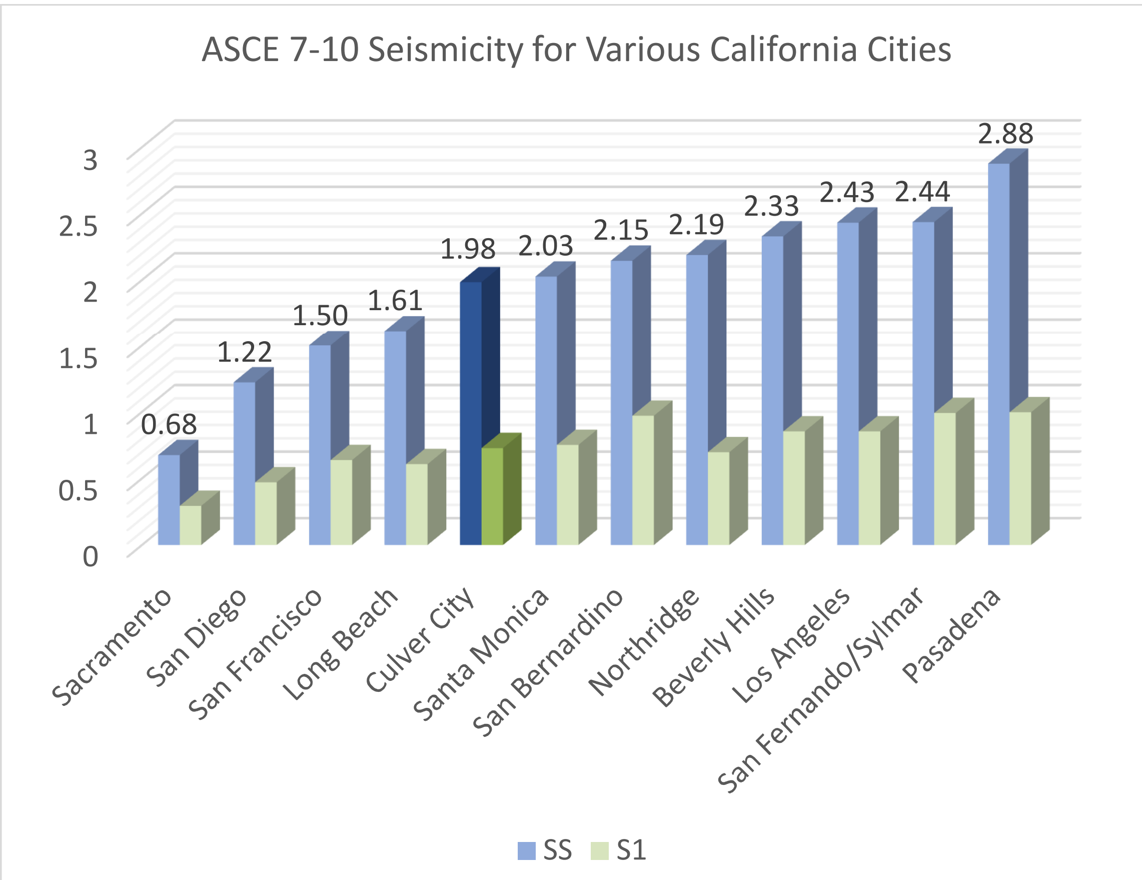


Figure 1 - California Building Code Seismic Hazard Parameters S_1 and S_s Comparison

As part of this effort to mitigate the risk of SWOF wood buildings, the City of Culver City contracted Degenkolb Engineers to identify and create an inventory of potential wood SWOF buildings. This report gives a summary of Degenkolb Engineers' findings along with general recommendations that may be considered in developing a seismic risk mitigation program for these types of structures.

2.0 Wood-frame Construction History

Since the 1800's, wood-frame construction in the United States has evolved to become the most common construction type for houses and low-rise construction. Its popularity is predominantly due to the low cost, ease of construction, availability of material, and design flexibility. Early lateral force resisting systems consisted of straight or diagonal sheathed diaphragms and stucco, plaster, or gypsum shear walls. Unfortunately, these types of systems are brittle and have low structural capacities. As a result, they are no longer used in modern lateral force resisting systems in high seismic regions. Modern construction in high seismic regions currently utilize structural plywood sheathing for both floor/roof diaphragms and shear walls.

Extensive damage to wood structures during the 1925 Santa Barbara and 1933 Long Beach Earthquakes was largely due to unanchored cripple walls. This lead to code updates requiring wood cripple walls to be anchored to the foundation. During the 1960's plywood sheathing replaced straight and diagonally sheathing at the roof and floors. However, it wasn't until the allowable shear capacity of stucco and gypsum board was reduced in the 1988 Uniform Building Code (UBC) by 50%, that plywood would be commonly used for shear walls. Additional requirements following the 1971 San Fernando, 1989 Loma Prieta, and 1994 Northridge earthquakes would lead to more extensive hold-down anchorage and perforated shear wall requirements.

Soft/weak story deficiencies are not unique to wood framed buildings, but are common in structures that contain tuck-under parking. This high-risk seismic deficiency resulted in significant structural failures in the 1971 San Fernando Earthquake, 1989 Loma Prieta Earthquake, and 1994 Northridge Earthquake. The 1976 UBC became the first California building code to recognize structural irregularities in buildings, but it was not until the 1988 UBC that this type of deficiency was prohibited for construction above two stories. Unfortunately, many governing agencies did not adopt these code provisions until the 1990's. Currently, the 2016 California Building Code (CBC) does not permit construction with this type of seismic deficiency in areas with high seismicity.

2.1 Soft, Weak, or Open Front (SWOF)

A soft/weak story is characterized when a given floor has less stiffness and/or strength relative to the floors above it and is commonly the result of large openings or insufficient walls on the lower floors of a building. A lack of stiffness and/or strength for a given floor relative to the one above does not immediately constitute a soft/weak story deficiency; the key criteria for determining a soft/weak deficiency lies in the severity of the difference in stiffness/strength between adjacent floors. The building design standard ASCE 7-10, which is adopted by the 2016 California Building Code, defines a soft-story deficiency when a floor has less than 70% of the stiffness of the floor above or when a floor has less than 80% of the average stiffness of the three floors above. Similarly, a weak-story deficiency is defined when a floor has less than 80% of the strength of the floor above. Soft, weak, or open front walls are a primary cause of soft/weak story deficiencies because of the lack of strength and stiffness in those wall lines. SWOF wall lines typically occur in multi-family/commercial wood buildings with many tuck-under parking stalls or an open layout on the ground floor.

3.0 City Survey

3.1 General Description

Degenkolb Engineers conducted a city-wide building survey between March 27, 2019 and July 30, 2019 using a two-tiered approach which consisted of a computer survey via Google Maps and an on-site visual observation from the public right of way. The intent of the survey was to identify potential wood SWOF buildings in the city based on visual observations. Although many of the nearby cities are only targeting multi-family/commercial buildings with soft, weak, or open fronts, Culver City requested that residential areas also be surveyed to identify structures that have similar characteristics. A mobile surveying application was used to consolidate and streamline the data collection process.

3.2 Survey Methodology

3.2.1 Computer Survey

The first phase of the survey was to set up an electronic web-based database using the information provided by the City's GIS database and the Los Angeles County Assessor's Office. This information was then used to identify potential wood buildings based on zoning designation in order to generate an initial list of wood buildings. All pertinent survey information for each identified wood building (e.g. zoning designation, number of stories, building year, number of units, etc.) was imported into the database from which the initial screening of these buildings was conducted.

Google Maps Street View was used to perform the initial screening of potential wood SWOF buildings, enabling engineers to preliminarily screen wood buildings more efficiently than a pure on-site survey. Potential wood SWOF buildings were documented with the soft story type, number of parking lines and stalls, and flagged to indicate that a follow-up on-site survey was required to confirm the computer survey findings. Wood buildings determined to not be a potential SWOF building were crossed off the survey list. No further action was taken on these buildings.

3.2.2 On-site Survey

Potential wood SWOF buildings identified in the computer survey were confirmed or removed from the final SWOF building list using an on-site survey, whereby a walk or a drive survey was conducted depending on the zoning designation of the building.

