City of Palo Alto (ID # 7095)

City Council Staff Report

Report Type: Informational Report Meeting Date: 4/17/2017

Summary Title: Palo Alto Seismic Risk Assessment Study Results

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From: City Manager

Lead Department: Development Services Department

RECOMMENDATION

This is an Informational Report, no City Council action is required at this time. Staff recommends that the City Council review the Seismic Risk Assessment Study prepared by Rutherford + Chekene, structural engineers. The study includes input from City of Palo Alto's Seismic Risk Management Advisory Group. Once Council is familiar with this study, staff will prepare to return for a study session and direction.

EXECUTIVE SUMMARY

This informational item is intended to give the City Council advance background for an upcoming study session related to a Seismic Risk Assessment Study of vulnerable building construction in Palo Alto. In 2014, following the 6.0 magnitude earthquake in August 2014 in the Napa Valley and the Office of Emergency Service's Threats and Hazard Identification and Risk Assessment Report, the Council directed staff to identify and prioritize buildings that pose a potential seismic hazard in Palo Alto; review 'best practices' used by other communities for addressing retrofit of seismically vulnerable buildings; and review current and pending State legislation addressing these building types.

Rutherford + Chekene was selected to perform a comprehensive assessment of the expected performance of the City's building stock in potential earthquakes, including a community engagement effort to help identify resiliency goals and associated mitigation policies and programs. Specific details about the report can be found in this staff report and attached consultant report. (Attachments B)

In this staff report, staff has summarized the outcome of the Seismic Risk Assessment and the Advisory Group's input on revisions to consider for the City's Building and Zoning Ordinances. Some of the study recommendations have significant policy and cost implications that will require further study and Council review. All of these recommendations are discussed in this staff report and in the detailed technical reports attached. (Attachments B and G)

Next steps following council study session on this matter may include public outreach to educate the community on vulnerable buildings. Staff, with the help of consultants, will review potential incentives for retrofits and policies to minimize displacement of existing uses and tenants. Staff would return to the Council with a recommendation to revise the current seismic mitigation ordinance based on findings and community feedback. To be effective, there will need to be a plan for staffing the program. Finally, during the study session staff will also discuss potential policy implications such as displacement of existing building uses and tenants, incentives for voluntary building retrofits, and the effects these benefits might have on construction.

BACKGROUND

On September 15, 2014, the City Council directed staff to work with the Policy and Services Committee to address the following:

A. Identification and prioritization of buildings that pose a potential hazard in an earthquake, including soft-story buildings and other types of construction
B. Review of "best practices" from other cities regarding prioritization of various seismically vulnerable buildings, including retrofit incentives and requirements
C. Review of current or pending State legislation related to soft-story buildings and other structurally deficient buildings

Two events precipitated the Council's direction: (1) the 6.0 magnitude earthquake on August 24, 2014, in Napa Valley and (2) the City Council's review of the Office of Emergency Service's Threats and Hazard Identification and Risk Assessment report on September 15, 2014, which identified over 130 seismically vulnerable buildings. (Attachment C) <http://www.cityofpaloalto.org/civicax/filebank/documents/43866>

Current Code Provisions, Building Identification and Prioritization

In 1986, the City Council adopted the Seismic Hazards and Identification Program codified at PAMC Section 16.42. (Attachment A) This ordinance established a mandatory evaluation and reporting program and created incentives for property owners primarily in the Downtown area to voluntarily upgrade their structurally deficient buildings. Three categories of buildings were identified, including:

1. Category I Buildings: Buildings constructed of unreinforced masonry (except for those smaller than 1,900 square feet with six (6) or fewer occupants). These buildings are located in the Downtown Commercial area.
2. Category II Buildings: Buildings constructed prior to January 1, 1935, containing one hundred (100) or more occupants.
3. Category III Buildings: Buildings constructed prior to August 1, 1976, containing three hundred (300) or more occupants.

The categories used in 1986 were developed by a citizens' committee, reviewed by staff and the Policy and Services Committee, and adopted by the City Council. These categories were created to record known URM buildings and other potentially structurally deficient buildings with relatively high numbers of occupants.

This program identified 89 buildings and was successful in two significant ways. One hundred percent (100%) of the property owners complied with the ordinance and submitted engineering reports detailing structural deficiencies and recommendations to strengthen structures to alleviate the threat of collapse. Further, approximately seventy-four percent (74%), or sixty-six buildings, were strengthened, demolished, or proposed to be demolished. See (Attachment D) for current status of all inventoried properties.

Part of this success may be attributed to incentives that allowed upfront engineering report costs be applied toward permit fees and the ability for property owners in the Downtown Commercial (CD) district to add up to 2,500 square feet of new floor area, or twenty-five percent (25%) of the existing building area, whichever is greater, to the site without having to provide additional parking. This floor area bonus could be used onsite or transferred to another owner or property in the Downtown Commercial district. Approximately twenty-one (21) property owners took advantage of this incentive.

Despite its successes, twenty-three (23) buildings identified from that original inventory remain vulnerable. Further, there are other building types in the City that were not surveyed prior to adoption of the 1986 ordinance. For example, problems with soft story wood-frame construction were documented following the 1994 Northridge Earthquake, which resulted in changes to construction industry standards a few years later.

In 2003, the Collaborative for Disaster Mitigation at San Jose State University completed an "Inventory of Soft-First Story Multi-Family Dwellings in Santa Clara County." According to the report, the City of Palo Alto had 130 soft story multi-family buildings including 1,263 residential units housing 3,158 occupants.

Other construction types of concern that were not surveyed in 1986 include non-ductile concrete buildings, older steel moment frame buildings, and older concrete tilt-up buildings, in addition to soft story wood-frame construction.

The City's existing ordinance requires annual reporting to the City Council on the status of the program. This reporting appears to have ended in 2004 for unknown reasons. More recently, the City Council adopted an ordinance (Attachment E - update to ORD 5356) modifying the seismic incentive so that parking must now be provided if an owner seeks to add 2,500 square feet or 25% of the total building area in the CD District.

Policy and Services Recommendation and Council Authorization

On December 9, 2014, the Policy and Services Committee of the Palo Alto City Council recommended the City Council authorize a Request for Proposal (RFP) to develop information for use in updating the City's Seismic Hazards Identification Program (Ordinance 3666). See Staff Report 5293 "Discussion of Updating the Seismic Safety Chapter of the Municipal Code for Hazardous Buildings" (Attachment D). The City Council approved the recommendation and an RFP was prepared. A consulting team led by Rutherford + Chekene was selected to:

A. Develop summarize relevant state and local seismic mitigation legislation
B. Obtain detailed information on Palo Alto's existing building stock
C. Develop conceptual retrofits for vulnerable building types
D. Make loss estimates of expected damage to current and retrofitted building
E. Work with a City advisory group to develop policy recommendations for consideration by the Council.

A stakeholder Advisory Group was convened and was an essential element in discussing earthquake risks in Palo Alto's existing building stock prepared by the consultant team and in reviewing policy alternatives. Members included people with a range of relevant expertise and interests, including interested citizens, earthquake risk and engineering experts, local developers and owners, and representatives of various community groups. City departments also participated in the Advisory Group, including Building, Planning, Fire, Office of Emergency Services, and Public Works. See Attachment F for a list of Advisory Group members.