Based on Degenkolb Engineer's review of the City's building stock and zoning, the Residential Low, Medium, and High Density multi-family/commercial zones (RLD, RMD, RHD) and the Planned Development zone (PD) were believed to contain the highest quantity of potential wood SWOF buildings and would be most efficiently surveyed with a physical walk from the public right-of-way. The remaining survey areas were expected to contain a much lower density of potential wood SWOF buildings and would be most efficiently surveyed by driving the areas in a vehicle.

Buildings that were confirmed as potential wood SWOF building via the on-site survey were incorporated into the final SWOF building list. Each building was assigned a potential SWOF configuration "type". The types would allow the City to better understand their characteristics of their wood building stock. Two sets of types where used depending on zoning. The types used in multi-family/commercial zones is the same those currently being used by the City of West Hollywood in their SWOF ordinance. The types used for residential zones are different and were developed by Degenkolb Engineers since they have different characteristics than multi-family/commercial zones. Figures 2 and 3 provide figures showing the different SWOF ("Soft Story") configuration types.

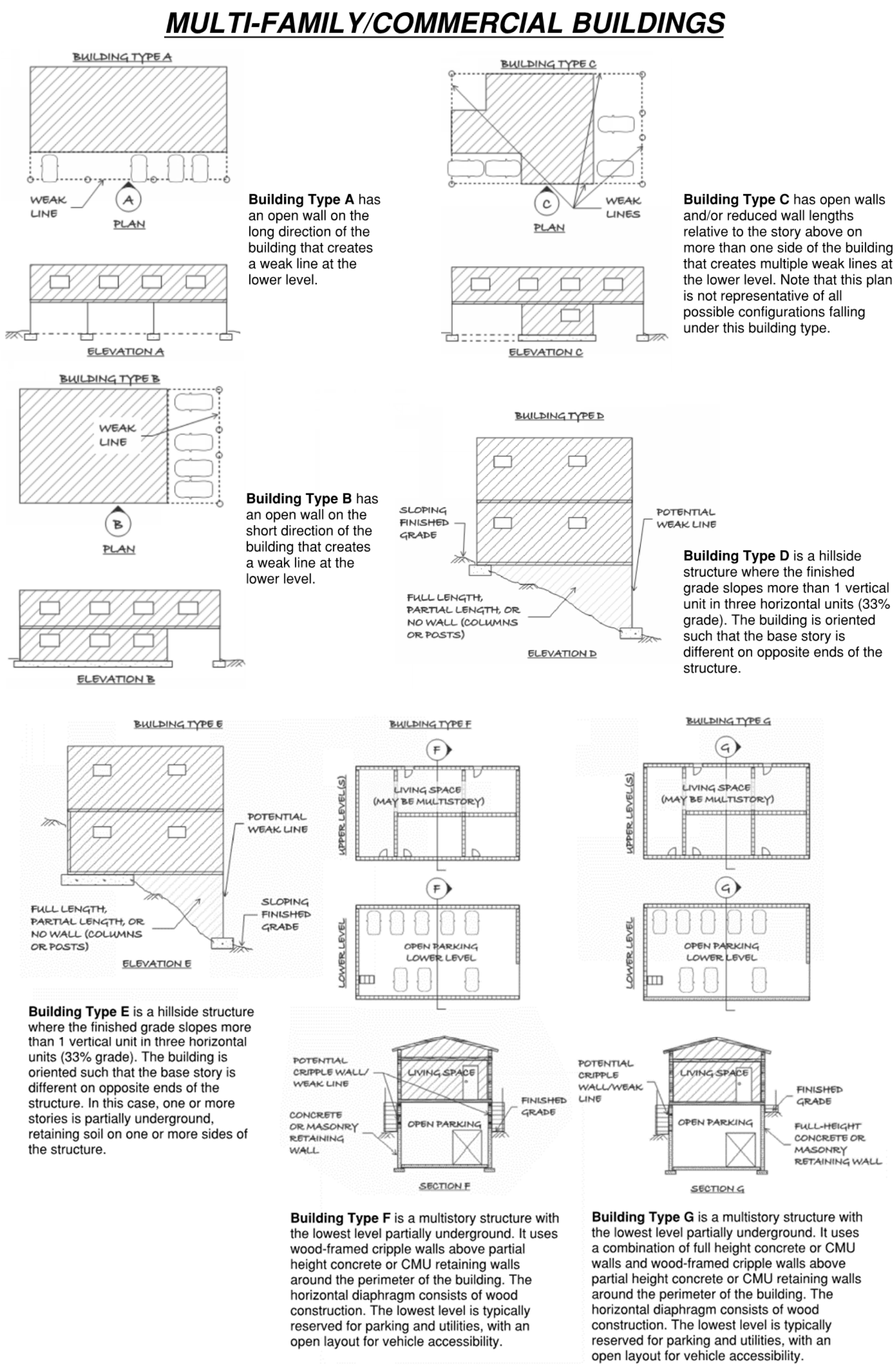


Figure 2 - SWOF Types for Multi-family/Commercial Buildings

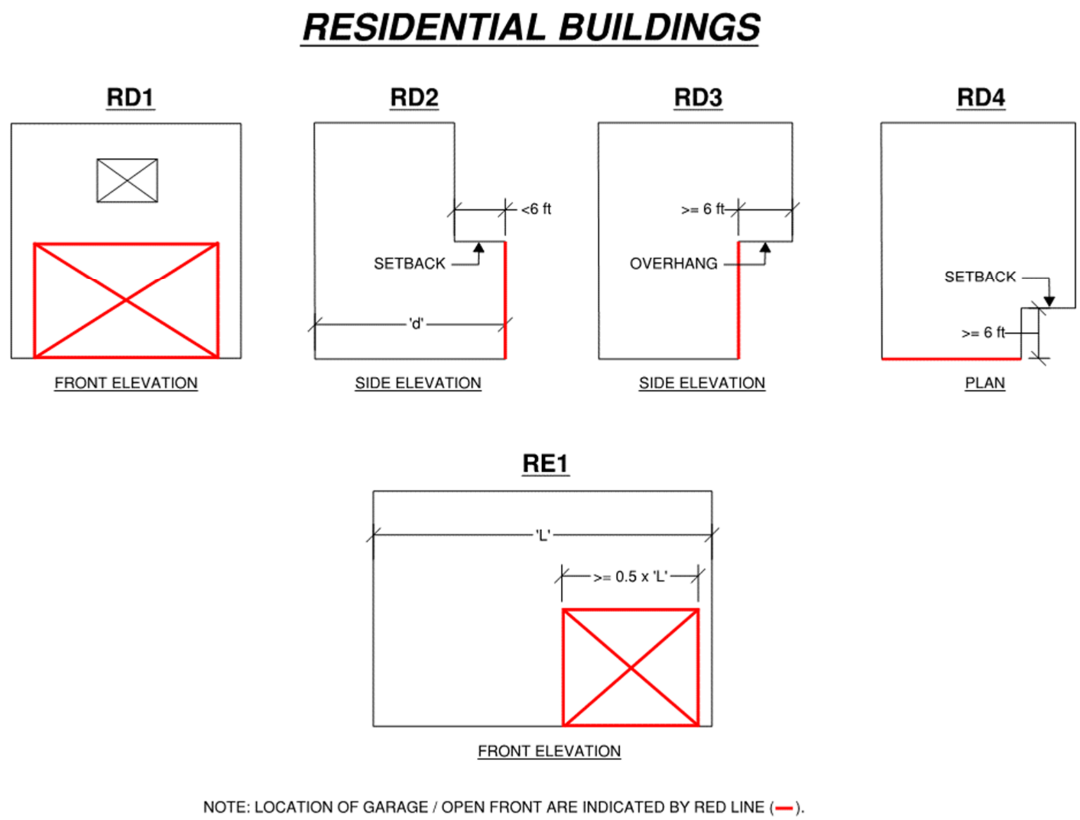


Figure 3 - SWOF Types for Single Family Residential Buildings

3.3 Survey Limitations

The survey conducted by Degenkolb Engineers was limited to the identification of potentially vulnerable wood SWOF buildings. Among other things, Degenkolb Engineers' survey did not include and/or was not the focus of the following buildings and/or items:

- Healthcare facilities under the regulation of the Office of Statewide Health Planning and Development (OSHPD).
- Schools under the regulation of the Division of the State Architect (DSA).