City Policy Implications

Currently, the City is in the process of updating its Comprehensive Plan. In its Goal statements, this document expresses the community's vision for its future. Further, in its policies, the Plan defines the appropriate actions to implement the vision. The Seismic Risk Assessment Study's findings and its guiding conclusions informed by the Seismic Risk Management Advisory Group are integral to several key elements of the Comprehensive Plan: the Safety Element, the Housing Element, and the approach to, and needs for, coordinated Community Emergency Services. Policies being considered in the Comprehensive Plan Safety Element support regular review and update of the City's seismic retrofit regulations.

Although focused on multiple family and commercial structures, the seismic risk assessment identifies both the type of seismically vulnerable structures and the geographic areas in the community that will be most affected by a major earthquake. To gage the impact, the study looked at the cost of retrofitting each type of structure. It also evaluated the community impact of the aftermath of a major earthquake in terms of loss of property and effect on the City's economy.

Palo Alto is currently participating with the other cities in the County in updating the State and Federally mandated five-year update of the Santa Clara County Local Hazard Mitigation

Plan (Santa Clara LHMP) as required by the Federal Disaster Mitigation Act of 2000. This plan is required before Palo Alto can request FEMA assistance following a natural disaster. The Local Hazard Mitigation Plan focuses on community mitigations to fire, flood and earthquake events.

The data in the Seismic Risk Assessment Study will be useful as a tool to inform the Santa Clara LHMP about the City's needs in the event of a major earthquake. The Council's subsequent direction on revising of the City's seismic renovation requirements will be integrated into Palo Alto's mitigations outlined in the Santa Clara LHMP plan.

The Seismic Risk Assessment Study and its implementation have important implications for both City and emergency planning policy. First and foremost, the study provides valuable information for the development of the City's long range planning policy expressed in the Comprehensive Plan in areas of community safety, housing, and coordination of community services, which also includes community education and neighborhood volunteers. It also provides information that can be used to refine the community's vision regarding its residents' wellbeing and improve its preparedness for a major seismic event by addressing risk to loss of life and property associated with vulnerable building types. The information can also improve the community's ability to recover from a major seismic event including displacement of residents and businesses, loss of housing and commercial buildings and community wide economic impacts and recovery.

Other policy implications involve the potential for displacement of existing uses and tenants if building owners need to remove the uses/tenants to upgrade their buildings or if they increase rents to cover the cost of engineering studies and retrofit work, and the how this displacement can be minimized. Also, potential incentives for voluntary building retrofits may need to be considered along with changes to the existing zoning incentives (Transfer of Development Rights program) that grant bonus square footage to buildings that are retrofitted downtown, and the potential impacts/benefits that might result from new incentives or modifications.

SEISMIC RISK ASSESSMENT STUDY

The risk assessment carried out by R+C included a series of task reports. They have been combined into one composite report as Attachment B and include surveys of state and local seismic policies and practices, an inventory of buildings in Palo Alto, a summary of vulnerable building categories, conceptual seismic retrofitting of representative vulnerable buildings, loss estimates for the current condition of the building stock and if buildings are retrofit, a review of past seismic retrofits in Palo Alto from selected City records, and a discussion of additional recommended program features for an improved seismic risk mitigation program.

Table 1 summarizes the outcome of the seismic risk assessment and includes the Advisory Group discussions. The table is organized around eight vulnerable building categories or building types. Categories I, II and III encompass the identified vulnerable buildings for the

Table 1: Summary of Recommended Policy Directions from the Seismic Risk Management Program Advisory Group

Category	Approx. Number	Building Type	Date of Construction	Occupants	Evaluation Report	Voluntary, Triggered, or Mandatory Retrofit[1]	Deadlines for Evaluation Report and Retrofit Construction (years)[2]	Disclosure	Potential Incentives
Current Program (Potential Revision in *Italics*)									
I	10	Un-reinforced masonry	N/A	Over 6 (and over 1,900 sf)	Required	*Mandatory*	Report: Expired Construction: *2-4*	*Website listing and tenant notification*	*Fee waiver, expedited permitting, FAR bonus/ transfer of development rights (TDR)*
II	4	Any	Before 1/1/35	Over 100	Required	Voluntary *or Triggered*	Report: Expired Construction • Voluntary: Not required • *Triggered: At sale or renovation*		
III	9	Any	Before 8/1/76	Over 300	Required	Voluntary *or Triggered*			
Expanded Program									
IV	294	Soft-story wood frame	Before 1977	Any	Required	Triggered or Mandatory	Report: 2-4 Construction • Triggered: At sale or renovation • Mandatory: 4-6	Same as above	Fee waiver, expedited permitting, TDR, parking exemptions, permission to add units
V	99	Tilt-up	Before 1998	Any	Required	Triggered or Mandatory	Report: 2-4 Construction • Triggered: At sale or renovation • Mandatory: 4-6	Same as above	Same as Categories I, II and III
VI	37	Soft-story concrete	Before 1977	Any	Required	Voluntary, Triggered or Mandatory	Report: 2-4 Construction • Voluntary: Not required • Triggered: At sale or renovation • Mandatory: 6-8	Same as above	Same as Categories I, II and III
VII	35	Steel moment frame	Before 1998	Any	Required	Voluntary, Triggered or Mandatory			
VIII	TBD	Other older non-ductile concrete	Before 1977	Any	Not rec. at this time	Not recommended at this time	Report: N/A Construction: NA	N/A	N/A

[1]Voluntary: Retrofit is voluntary.
Triggered: Retrofit is triggered when the building is sold or undergoes substantial renovation.
Mandatory: Retrofit is required per a fixed timeline.

[2]Deadlines provide a potential range. Timelines would vary depending on tiers or priority groupings of different subcategories.

Figure 1: Category IV, Wood-frame Soft Story Building built before 1977 Earthquake Damage

Figure 2: Category I, Unreinforced Masonry Building Earthquake Damage

Figure 3: Category I, Unreinforced Masonry Building Earthquake Damage

Survey of State and Local Seismic Policies

The risk assessment study includes two reports that address (1) a detailed review of the seismic risk management policy context within the State of California including relevant State legislation, and (2) the status of local seismic safety and mitigation programs. Development of the reports included searches of legislative data bases, search and review of published and online reports and materials, phone interviews with community leaders as well as local and State government staff, and development of insights from the consulting team based on their experiences in this arena. The two reports were discussed at Advisory Group meetings and helped inform the development of potential seismic risk management policies relevant to Palo Alto.

State Level Policy Review

The report on State level risk mitigation policies provides review of relevant historic and pending State legislation related to seismic risk mitigation of vulnerable buildings. High level legislative findings from the report include the following:

A. Palo Alto is affected by numerous relevant California existing laws and regulations dating from the 1930s through the present. These laws regulate many aspects of Palo Alto's built environment, including certain classes of building uses such as hospitals, public schools, and essential facilities; setting code minimums for new construction; and mandating land use planning and real estate disclosure measures for natural hazards including earthquakes. Unreinforced masonry (URM) is at present the only structural system type for which the State requires local jurisdictions to have a program.
B. If it so chooses, Palo Alto has wide authority to expand or strengthen its approaches to seismic mitigation. The power to do more about earthquake vulnerabilities is primarily in the hands of the local jurisdictions that have significant discretion in the kinds of policies they can adopt.
C. Palo Alto has many additional actions it can take to make sure it is complying and taking greatest possible advantage of State level regulations and opportunities. In particular, opportunities exist now to align a new seismic program with two ongoing mandated planning efforts the City is already engaged in: Palo Alto's Comprehensive Plan update and the Santa Clara County Local Hazard Mitigation Plan update.

Based on what state laws allow and in some cases recommend policy directions Palo Alto could pursue going forward include the following:

A. Implement measures to increase the effectiveness of its current program, for instance by offering additional or larger incentives or devoting more resources to program visibility and implementation
B. Expand the City's current voluntary seismic mitigation programs to address additional building types, uses, or sizes

C. Add mandatory screening or evaluation measures for one or more vulnerable building types such as soft-story wood frame or concrete buildings
D. Upgrade the City's current voluntary URM program to make retrofitting mandatory
E. Create a program that mandates seismic retrofits for one or more additional (non-URM) vulnerable building types
F. Craft a program that combines any or all of the above measures. Local precedents for all of these types of approaches exist
G. Continue the status quo current program

Local Program Best Practice Assessment
The local program best practices assessment report reviews current practices among local jurisdictions and agencies that require seismic retrofitting. The report summarizes what has been done legislatively and programmatically to increase awareness, assess, and motivate mitigation of seismically vulnerable buildings.

Palo Alto is currently laying a solid foundation for future program development by investing in new inventory and risk information as well as community outreach and internal staff discussions. In doing so, it is joining a group of leading California coastal jurisdictions such as Berkeley, Oakland, San Francisco and Los Angeles that have recently stepped up their earthquake risk reduction efforts. San Leandro and Fremont have also had policies in place for over a decade. While there is much learning and information sharing going on, each jurisdiction has developed their own customized policy package. There is no single best model that Palo Alto can straightforwardly adopt. Existing local approaches differ widely in the following ways:

A. Policy mechanisms used to achieve progress
B. Scope of targeted building types or uses addressed
C. Prioritization for retrofit among vulnerable structures and compliance timeframes
D. Types of incentives offered to property owners
E. Disclosure measures used to increase public awareness

<u>Policy Mechanisms</u>
The policy mechanisms being used by other jurisdictions range from inventory only with no subsequent requirements to mandatory retrofit completion in under five years. In between are more gradual approaches such as voluntary retrofit advocacy, incentives, provisions that make building deficiencies more visible to the public (disclosure measures), and mandatory screening and evaluation requirements. An important policy decision is whether any mandated actions are implemented on a fixed timeline or triggered at sale or at some renovation cost threshold.

Scope of targeted building types and characteristics

The most commonly addressed building type is unreinforced masonry (URM) construction due to state law SB 547, passed in 1986. Over half of URM building programs in the state require mandatory retrofit, often but not always, with a time frame on the order of ten to twenty years. By 2006, seventy percent of all identified URM buildings statewide were either demolished or retrofitted. Retrofit rates on average were three times higher in jurisdictions with mandatory retrofit compared to voluntary programs. Jurisdictions used a wide variety of both financial and policy incentives to assist URM building owners. Some voluntary URM building programs coupled with incentives, including Palo Alto's, have achieved similar rates of success to mandatory programs.

More recent programs have focused on soft-story wood frame multi-family residential buildings, including ten Bay Area jurisdictions and, most recently, Los Angeles as of 2015. Soft-story wood frame building programs range in requirements from notification only to mandatory retrofit. Several jurisdictions have innovatively used intermediate mandatory screening and evaluation phases to further assess risk exposure and determine the final set of buildings that will be affected by retrofit requirements. Soft-story wood frame programs have largely been supported in the local community. Compliance timeframes in soft-story wood frame programs tend to be short, on the order of two to seven years.

A comparatively small number of Southern California jurisdictions have acted to address older concrete buildings, including Los Angeles, Burbank, Santa Monica, and Long Beach. Non-ductile concrete frame and tilt-up concrete structures, in particular, are known to pose serious risks. Programs aimed at older concrete buildings range from voluntary guidelines to mandatory evaluation and full retrofit requirements. Timeframes on mandatory retrofit of older concrete buildings vary greatly, from years to decades. Information about the implementation and outcomes of these few programs is very limited.

Incentives

To complement program compliance requirements, jurisdictions can offer either financial or policy oriented incentives. Financial incentives in increasing order of cost and implementation difficulty include: waivers or reductions of building department fees, pass through of retrofit costs to tenants (in jurisdictions with rent control), property-assessed financing loads, subsidized or special term loans, real estate transfer tax rebates, special district or historic designation tax reductions, tax credits, grants, and general obligation bonds. Program incentives in order of increasing difficulty include exemption from future retrofit requirements, expedited reviews, exemption or relief from standards or non-conforming conditions, condominium conversion assistance, technical assistance for retrofitting, zoning incentives, transfer of development rights, and density or intensity bonus such as a floor area or floor area ratio bonus. Jurisdictions vary widely in the extent and type of incentives offered, and many offer a number of different types of incentives.

Disclosure Measures

Public disclosure provides a powerful mechanism for influencing the opinions and actions of owners, renters, and buyers, particularly in programs without mandatory retrofitting requirements. Officially publicizing a city's concerns about deficiencies of a specific building type could, for instance, change public opinion about the resale or rental value of listed properties, an owner's eligibility for refinancing or future loan terms, or the cost of purchasing property and earthquake insurance.

Jurisdictions have used a variety of techniques to motivate attention to seismic risk concerns.

Disclosure measures include the following:

A. Mandatory disclosure at time of sale: Sellers of property are required to disclose features that could relate to earthquake performance.
B. Recorded notice on deed: Jurisdictions can record on the property title or deed, the fact that the building is subject to additional requirements related to its seismic vulnerability status.
C. Public listing of affected properties: Jurisdictions that operate web sites to describe their programs can feature a full list of property addresses and the compliance status of the property. Generally, owner names are not listed.
D. External signage: California law requires signage on all URM buildings. Similar signage has been required since 2007 on soft-story wood frame buildings in the City of Berkeley and non-complying soft-story wood frame buildings in San Francisco.
E. Tenant notification: Owners are required to present straightforward, standardized information about the listed status of the property.
F. Earthquake performance rating systems: Owners can be either encouraged or required to have their building rated on a standardized scale that classifies expected performance in an earthquake. In 2015, the City of Los Angeles launched a voluntary effort to encourage owners to rate the properties using the US Resiliency Council's rating system and pledged to rate its own public buildings. For more information about the US Resiliency Council, see their website at <http://www.usrc.org/>.

Palo Alto Options

Based on the review of state and other jurisdiction policies, alternative program options for Palo Alto were identified:

1. Status Quo: In this option, the existing ordinance with its mandatory evaluation, voluntary retrofit approach remains in place without changes. Floor area ratio bonuses are (were) available and could continue to be offered.
2. Increase Number of Building Types Regulated, but Retrofit Remains Voluntary: Additional categories of structures are added to the mandatory evaluation requirements beyond those of the current ordinance. These could include any or

all of the building types discussed above, potentially also using additional location, use, or occupancy criteria.

3. Increase Number of Building Types Regulated with Additional Disclosure Measures Incorporated: This option would be similar to Option 2, but with increased use of disclosure measures such as prominently posting the building list on the City website, notifying tenants, requiring signage, and/or recording notice on the property title.
4. Increase Number of Building Types Regulated, Some Building Types Have Voluntary Retrofit and a Few Building Types Have Mandatory Retrofit, with Enforcement by a *Trigger Threshold*: This option builds on Option 3, but retrofitting would be required for some building types at whenever future time a building is sold or undergoes substantial renovation above a set threshold.
5. Increase Number of Building Types Regulated, Retrofits for Some Categories are Voluntary and a Few Categories are Mandatory, with Enforcement by a *Fixed Timeline*: This option would be similar to Option 4, but retrofitting is required according to a fixed timeline. Timelines and enforcement emphasis could vary depending on tiers or priority groupings to motivate prompt action for the most vulnerable or socially important structures.
6. Increase Number of Building Types Regulated, but More Categories are Required to Have Mandatory Retrofits: This alternative is similar to Option 5, but retrofitting would be required for additional categories on a fixed timeline.