Other potentially seismically vulnerable structural systems that may be present throughout the city, but were outside the scope of Degenkolb Engineers' survey, include:

- Under-reinforced and unreinforced masonry buildings.
- Masonry infill buildings.
- Non-ductile concrete buildings.
- Pre-Northridge steel moment frame buildings.

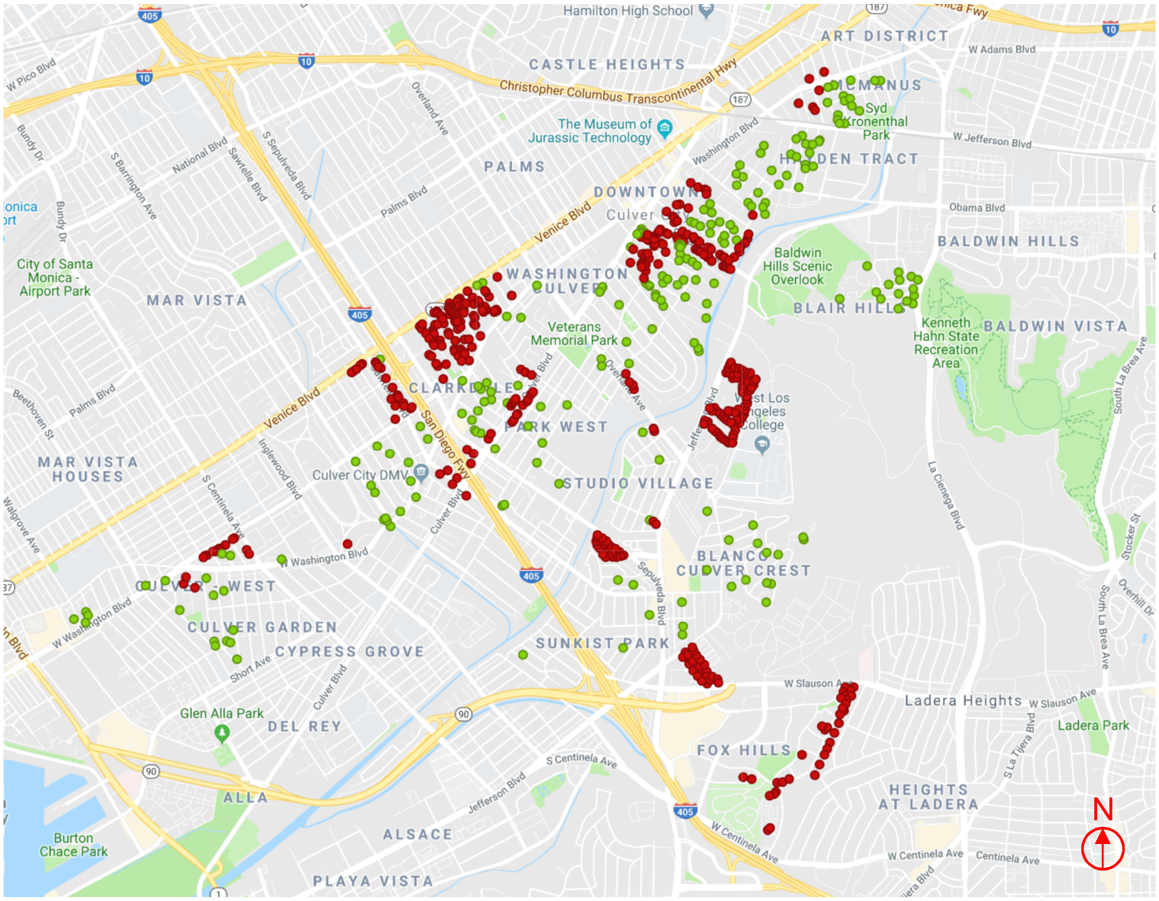
- Wood structures supported by concrete podiums with soft or weak stories.
- Concrete wall buildings (including tilt-up) and masonry wall buildings with flexible diaphragms and out-of-plane anchorage deficiencies.
- Residential wood structures supported by cripple walls.

Finally, it is noted that the survey is considered a rapid visual screening without document research. As such Degenkolb Engineers cannot and does not guarantee that all wood SWOF buildings in the City of Culver City were identified. This is specifically true for residential buildings which do not have as well defined SWOF characteristics as the multi-family/commercial buildings. In addition, the residential buildings are more difficult to survey given the number and access to the actual properties. For this reason, it is important to understand that if the city chooses to do a SWOF ordinance that includes residential buildings, extra verification of the identified properties would need to take place.

3.4 Results

During the survey, Degenkolb Engineers identified 609 wood buildings in both residential and multi-family/commercial zones that are potential SWOF buildings. The areas of the city which have the highest concentration of such buildings were determined to be in the areas zoned for multi-family/commercial or planned development (see Figure 4). Of those buildings identified, 34% are in single family residential (R1, R2, R3) or commercial (CN, CG) zoned areas and 66% are in multi-family/commercial or planned development zoned areas (RLD, RMD, RHD, PD) (see Figure 5).

As part of the survey, the year of construction (or year of record drawings), number of stories, units, and building area were determined based on visual observation, the City's GIS data, and the Los Angeles County Assessor's Office. The highest concentration of buildings was identified to be constructed between 1940 and 1980 (see Figure 6), and of the multi-family/commercial buildings identified, most contain between 3 to 8 units (see Figure 8). The buildings range in height from 2 to 4 stories, with the majority being 2 to 3 stories (see Figure 11). The most common soft story type was Type RD1 for residential single-family buildings and Type A for multi-family/commercial buildings (see Figures 12 to 14).



Key:

🟢= Potential SWOF Building in Single Family and Commercial Zoning (Drive Survey)

🔴= Potential SWOF Building in Multi-Family and Planned Dev. Zoning (Walk Survey)

Figure 4 - City Aerial View of Identified Potential Wood SWOF Buildings. Total No. of Identified Potential Wood SWOF Buildings is 609.

BUILDING TYPE	ZONE	TOTAL		PERCENTAGE
RESIDENTIAL	R1	72	181	30%
	R2	106		
	R3	3		
COMMERCIAL	CG	19	26	4%
	CN	7		
MULTI-FAMILY	PD	66	402	66%
	RHD	85		
	RLD	3		
	RMD	248		

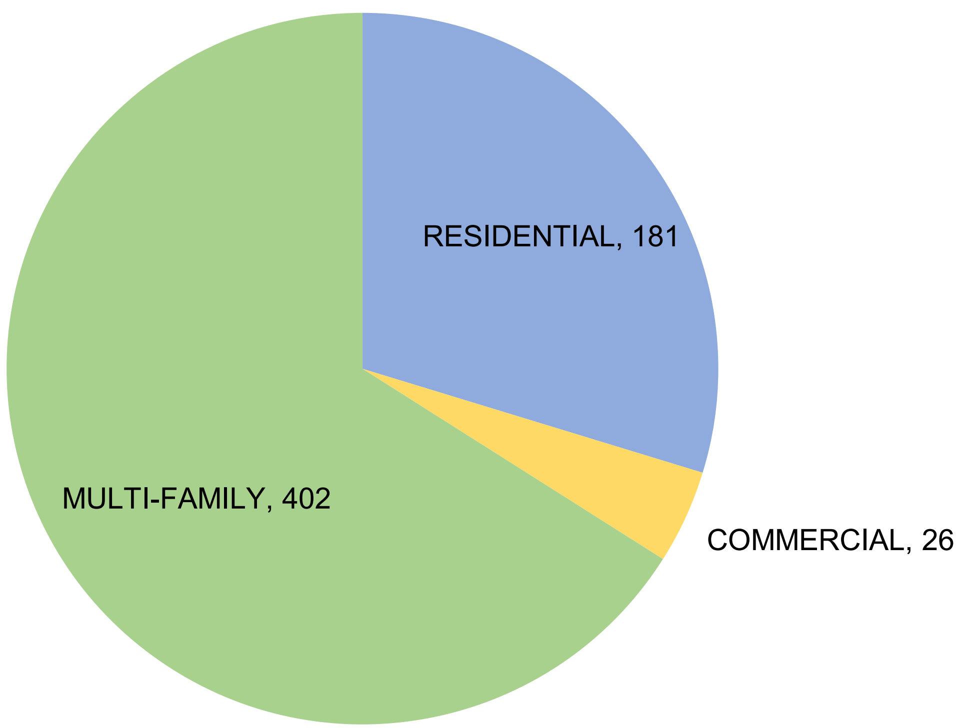
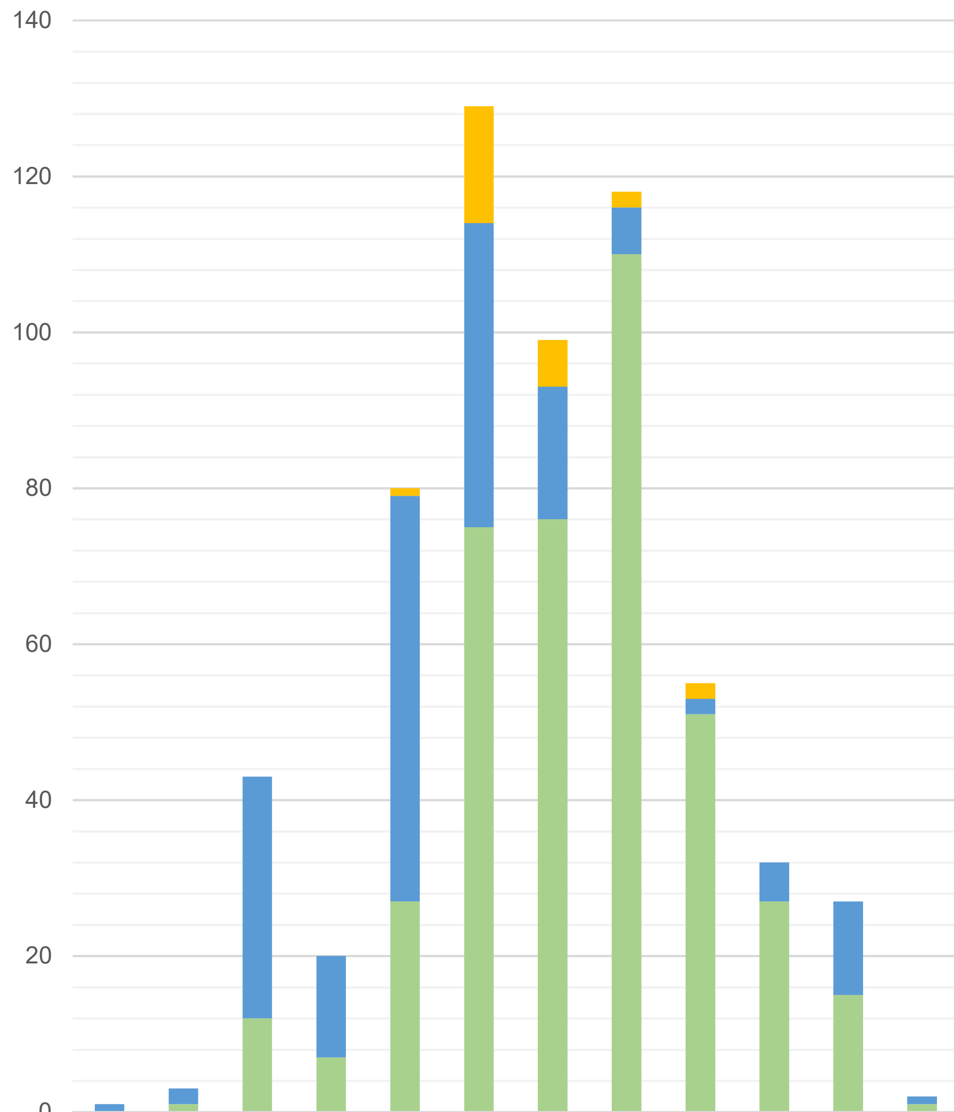


Figure 5 - No. of Potential Wood SWOF Buildings vs. Zoning Designation

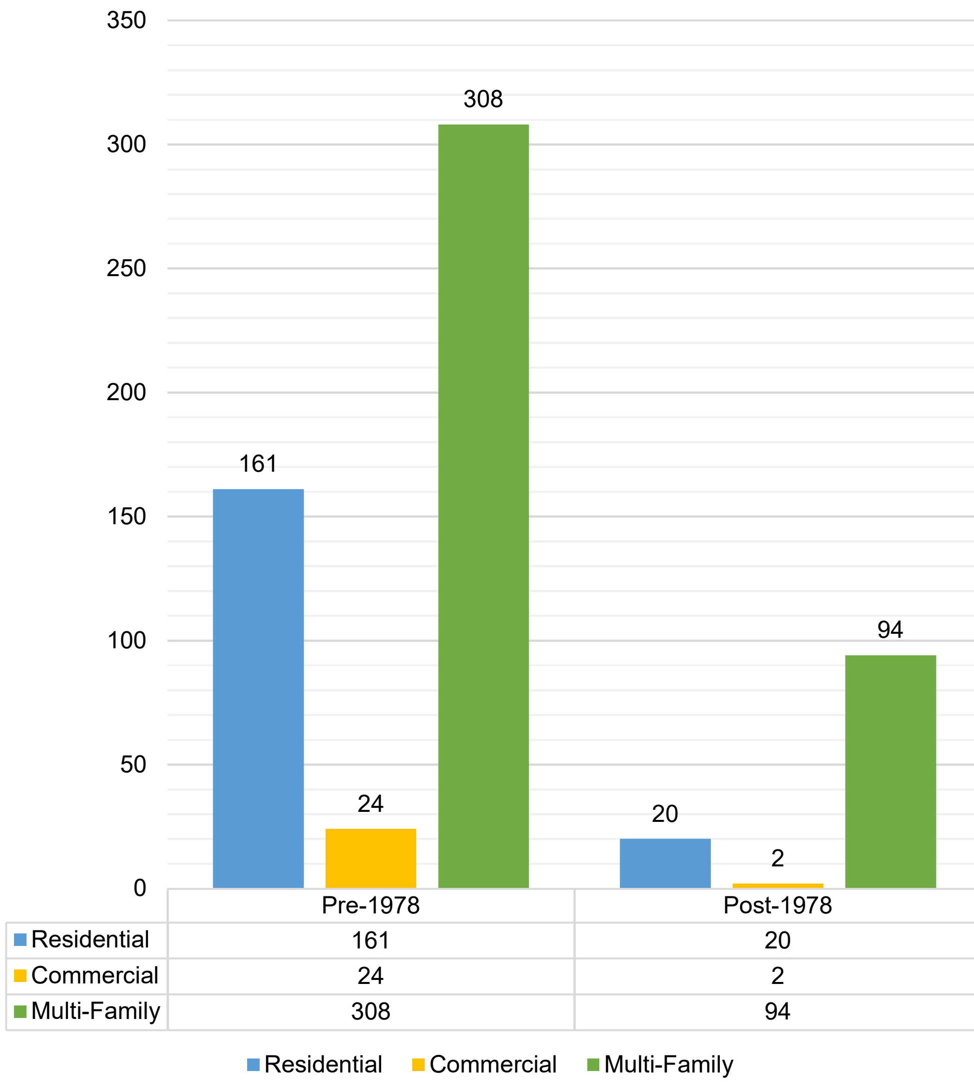


	1900-1909	1910-1919	1920-1929	1930-1939	1940-1949	1950-1959	1960-1969	1970-1979	1980-1989	1990-1999	2000-2009	2010-2019
Commercial	0	0	0	0	1	15	6	2	2	0	0	0
Residential	1	2	31	13	52	39	17	6	2	5	12	1
Multi-family	0	1	12	7	27	75	76	110	51	27	15	1