Other Program Features and Implementation Factors

By updating its current ordinance, Palo Alto has a variety of opportunities to expand and better link its earthquake mitigation program efforts to other City efforts in support of community resilience goals. For instance, Palo Alto could encourage a building occupancy and resumption program like San Francisco, encourage or fund installation of strong motion instruments, or pursue special programs or requirements for cell phone towers, facades, private schools, and/or post-earthquake shelter facilities. A detailed description of several leading local program models and planning resources for these types of efforts are included in Attachment B.

Building Inventory

Summary of Survey Methodology

One of the first steps in the Seismic Risk Assessment Study was to develop a digital inventory of buildings in Palo Alto that includes all the information necessary to build the exposure model for the loss estimate. Information sources used to develop the inventory included county tax assessor files, City GIS files, a survey done by the Palo Alto Fire Department and San Jose State University of soft-story wood frame buildings, field notes from the building department files of selected buildings when the 1986 ordinance was being developed, Google Earth and Street View visual reviews, and an extensive visual sidewalk survey.

After the sidewalk surveys and additional quality assurance refinements, the study identified a total of 2,632 buildings in the study group for Palo Alto. This included 66 buildings subject to Palo Alto's current seismic mitigation ordinance, because 23 of the original 89 buildings subject to the ordinance have been demolished.

Not all buildings were field surveyed and not all key attributes needed for loss estimation were available for all buildings. For buildings that were not surveyed and were missing information, the missing attributes were developed using statistical comparisons with buildings that were surveyed on a sector- by- sector basis. A multi-step procedure was developed to fill in other missing attributes based on the best available comparative information. As a result, while the information for buildings that were not surveyed may not be fully accurate at the individual building level, the overall data set is seen as sufficiently representative for the type of loss estimates used in the project and relative comparisons made between different building types that are discussed ahead.

Replacement Cost Values for Palo Alto

In addition to the information discussed above, a locally-customized replacement cost had to be established for each building. Standard 2014 *RS Means* Replacement Cost values included in the project loss estimation software (Hazus) used were reviewed as a starting point, but not considered representative for Palo Alto. R+C and Vanir Construction Management prepared adjustments to RS Means values to capture 2016 data and local factors unique to Palo Alto. These were reviewed by a task group of the City's project Advisory Group that included local design professionals and developers familiar with the local cost climate. The group recommended an increase of the values in general and identified target values for selected common occupancies. Based on these recommendations, R+C updated the values and Vanir reviewed them and revised the non-targeted occupancies for estimating consistency. The resulting replacement costs are shown in Table 2, and were used in the loss calculations. It is noted that resulting costs are 1.7-2.6 times the RS Means-based Hazus default values (2014 cost data), and that costs are intended to be representative of averages across the town.

Table 2: Average $/SF replacement building cost by Hazus occupancy class.

Occupancy Class	RS Means 2014 Average Palo Alto Cost[1] [$/SF]	Market Factor for Palo Alto	Escalation Factor from 2014 costs to 2016 costs	Demo & Minimal Sitework (5' around building) [$/SF]	Soft Cost Premium[2]	Average 2016 Palo Alto Cost w/ Soft Costs [$/SF]	Multiplier (Replaced with Soft Costs / RS Means)
Multi Family, duplex	$130.75	40%	10%	$17.50	20%	$263	2.01
Multi Family, triplex/quad	$114.94	40%	10%	$17.50	20%	$233	2.03
Multi Family, 5-9 units	$206.41	40%	10%	$17.50	20%	$402	1.95
Multi Family, 10-19 units	$194.12	40%	10%	$17.50	20%	$380	1.96
Multi Family, 20-49 units	$212.26	40%	10%	$17.50	20%	$413	1.95
Multi Family, 50+ units	$199.90	40%	10%	$17.50	20%	$390	1.95
Temporary Lodging	$217.83	40%	10%	$17.50	20%	$424	1.94
Institutional Dormitory	$234.44	50%	14%	$25.00	20%	$511	2.18
Nursing Homes	$238.07	50%	12%	$25.00	20%	$510	2.14
Retail Trade	$121.66	80%	10%	$17.50	20%	$310	2.55
Wholesale Trade	$118.13	60%	10%	$17.50	20%	$$270	2.29
Personal & Repair Services	$143.47	60%	10%	$17.50	20%	$324	2.26
Professional/Technical/ Business Services	$194.52	65%	12%	$17.50	20%	$452	2.33
Banks	$281.88	40%	12%	$25.00	20%	$560	1.99
Hospitals	$372.59	50%	14%	$35.00	20%	$807	2.16
Medical Office/Clinics	$267.85	20%	10%	$17.50	20%	$445	1.66
Entertainment/Recreation	$248.61	25%	12%	$25.00	20%	$448	1.80
Theaters	$186.45	35%	12%	$25.00	20%	$368	1.98
Parking	$84.59	20%	10%	$17.50	20%	$155	1.83
Heavy	$144.71	25%	10%	$17.50	20%	$260	1.80
Light	$118.13	25%	10%	$17.50	20%	$216	1.83
Food/Drugs/Chemicals	$229.48	30%	12%	$17.50	20%	$422	1.84
Metal/Minerals Processing	$229.48	30%	12%	$17.50	20%	$422	1.84
High Technology	$229.48	40%	14%	$17.50	20%	$461	2.01
Construction	$118.13	30%	10%	$17.50	20%	$224	1.89
Church	$118.13	50%	12%	$25.00	20%	$268	2.27
Agriculture	$199.08	10%	12%	$17.50	20%	$315	1.58
General Services	$152.63	40%	10%	$17.50	35%	$341	2.23
Emergency Response	$259.52	40%	14%	$25.00	35%	$593	2.28
Schools/Libraries	$193.00	40%	12%	$25.00	35%	$442	2.29
Colleges/Universities	$214.91	60%	12%	$25.00	35%	$554	2.58

Notes:

1. RS Means average cost includes RS Means default location factors to adjust national average to Palo Alto of 15% for residential and 11% for commercial.
2. Soft costs include architect and engineer design fees, testing and inspection, utility connection fee, permits, and an allowance for owner change order contingency.
3. Costs are intended to be representative of average in Palo Alto across the town, including downtown areas together with other areas in the city.
4. Costs were previously prepared following a 3/7/2016 discussion with the Palo Alto Seismic Risk Program Advisory Group Technical Advisory Committee. Table includes minor updates based on internal review between

Rutherford + Chekene and Vanir Construction Management to achieve improved relative ratios between different occupancy types.

Number and Distribution of Vulnerable Buildings by Aggregate Size and Value

Table 3 shows how the number and aggregate value of Palo Alto's buildings is distributed by type of structure, using the FEMA Model Building Type classification system for structural system. The table is sorted by aggregate building value. Wood frame buildings make up about 60% of the number of buildings and represent 35% of the total value. About 20% of the buildings are concrete, and they represent over 40% of the total value. Of the remaining 20%, about two-thirds are masonry buildings, and one-third steel. However, the steel buildings represent about twice the value of the masonry buildings.