Decade

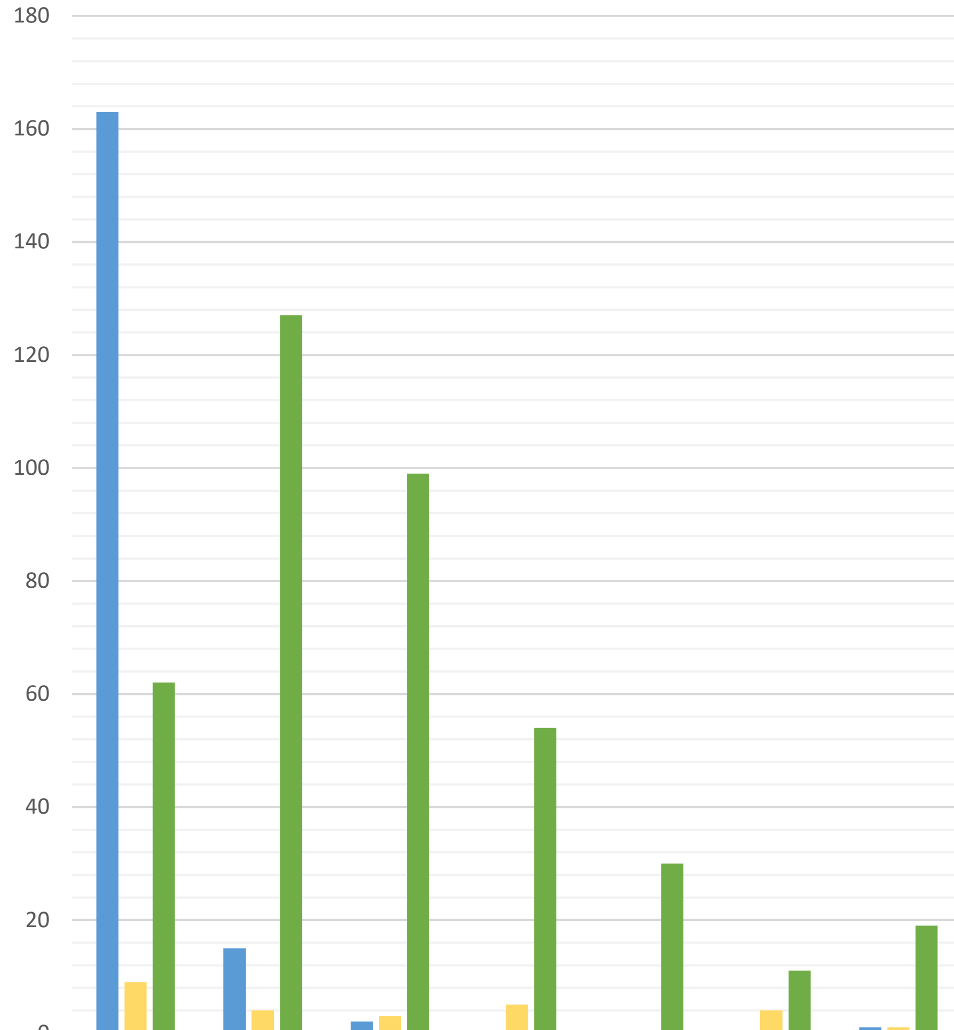
Multi-family Residential Commercial

Figure 6 - Number of Potential Wood SWOF Buildings vs. Year of Construction



	Pre-1978	Post-1978	Total
Residential	161	20	181
Commercial	24	2	26
Multi-Family	308	94	402
Total	493	116	609

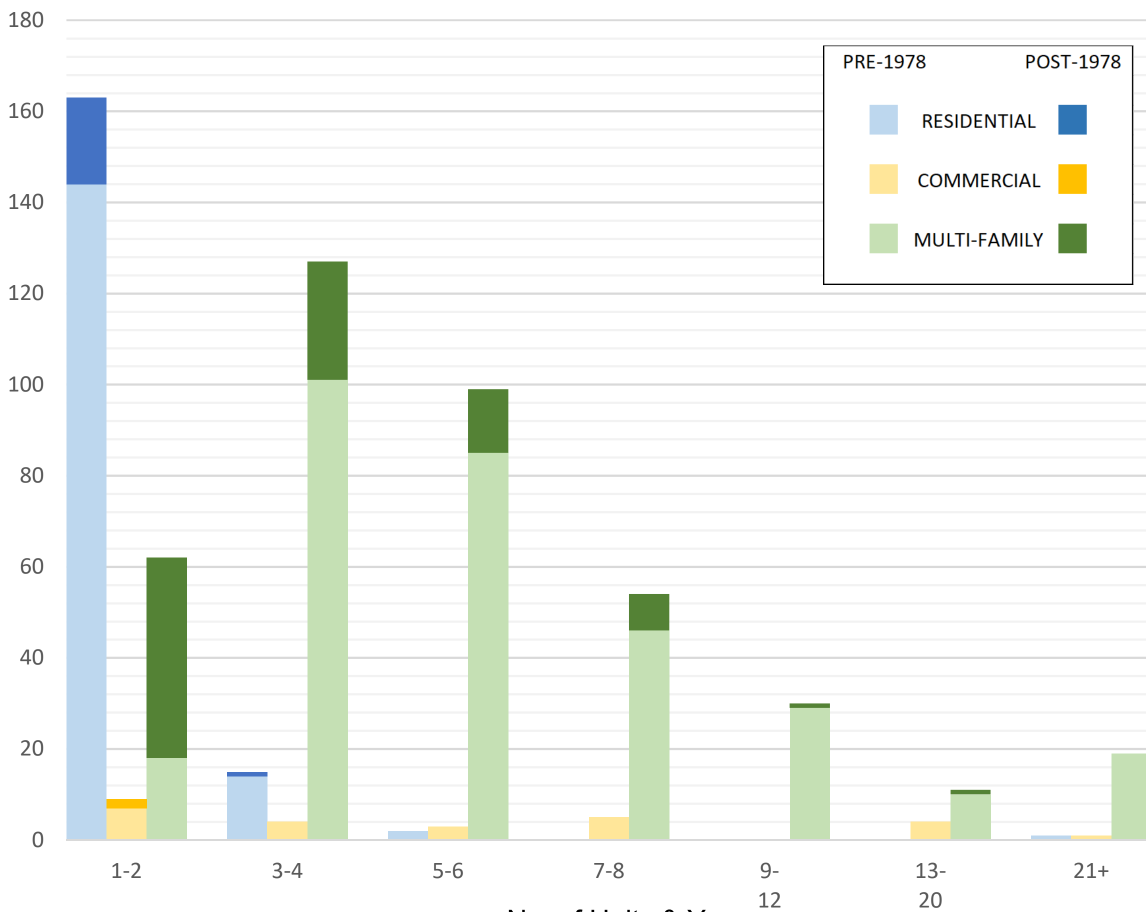
Figure 7 - Number of Potential Wood SWOF Buildings vs. Pre or Post-1978. Note that the Cities of Beverly Hills, Los Angeles, Santa Monica, West Hollywood, and Pasadena have a 1978 cut-off year for their SWOF ordinances



UNITS	1-2	3-4	5-6	7-8	9-12	13-20	21+
RESIDENTIAL	163	15	2	0	0	0	1
COMMERCIAL	9	4	3	5	0	4	1
MULTI-FAMILY	62	127	99	54	30	11	19