Table 3: Distribution of number of buildings, building area, and building value by Model Building Type.

Model Building Type	Number of Buildings	Aggregate Square Feet (1,000)	Aggregate Building Value ($M)
Concrete shear wall (C2)	318	9,699	4,082
Concrete tilt-up (PC1)	242	8,054	3,368
Wood frame larger residential (W1A)	331	8,403	3,232
Wood frame commercial/industrial (W2)	307	6,209	2,369
Steel braced frame (S2)	50	3,116	1,391
Wood frame smaller residential (W1)	898	3,821	1,278
Steel moment frame (S1)	75	3,005	1,242
Reinforced masonry, wood floor (RM1)	285	2,806	1,209
Reinforced masonry, concrete floor (RM2)	30	574	211
Steel light metal frame (S3)	41	533	177
Precast concrete frame (PC2)	5	334	125
Concrete moment frame (C1)	18	325	117
Steel frame with concrete shear walls (S4)	13	162	72
Unreinforced masonry bearing wall (URM)	9	274	15
Concrete with masonry infill (C3)	8	26	8
Steel frame with masonry infill (S5)	2	6	3
Totals	**2,632**	**47,346**	**18,899**

The study group of buildings can be further divided into age groups separated by significant milestones in building code implementation. The following age groups were selected: pre-1927, 1927-1961, 1962-1976, 1977-1997, and 1998 to present. The milestones reflected include the first earthquake code in Palo Alto in 1926, adoption of the 1961 Uniform Building Code (UBC) and associated more stringent design requirements, code changes in the 1976 UBC following the 1971 San Fernando Earthquake, and code changes in the 1998 UBC following the 1994 Northridge Earthquake. Figure 1 shows a histogram of the year built of the buildings in the study group.

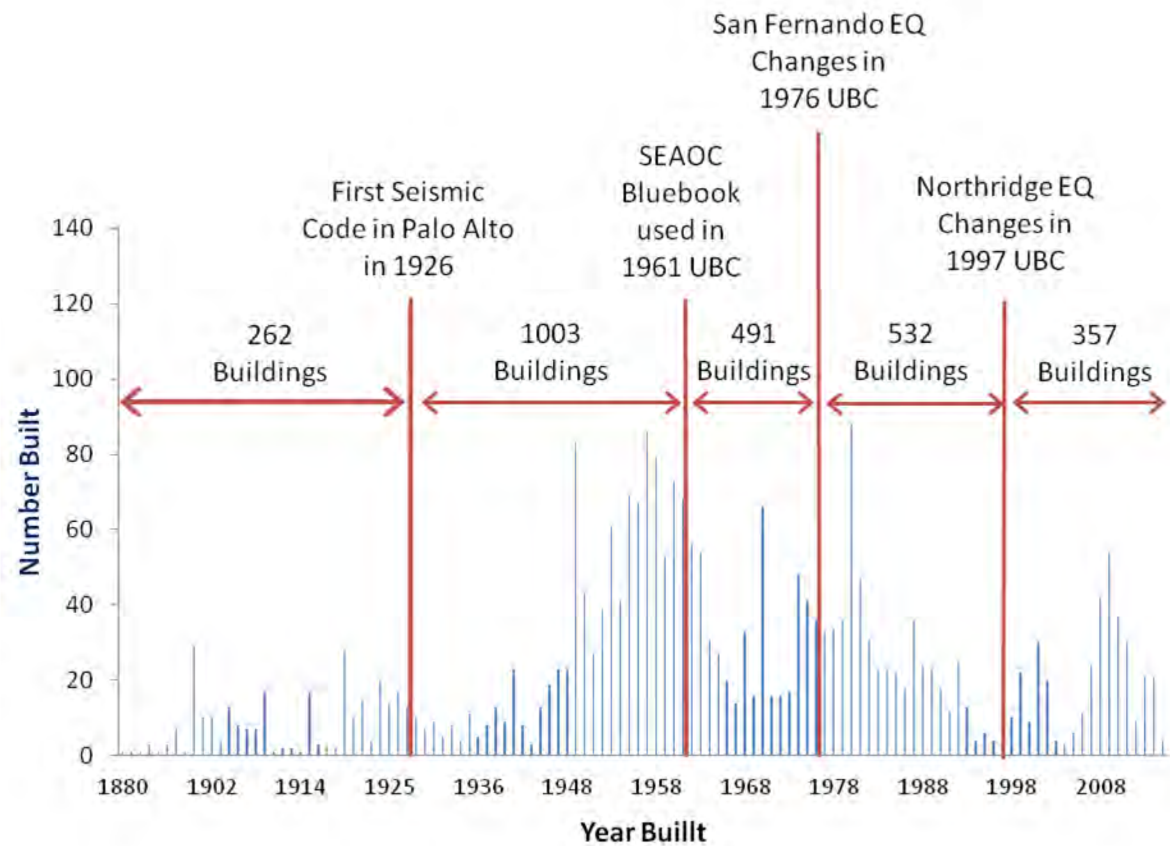

Figure 1: Distribution of year built of buildings in study group with significant changes in the building design practice.

Vulnerable Building Categories

One of the important tasks in the risk assessment study was to identify potentially vulnerable building categories specific to Palo Alto. Using the building inventory that was developed early in the project, R+C identified potentially vulnerable structural system types based on insights from past earthquake events, milestone improvements in seismic code requirements made in Palo Alto, rankings in prominent seismic risk assessment tools such as the 2015 edition of FEMA P-154 *Rapid Visual Screening of Buildings for Potential Seismic Hazards,* results from past seismic risk assessment studies in California communities, and engineering judgment. The building categories were then evaluated in analytical loss estimate studies, described ahead, which helped to narrow in on the most important categories for Palo Alto. Key building vulnerability metrics include the risk of deaths and injuries, the cost of damage, and the extent of downtime or loss of use. Buildings in the identified vulnerable building categories tend to perform poorly with respect to all three of these metrics though the relative degree of vulnerability to each factor varies.

Community Resilience

Community resilience is improved if residents have homes that remain usable after an earthquake and if businesses can still operate. From a program perspective, the consultant team and advisory group believe that the greatest reduction in losses and the largest benefit to community resilience will come from seismically retrofitting building types known to be both potentially hazardous and present in significant numbers in Palo Alto. .

In addition to the three categories already in Palo Alto's seismic hazard identification ordinance (Categories I, II, and III below), five additional categories of vulnerable building types were identified. All five categories meet the criteria of being potentially hazardous and having a significant presence in Palo Alto. The eight categories and the approximate number of buildings included in each category are as follows:

1. Category I: Constructed of unreinforced masonry, except for those small than 1,900 square feet with six or few occupants (10 remaining buildings in Palo Alto)
2. Category II: Constructed prior to January 1, 1935 containing 100 or more occupants (4 remaining buildings)
3. Category III: Constructed prior to August 1, 1976 containing 300 or more occupants (9 remaining buildings)
4. Category IV: Pre-1977 soft-story wood frame (294 buildings)
5. Category V: Pre-1998 tilt-up concrete (99 buildings)
6. Category VI: Pre-1977 concrete soft-story (37 buildings)
7. Category VII: Pre-1998 steel moment frame (35 buildings)
8. Category VIII: Other pre-1977 concrete construction (170 buildings)

The technical assessment confirms that the potential reduction in losses from retrofitting is significant for these categories.

Conceptual Seismic Retrofitting of Representative Vulnerable Buildings

Retrofit was considered for all buildings that have not already been retrofitted and were either constructed before 1961 or between 1962 and the "benchmark" year with a soft story. A "benchmark" year is when the code requirements for that building type became similar to those currently in place. Consistent with typical practice, the performance of the retrofitted buildings in an earthquake is assumed to be less than that of newly constructed buildings.

For estimating the cost of retrofit for the improved buildings, R+C developed conceptual designs for Model Building Types that represent a significant number and value of Palo Alto's building stock, as well as a significant loss and loss reduction after retrofit. This process identified wood frame (W1, W1A, W2), steel moment frame (S1), concrete shear wall (C2), concrete tilt-up (PC1), and reinforced masonry (RM1) and unreinforced masonry (URM) as appropriate candidates. For each Model Building Type, the age, square footage and number of stories were reviewed to identify a "prototype" building. In cases where the prototype building was not representative of more than two-thirds of the total number of buildings, multiple prototypes were considered.

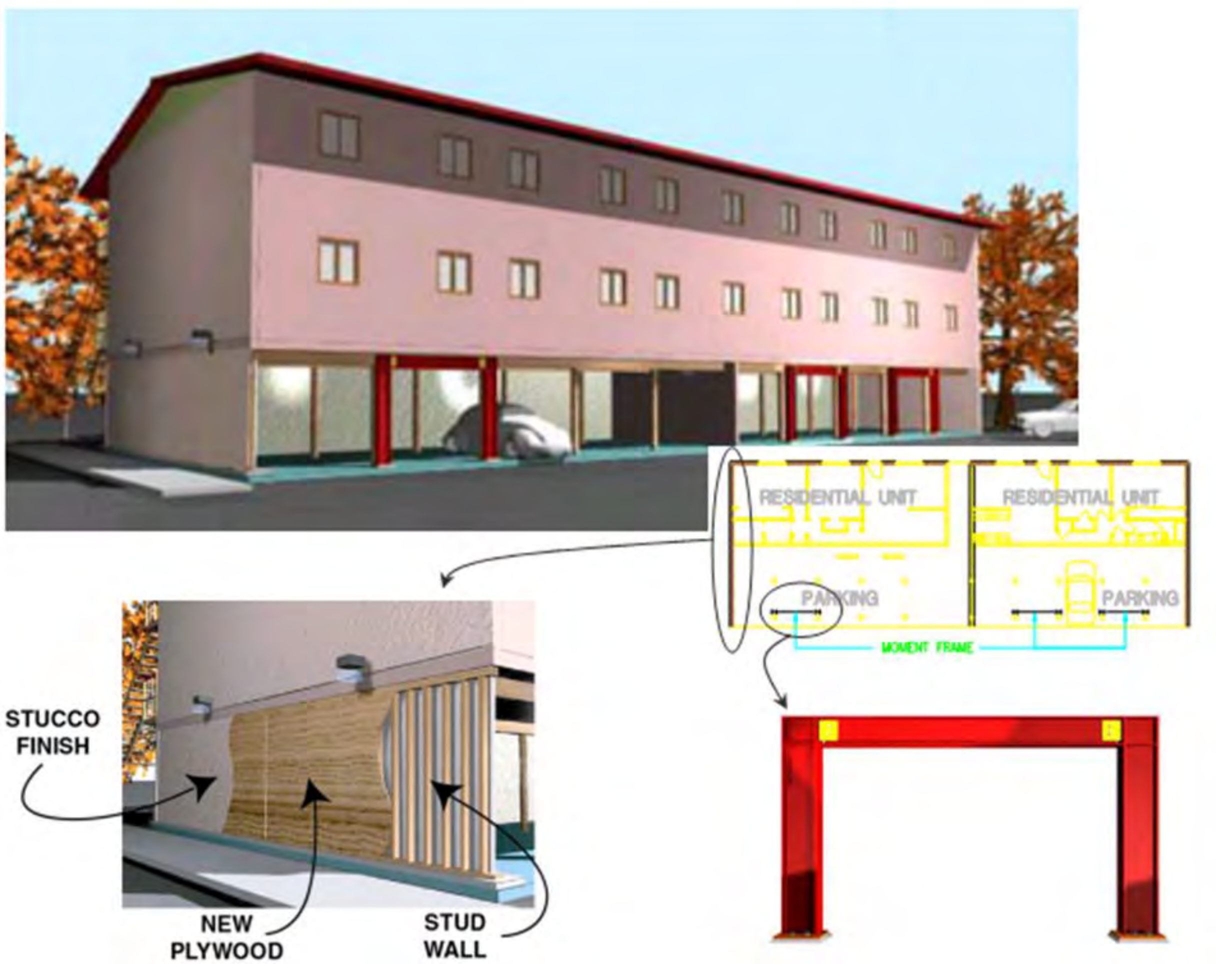

Figure 2: Retrofit scheme for Large Multi-family Soft-Story Wood Frame Building.

An example of a conceptual retrofit for the W1A prototype building is shown in Figure 2 from a 2000 brochure by R+C for the City of San Jose entitled "Practical Solutions for Improving the Seismic Performance of Buildings with Tuck-under Parking." The retrofit elements were keyed to representative details in 2006 FEMA 547 *Techniques for the Seismic*

Rehabilitation of Existing Buildings, and a written description of collateral impacts was developed as well to provide sufficient detail to allow a rough order of magnitude cost estimate to be prepared.

The cost estimators of Vanir Construction Management used the conceptual designs to estimate a range of probable cost to implement the retrofits. The retrofit costs for each prototype building are shown in Table 4. These costs include hard costs, which are the costs the owner pays the contractor, plus a design contingency since these are conceptual retrofits. The estimate further includes soft costs, representing architect and engineer design fees, testing and inspection costs, permit fees, and an owner change order contingency.

Considered costs do not include hazardous material abatement, costs associated with performing the work while occupants are using the building, triggered accessibility upgrades, cost premiums associated with retrofit of a historic building, tenant relocation or business interruption during construction, project management, renovation, financing, repair of existing conditions, and legal fees. These costs are more variable and project and site specific, and are typically not included in loss estimates for this type of study.

The retrofit costs were extrapolated to Model Building Types not represented by a prototype retrofit as shown in the fifth column of Table 4.

Additional information the conceptual retrofits and their estimate cost is contained in Attachment B.

Table 4: Conceptual retrofit cost.

Retrofit Prototype	Model Building Type	Stories	Square Feet	Used for Model Building Types	Used for Square Feet	Average Retrofit Cost ($/SF)
1	Wood frame smaller residential (W1)	2	5,320	W1	All	12
2	Wood frame larger residential (W1A)	2	9,500	W1A	< 15,000	11
3	Wood frame larger residential (W1A)	3	30,000	W1A	≥ 15,000	6
4	Wood frame commercial/industrial (W2)	2	10,000	W2	All	14
5	Steel moment frame (S1)	2	43,900	S1, S2, S3	All	10
6	Concrete shear wall (C2)	1	5,000	C1, C2, S4, PC2	< 10,000	50
7	Concrete shear wall (C2)	2	17,280	C1, C2, S4, PC2	≥ 10,000	40
8	Concrete tilt-up (PC1)	1	18,435	PC1	< 25,000	29
9	Concrete tilt-up (PC1)	2	38,400	PC1	≥ 25,000	21
10	Reinforced masonry, wood floor (RM1)	1	2,750	RM1, RM2	< 5,000	74
11	Reinforced masonry, wood floor (RM1)	2	8,150	RM1, RM2	≥ 5,000	46
12	Unreinforced masonry bearing wall (URM)	1	5,000	URM, S5, C3	All	110

Loss Estimate Findings for Current Condition

Hazus is a geographic information system (GIS) based, standardized, nationally applicable multi-hazard loss estimation methodology and software tool. It is used by local, state, and federal government officials for preparedness, emergency response, and mitigation planning. The Advanced Engineering Building Module from the latest Hazus version 3.1 was used to conduct the loss estimates in the study so that individual buildings could be analyzed using the specific inventory data collected for Palo Alto.