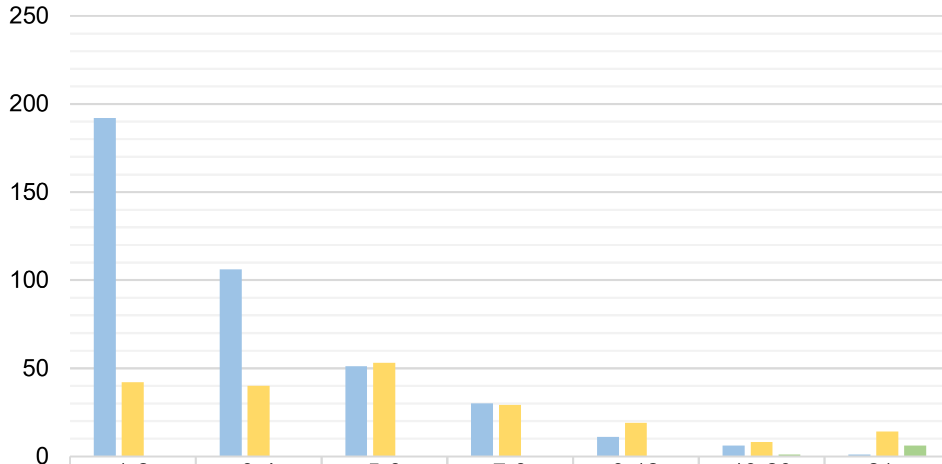
RESIDENTIAL   COMMERCIAL   MULTI-FAMILY

Figure 8 - No. of Potential Wood SWOF Buildings vs. No. of Units



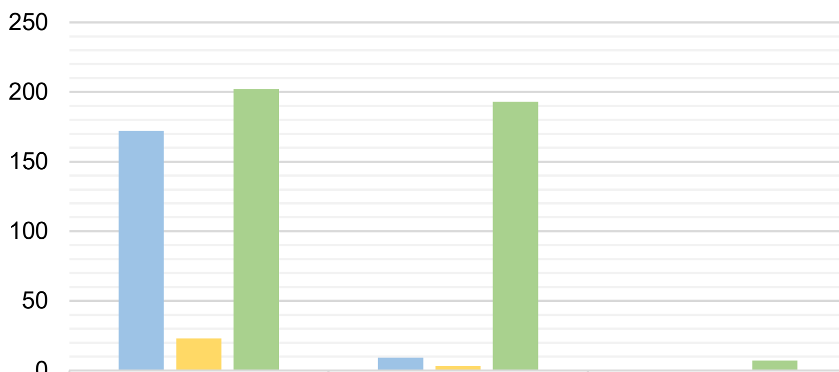
		ZONING						
		Pre-1978			1978 & Later			
		RESID.	COMM.	MULTI-FAMILY	RESID.	COMM.	MULTI-FAMILY	
UNITS	1-2	144	7	18	19	2	44	234
	3-4	14	4	101	1	0	26	146
	5-6	2	3	85	0	0	14	104
	7-8	0	5	46	0	0	8	59
	9-12	0	0	29	0	0	1	30
	13-20	0	4	10	0	0	1	15
	21+	1	1	19	0	0	0	21
		161	24	308	20	2	94	609

Figure 9 - No. of Potential Wood SWOF Buildings vs. No. of Units & Year



	1-2	3-4	5-6	7-8	9-12	13-20	21+
2 STORIES	192	106	51	30	11	6	1
3 STORIES	42	40	53	29	19	8	14
4 STORIES	0	0	0	0	0	1	6

Figure 10 - Number of Potential Wood SWOF Buildings Identified vs. Number of Stories & Units

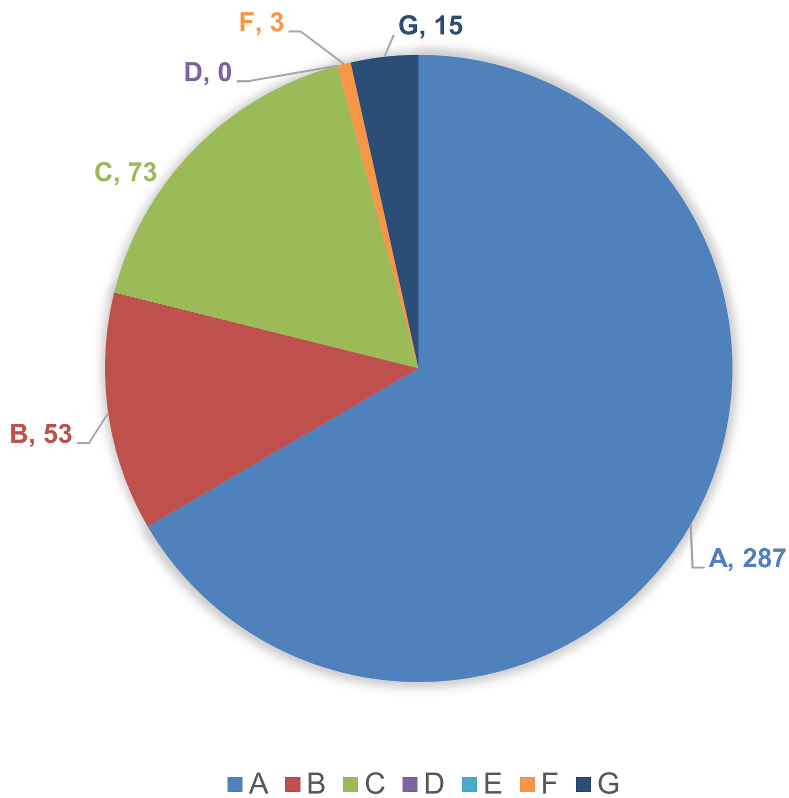


	2	3	4
RESIDENTIAL	172	9	0
COMMERCIAL	23	3	0
MULTI-FAMILY	202	193	7

Figure 11 - Number of Potential Wood SWOF Buildings Identified vs. Number of Stories & Zoning Designation

	ZONE	A	B	C	F	G	RD1	RD2	RD3	RD4	RE1	TOTAL		%
	R1	3	0	1	0	1	55	2	4	1	5	72		
RESID-ENTIAL	R2	2	0	1	0	0	80	2	5	2	14	106	181	30%
	R3	0	0	0	0	0	2	0	0	0	1	3		
COMM-ERCIAL	CG	10	2	3	0	0	3	0	0	0	1	19	26	4%
	CN	4	1	2	0	0	0	0	0	0	0	7		
	PD	66	0	0	0	0	0	0	0	0	0	66		
MULTI-FAMILY	RHD	69	2	11	0	3	0	0	0	0	0	85	402	66%
	RLD	3	0	0	0	0	0	0	0	0	0	3		
	RMD	130	48	55	3	11	1	0	0	0	0	248		

Figure 12 - Number of Potential Wood SWOF Buildings Identified vs. Zoning Designation & Soft Story Type



SS TYPE	#	PERCENTAGE
A	287	67%
B	53	12%
C	73	17%
D	0	0%
E	0	0%
F	3	1%
G	15	3%
TOTAL	431	100%

Most Common:

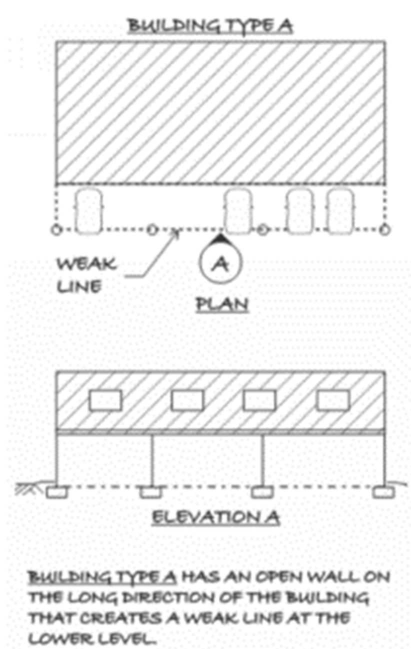
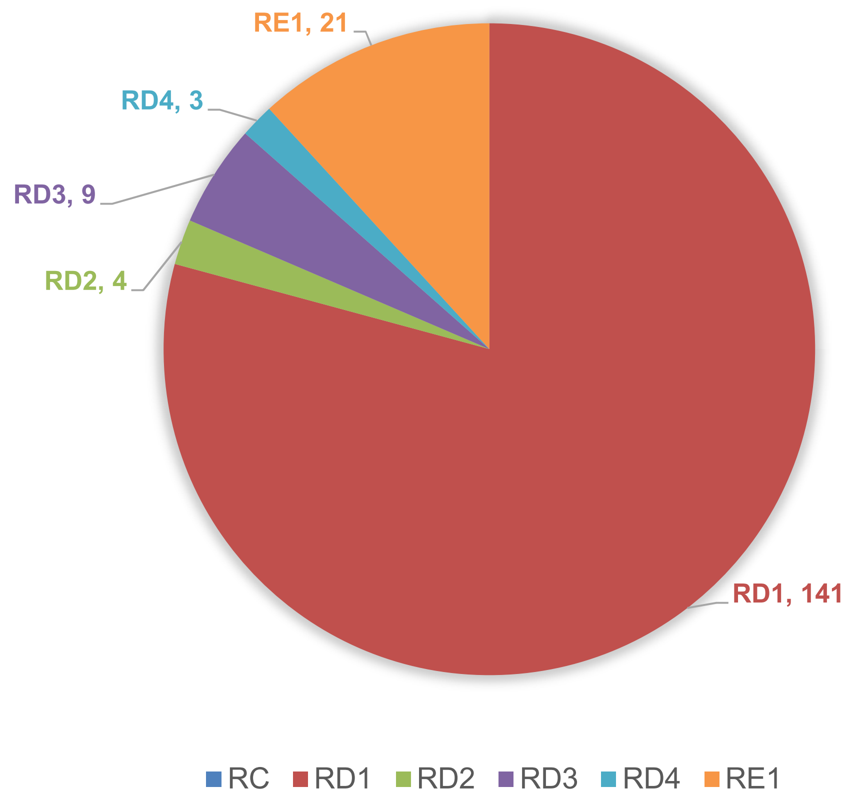