Analyses were conducted for two specific earthquake scenarios developed by the United States Geological Survey (USGS): a major M7.9 San Andreas Fault event, and a strong M6.7 San Andreas Fault event.

Contour plots for the short period spectral acceleration for the two M6.7 and M7.9 scenarios are shown in Figure 3. Spectral acceleration is a measure of the building response to shaking at the site.

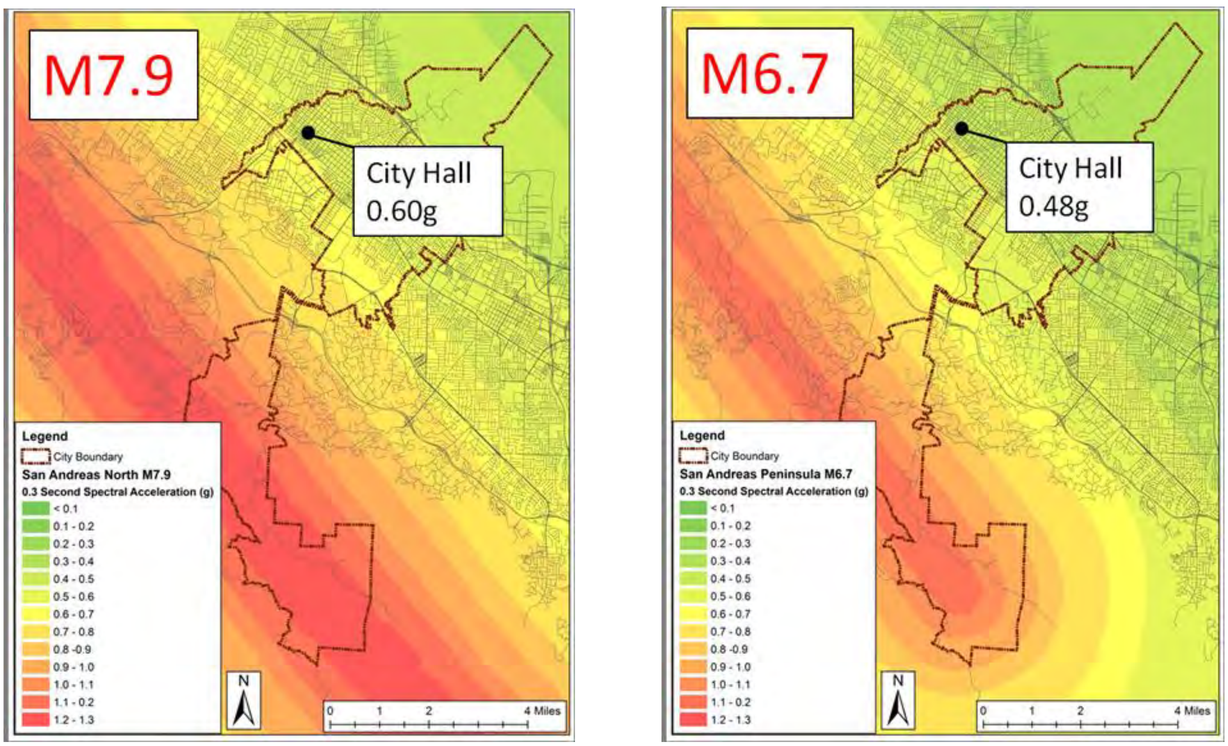

Figure 2: Predicted short period spectral acceleration in vicinity of Palo Alto (city boundary shown) for two selected San Andreas Fault scenarios.

Estimated Losses for Buildings in Their Current Condition

Table 5 summarizes the total loss calculated by Hazus for the as-is condition for the two earthquake scenarios. The results show that the estimated losses to Palo Alto buildings and contents in a M6.7 scenario will be significant, on the order of $1.2 billion. Though ground shaking in the M7.9 scenario is only about 25% larger than it is in the M6.7 scenario, overall building and content losses double to $2.4 billion. Average building damage and content damage also approximately double with a M7.9 event. The difference in the number of buildings that are heavily damaged with the larger earthquake is more pronounced with a 12-fold increase from the M6.7 to the M7.9 scenarios. This is shown in the fourth column of Table 5 as the number of buildings with a damage ratio exceeding 20%.

Table 5: Total losses for study group in as-is condition.

Earthquake Scenario	Building Value[1] ($B)	Content Value[2] ($B)	Number of Bldgs. with Damage Ratio ≥ 20%[3]	Estimated Building Damage[4] ($B)	Estimated Content Damage[4] ($B)	Total Building and Content Damage ($B)
M7.9	18.9	17.3	224	1.7	0.7	2.4
M6.7	18.9	17.3	19	0.8	0.4	1.2
Ratio of M7.9/M6.7				2	2	2

Notes:

1. Building value is the complete replacement cost for the building, and includes the structure, architectural, mechanical, electrical, and plumbing components (e.g., ceilings and lighting).
2. Content value includes the complete replacement cost of furniture and equipment that is not integral with the structure (e.g., computers and other supplies). They are estimated as a percent of structure replacement value, dependent on occupancy.
3. Damage ratio is defined as the cost of repairing damage divided by the replacement cost of the building.
4. Estimated building and content damage cost is the cost associated with repair and replacement of the building and its content.

To put the loss from building damage in context, the average annual valuation of Palo Alto construction permits was $400M between 2013 and 2016 (which represents a boom period). The total loss of $1.7B in a major M7.9 earthquake represents more than four years' worth of construction, and the total loss of $0.8B in a strong M6.7 earthquake represents more than two years' worth of construction.

It should be noted that these losses do not include the effects of lives lost and business disruption, or the ripple effects in the local economy or real estate market. Much of this loss will not be insured.

Estimated Losses by Building Type

It is important to look at multiple metrics when deciding which buildings are the most vulnerable and significant to the community as a whole. Table 6 breaks out the estimated loss and damage ratio for various model building types, and it can be seen that it depends on the metric used which building type is considered the poorest performer. Looking at the total loss alone, concrete bearing wall buildings and commercial wood frame buildings are responsible for the highest total loss. This tracks well with the earlier finding that these structural systems are the most prevalent ones. If we look at the highest average building damage ratio instead, buildings with unreinforced masonry bearing walls and unreinforced masonry infills are the most prone to damage. However, not very many of them exist in Palo Alto, and as a result they do not represent much of the aggregate loss.

Additional information on the loss estimate for the existing building stock is contained in Attachment B.

Table 6: Top three vulnerable building types ranked by total loss, average damage ratio, and number of severely damaged buildings.