Figure 13 - Number of Potential Wood SWOF Buildings Identified vs. Soft Story Type for Multi-Family/Commercial Buildings



SS TYPE	#	PERCENTAGE
RD1	141	79%
RD2	4	2%
RD3	9	5%
RD4	3	2%
RE1	21	12%
TOTAL	178	100%

Most Common:

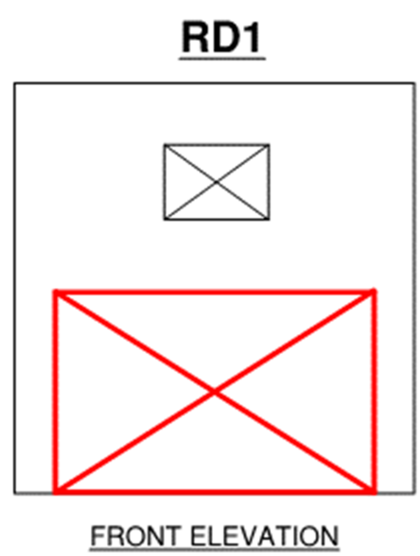


Figure 14 - Number of Potential Wood SWOF Buildings Identified vs. Soft Story Type for Residential Buildings

4.0 Recommendations

The following sections provide various recommendations that should be considered in the development of a seismic risk mitigation program for SWOF buildings. These recommendations are based on Degenkolb Engineers' experience and judgement. In addition, further recommendations can be found within the references listed in Appendix A.

4.1 Mandatory Multi-family/commercial Wood Ordinances in California Cities

When developing a seismic strengthening program, the city is encouraged to examine previous programs implemented by California cities for their technical and policy requirements. The following table provides a brief summary of three well-known soft/weak story programs targeting SWOF wood buildings by different cities in Southern California. Other cities in Southern California have adopted similar ordinances:

	Los Angeles	West Hollywood	Santa Monica
Ordinance Status	Ordinance 183893 approved effective 11/22/15	Ordinance No 17-1004	Ordinance 2537 approved on March 28, 2017
Ordinance Criteria	Buildings submitted for Permit before January 1, 1978	Buildings submitted for Permit before January 1, 1978	Buildings built under code standards enacted before January November 10, 1980
Exceptions	Residential 3 units or less	No Exceptions *	No Exceptions *
Start Date	May 2, 2016 (Priority 1)	April 2018 (Priority 1)	September 25, 2017 (Priority 1)
Prioritization	Priority 1: 16 or more units Priority 2: 3 or more stories Priority 3: 2 or less stories	Priority 1: 16 or more units Priority 2: 3 or more stories Priority 3: 2 or less stories	Priority 1: more than 2 stories Priority 2: 16 or more units Priority 3: 7 to 15 units Priority 4: Less than 7 units
Timeline (starting from receiving letter from City)	[2 years] Submit Proof of previous retrofit or structural retrofit plans [3.5 years] Obtain permit to start construction [7 years] Complete Construction	[1 year] Submit Screening Report [2 years] Submit Retrofit Plans [4 years] Obtain Permit and Commence Construction [5 years] Complete Construction	[2 years] Submit Structural Evaluation Report [3 years] Submit Retrofit Plans and Application for Permit [6 years] Final Approval
Evaluation/Retrofit Criteria	75% ASCE 7, R not less than 3.5 (except cantilever column systems)	75% ASCE 7 and City Seismic Design Guidelines (Under Development)	75% ASCE 7-10 Base Shear, R not less than 3.5 (except cantilever column systems)

*SINGLE FAMILY HOMES NOT TARGETED.

Table 1 - Southern California Soft, Weak, or Open Front (SWOF) Wood Frame Retrofit Ordinance Summary [Zepeda et al. 2017 SEAOC Convention Proceedings]

4.2 Policy Considerations

It is recommended that a seismic risk mitigation program prioritize the evaluation and retrofit of the wood SWOF buildings based on the following factors:

- **Voluntary vs. Mandatory**
  - **Voluntary** – A voluntary risk mitigation program includes the development of technical evaluation and retrofit guidelines but does not mandate them. The advantage of this type of program is that owners can set their own milestones considering their financial situation. In addition, the retrofits that are conducted under a voluntary ordinance can be benchmarked in case the city chooses to make the ordinance mandatory in the future.
  - **Mandatory** – A mandatory risk mitigation program is similar to a voluntary program, except that the city mandates the evaluation and possible retrofit of targeted buildings within a preset timeframe. The advantage of this program is a higher compliance rate. However, because the preset timeframe is uniform regardless of an owner’s financial situation, a mandatory program may not be as accommodating of each owner’s financial hardship, if any, as compared to a voluntary program.
- **Scope**
  - **Single Line Retrofits vs. Story or Full Building Retrofits** – A seismic risk mitigation program has to balance between financial cost and risk mitigation. Older wood buildings can contain many deficiencies aside from their soft, weak, or open front walls. However, the SWOF walls are considered to be one of the most serious deficiencies on these buildings. As such, the city should first consider if they would like to target strengthening the entire building for all deficiencies, the story containing the SWOF wall lines (and possibly other deficiencies), or just the SWOF wall lines themselves. The more scope that is added to the seismic risk mitigation program the more expensive the program becomes. At some point the ordinance may become cost prohibitive. In Northern California, cities implementing multi-family/commercial wood seismic ordinances have determined that targeting full stories is good balance between risk and cost. However, Southern California cities that are implementing similar ordinances have determined that single line retrofits are all that the community is accepting.

  - **Cripple Walls on Multi-Family/Commercial Buildings** - Although not as common as the wood SWOF wall deficiency, there are multi-family/commercial buildings that are supported on cripple walls. These cripple walls are short stud walls that typically sit over concrete or masonry walls at the base of the building. During a seismic event they are known to lose their strength faster than the upper stories thereby forming a weak story. For this reason, the City should consider this type of building when developing their ordinance. It is noted that the City of West Hollywood is the only Southern California city currently targeting that type of structure under their mandatory ordinance.
  - **Multi-Family/Commercial vs. Residential -** Single-family buildings with slab-on-grade construction have historically had low damage in an earthquake. This is likely to due to the number of internal walls and size of buildings compared with multi-family/commercial buildings. Multi-family/commercial buildings with tuck-under parking on the other hand have been severely damaged in past earthquakes. As such all cities in California that have developed mandatory ordinances have only targeted multi-family/commercial buildings. The City should take this in consideration when developing a mandatory ordinance.

- **Prioritization**
  - **Building Height** – All buildings possess a different structural seismic risk depending on their year of construction, number and severity of structural seismic deficiencies, size, height and building material. As such, many seismic risk mitigation programs will prioritize the evaluations/retrofits based on the potential structural damage of the building during a seismic event. In wood SWOF buildings many of the characteristics are similar except for size and height. It is therefore common to prioritize the targeted buildings based on the height of the building since taller buildings have higher risk of severe damage. Once the buildings are ranked in some fashion, the jurisdiction will then have a better sense of how to assign different evaluation/retrofit milestones.
  - **Number of Units** – Similar to building height, it is recommended that as part of the wood SWOF building prioritization system, the number of units also be considered. The goal of the SWOF retrofits is to minimize the amount of property damage, recovery time, and human injury during a seismic event. As such, considerations for the number of units, which translates to building occupants, should be part of the prioritization process.
  - **Number of Lines of Retrofit** – Buildings with multiple SWOF lines (i.e. Type C Buildings) have a higher risk of potential damage and injury compared to building with a single line. This increased risk should be considered as part of the prioritization process.

- **Time Frame**
  - **Financial Considerations** – In the development of the program, it is highly recommended that special consideration be given to the financial costs the building owner may endure due to a seismic risk mitigation program. To help alleviate financial hardship to the owner, some programs have implemented a phased approach in which different milestones are set for performing building evaluations and retrofit. This allows the owner to spread the cost of the retrofit over several years. Most cities in Southern California are allowing between 5 and 7 years to complete the retrofits from official notification to owner.
  - **City Building Department Workload and Staff Availability** – The City's building department will be required to review building screening reports, retrofit, or demolition plans from building owners who own property falling under the scope of the seismic program. It is recommended that the prioritization and timeframes of the seismic program consider the workload and staff availability of the City's building department.

The city is referred to FEMA P-420 Engineering Guidelines for Incremental Seismic Rehabilitation and ASCE 41-13 Appendix B for further discussions in the development of their program.

4.3 City Economic Impacts

In order to better understand the economic impact to the City that a potential ordinance would bring, Degenkolb Engineers evaluated the potential retrofit costs for multi-family/commercial wood SWOF buildings that are publicly available. SWOF retrofit of single-family and/or wood buildings with cripple wall deficiencies were not evaluated because there is insufficient market data for the retrofit of this type of deficiency.

The typical method of retrofit involves strengthening by adding steel moment frame bays to the SWOF lines of the building. Based on market data for wood SWOF retrofits, the construction cost of a typical steel moment frame bay ranges from $25,000 to $35,000. Additionally, plan review and permitting fees are estimated to range between $8,000 to $12,000 per frame.

Based on the survey list of potential wood SWOF buildings (multi-family and commercial only), Degenkolb Engineers estimated the number of required frames for each building based on our judgment and experience to typically range from 1 to 4 frames, with some select buildings requiring up to 8 frames. The typical number of frames per building was estimated to be 2 frames. Assuming an average total cost of $40,000 per frame, it can be estimated that the cost to retrofit most multi-family/commercial buildings will range from $40,000 to $160,000, with most averaging at $80,000. These costs are an approximation and are only intended for the purposes of understanding probable cost when exploring financial retrofit programs by the City. This information is not intended to be used by owners to estimate the retrofit costs for their buildings since these costs are intended to only provide a rough order of magnitude (ROM) estimate. Retrofit costs for individual buildings are best estimated once the retrofit scope is determined after an engineer has evaluated the specific building. There may also be indirect costs, such as business interruption costs, that have not been accounted for in the values provided above. Furthermore, because these ROM estimates were determined based on many assumptions about the probable building stock, it is expected that the actual retrofit costs will vary. It is noted that other cities with SWOF retrofit programs have estimated the probable costs of these retrofits. For example, the City of West Hollywood estimate the retrofit costs for SWOF buildings to be $8 to $17 per square foot and $8,000 to $17,000 per unit. However, these types of cost metrics should be used with caution due to the large variations in square footage and the number of units for these types of buildings.

5.0 Recommended Next Steps

The results presented in this report of the initial survey will be presented to City Council for further direction. If City Council directs City staff to proceed with the development of a seismic ordinance then the following steps are recommended:

- **Initial Draft Ordinance** – Degenkolb Engineers drafts the preliminary ordinance in collaboration with City staff. Lessons learned from Southern California cities implementing similar ordinances are used in the development of the document.
- **Advisory Group Meetings** – Advisory group meetings are conducted to allow a small, selected number of stakeholders to provide feedback on policy questions such as scope, prioritization, and timeframe. Participants for these meetings include but are not limited to financial experts, architects, engineers, building owners, renters and owners' representatives.
- **Technical Committee Meetings** – Degenkolb Engineers arranges meetings with the Structural Engineering Association of Southern California (SEAOSC) committee to discuss the technical aspect of the ordinance and to gather their feedback.
- **Community Outreach Meetings** – Community outreach meetings are vital to the Public's adoption and acceptance of a proposed seismic program by considering the Public's opinion prior to the finalization of the ordinance. Individuals who may be impacted by the proposed seismic program, e.g. building tenants and owners, will be able to voice their concerns at community outreach meetings.
- **Finalize Draft Ordinance** – After taking feedback from all of the meetings into consideration, the proposed seismic ordinance is revised, and a final draft ordinance is produced.
- **City Council Approval** – The final draft ordinance is presented to City Council and then signed by City Council.
- **Implementation Documents** – After approval of the ordinance, several documents are produced to assist in the implementation of the ordinance. These often include the following:
    - **Technical Documents:** A screener form will be developed to assist engineers, who are employed by building owners, in evaluating their building for SWOF deficiencies. The screener form is written in a way that allows evaluations to be conducted in a standardized manner that is easily reviewed by the City's building department. Technical guidelines will also be developed for buildings that are confirmed to have a SWOF deficiency. These technical guidelines assist the engineer in designing a SWOF retrofit that meets the requirements of the seismic program. Degenkolb Engineers will assist in the development of these documents.

- **Non-technical Documents:** A series of documents that will be used by the City to assist owners in guiding them through the process will be developed by City staff. This will include but are not limited to notification letters, brochures, website updates etc.

Appendix A: Current Retrofit Codes, Standards and Guidelines

- **FEMA P-420 Engineering Guidelines for Incremental Seismic Rehabilitation**
  - Federal Emergency Management Agency (FEMA) P-420 is a technical resource which includes discussions on several topics including building maintenance, capital improvement, and decision-making as a basis for communicating with decision-makers on seismic rehabilitation opportunities.
- **USRC 5 Star Rating System**
  - The US Resiliency Council’s 5 Star Rating System, also known as the Certification of Resilient Engineering (CoRE) Rating, is a rating system which assesses and defines a building’s resiliency in a major seismic event by evaluating three main criteria: safety, reparability and functionality. Buildings with a high degree of safety, reparability and functionality post-event are awarded higher ratings.
- **FEMA 154-155:** Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook. Second Edition
  - Federal Emergency Management Agency (FEMA) 154-155 describes and defines the Rapid Visual Screening (RVS) procedure which can be used by trained personnel to identify potentially hazardous buildings before an earthquake. The RVS procedure comprises a method and several forms that help users quickly identify, inventory, and rank such buildings according to their expected safety and usability during and after earthquakes.
- **FEMA HAZUS**
  - Federal Emergency Management Agency (FEMA) HAZUS is a nationally applicable standardized methodology developed by FEMA that contains models for estimating potential losses from earthquakes, floods and hurricanes. HAZUS is used for mitigation and recovery as well as preparedness and response.
- **CBC 2016**
  - The 2016 California Building Standards Code (CBC) is the latest edition of the standard which defines the minimum standards for building construction in the state of California.

- **ASCE 41-13**
  - American Society of Civil Engineers (ASCE) 41-13 is the latest edition of the standard which describes methods and procedures to evaluate and retrofit existing buildings to withstand the effects of earthquakes. It combines the evaluation and retrofit processes and puts forth a three-tiered process that marries targeted structural performance with the performance of non-structural elements.
- **IEBC 2015**
  - The International Existing Building Code (IEBC) is developed by the International Code Council (ICC) and provides a standard for the repair, alteration, addition and change of occupancy for existing and historic buildings. The IEBC establishes minimum regulations for existing buildings and is widely adopted and used by jurisdictions internationally.
- **NDS Specification for Wood Construction, 2015 Edition**
  - National Design Specification (NDS) Specification for Wood Construction is a standard for the design of wood structures and is adopted in all model building codes in the U.S. and is used worldwide.
- **FEMA P-807: Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings with Weak First Stories**
  - Federal Emergency Management Agency (FEMA) 351 provides guidelines on the seismic evaluation and retrofit of multi-unit wood buildings with soft or weak first stories.
- **FEMA 156-157: Typical Costs for Seismic Rehabilitation of Existing Buildings. Second Edition**
  - Federal Emergency Management Agency (FEMA) 156-157 provides a methodology to estimate the costs of seismic rehabilitation projects at various locations in the United States.