Building Type	**Number of Buildings**	**Building Value ($M)**	**M7.9 EQ Total Building + Content Losses ($M)**	**M7.9 EQ Average Building Damage Ratio**	**M7.9 EQ Number of Bldgs. with Damage Ratio ≥ 20%**
Concrete shear wall (C2)	318	4,082	**477**	14%	75
Concrete tilt-up (PC1)	242	3,368	**365**	12%	32
Wood frame commercial/industrial (W2)	307	2,369	**216**	9%	9
Steel frame with masonry infill (S5)	2	3	1	**38%**	1
Unreinforced masonry bearing wall (URM)	9	15	4	**29%**	9
Concrete frame with masonry infill (C3)	8	8	2	**29%**	6
Concrete shear wall (C2)	318	4,082	477	14%	**75**
Concrete tilt-up (PC1)	242	3,368	365	12%	**32**
Steel moment frame (S1)	75	1,242	130	18%	**27**

Loss Estimate Findings with Buildings Retrofitted

A second Hazus AEBM run was done assuming a retrofitted building stock. For this model run, it was assumed that a building would be retrofitted if it has not already been retrofitted and was either constructed before 1961 or between 1962 and the benchmark year with a soft story. The Hazus model was rerun with the updated properties simulating retrofit.

Table 7 shows the resulting total losses and damage ratios after buildings have been retrofitted. Though total losses are still significant, comparing the results of Table 7 with Table 5 shows a reduction in total loss of 45% for the M7.9 scenario, and 33% for the M6.7 scenario. In other words, aggregate loss to the community if all considered properties were retrofit could be reduced by one third in a very plausible event and almost halved in a much larger event.

Another important improvement is the reduction of the number of buildings with more than 20% damage. The M7.9 scenario shows a reduction from 224 buildings to 6 buildings. This means that the probability of building collapse and resulting injuries and fatalities has become very low.

Finally, the damage and loss of the M7.9 scenario remain approximately two times the amount of loss sustained in the M6.7 scenario. This suggests that the retrofit has a similar impact for both levels of ground shaking.

Table 7: Total losses after retrofitting.

Earthquake Scenario	Building Value ($B)	Content Value ($B)	Estimated Building Damage ($B)	Number of Bldgs. with Damage Ratio ≥ 20%	Estimated Content Damage ($B)	Total Building & Content Damage ($B)
M7.9	18.9	17.3	0.9	6	0.5	1.3
M6.7	18.9	17.3	0.5	0	0.3	0.8
Ratio of M7.9/M6.7			2	-	2	2

Table 8 breaks out the reduction in total loss by model building type for the M7.9 scenario, and shows the associated retrofit cost. The average reduction in loss varies by building type. URM buildings showed the highest reduction in loss after retrofit as a percentage of the loss itself. Steel braced framed buildings showed the lowest reduction in losses as a percentage of the loss itself. Wood frame and concrete buildings are responsible for the largest reduction in total loss, with wood frame construction representing over 20% of the loss reduction, and concrete buildings over 50%.

It should be noted that the data in Table 8 also includes buildings that were not retrofitted. As a result, further parsing of the data is needed to better understand which buildings are responsible for the most loss, and those that can be improved more cost-effectively.

Table 8: Comparison of retrofit benefits and costs by Model Building Type.

Model Building Type	M7.9 EQ	M7.9 EQ	Average	Retrofit

	Average Damage ($/SF)	Total Damage Reduction ($1,000)	Damage Reduction ($/SF)	Cost ($/SF)
Wood frame smaller residential (W1)	16	13,775	4	12
Wood frame larger residential (W1A)	25	61,317	7	6-11
Wood frame commercial/industrial (W2)	50	160,155	26	14
Steel moment frame (S1)	62	76,150	25	10
Steel braced frame (S2)	44	24,222	8	10
Steel light metal frame (S3)	108	38,163	72	10
Steel frame with concrete shear walls (S4)	101	11,118	69	40-50
Steel frame with masonry infill (S5)	247	695	121	110
Concrete moment frame (C1)	55	8,045	25	40-50
Concrete shear wall (C2)	70	336,574	35	40-50
Concrete frame with masonry infill (C3)	120	865	34	110
Concrete tilt-up (PC1)	68	218,491	27	21-29
Precast concrete frame (PC2)	21	0	0	21-29
Reinforced masonry, wood floor (RM1)	59	87,697	31	46-74
Reinforced masonry, concrete floor (RM2)	35	3,727	6	46-74
Unreinforced Masonry Bearing Wall (URM)	23	5,216	19	110
Totals	**51**	**1,046,210**	**22**	

Table 9 shows those types of buildings that may be considered good candidates for a retrofit program. Although representing only about 15% of the total inventory, these buildings are responsible for over 30% of the total loss. This is reflected in the considerably higher than average loss (fourth column of Table 9). The benefit of retrofit is also considerable for this group of buildings, since they are responsible for over 50% of the reduction in loss. Additionally, the cost to retrofit them is only a fraction of the losses avoided in a major event, ranging from a third for the concrete buildings to a tenth for the steel frames. Note that these values are based on conceptual retrofits. Actual retrofit costs for individual buildings would vary substantially. The steel moment frame benefit-to-cost ratio is higher than expected by engineering judgment, caused in part by a comparatively low retrofit cost for this Model Building Type.

Additional information on the loss estimate for the retrofitted building stock is contained in Attachment B.

Table 9: Comparison of benefits and costs by selected Model Building Type, date and characteristics.

Model Building Type	**Number of Buildings**	**Total SF (1,000)**	**M7.9 EQ Average Loss by**	**M7.9 EQ Average Loss**	**Average Cost to Retrofit**	**(Average Loss Avoided)**

			Building ($/SF)	Avoided by Retrofit ($/SF)	($/SF)	/ (Average Retrofit Cost)
Pre-1977 wood frame soft-story (W1, W1A, W2)	294	3,690	66	46	12	4
Pre-1998 tilt-up (PC1)	99	3,078	106	71	23	3
Pre-1977 concrete soft-story (C1, C2, C3)	37	842	149	108	42	3
Pre-1998 steel moment frame (S1)	35	690	152	110	10	11

Review of Past Seismic Retrofits
To gain a better understanding of the quality of the retrofits and identify relevant issues to updating Palo Alto's seismic risk mitigation program, a sample of the submitted engineering studies and building retrofits drawings for existing buildings was reviewed.

The review identified the following relevant needs for future seismic risk mitigation programs:

A. Clear identification of retrofit design intent, scope, and limitations, also for voluntary retrofits
B. Identification of existing structural systems
C. Decision on requirements for buildings that have had partial seismic retrofits completed; and may have remaining seismic deficiencies

Additional Recommended Program Features

In addition to expansion of the building categories included within the City's seismic risk mitigation program and refinement of disclosure measures and incentive options, a number of other program features are recommended. They are described in Attachment B, and include the following:

A. *Use the current inventory, taking note of its limitations* - The inventory developed for the effort to date involved use of digital information and field surveys. A complete field survey of all buildings in Palo Alto was outside the scope of the project. However, the inventory that has been developed is an excellent resource. The first step in any future ordinance will involve notification of building owners that they may be subject to the requirements of the ordinance. Those buildings that were field surveyed and fall within the scope of the ordinance can be notified using the existing inventory. For the remaining buildings, additional field survey is recommended. This would be a rapid visual assessment and could be conducted by City staff or outside consultants.

B. *Use an initial screening form phase* - Typically, as part of the notification process, a screening form of about one page in length is sent, and the owner is required to have a design professional, such as a structural engineer or architect, complete the form. This cost for to confirm whether or not the building actually is subject to the City's ordinance should be relatively nominal.

C. *Clearly specify seismic evaluation and retrofit scope* - For all buildings subject to regulation, the seismic evaluation (and retrofit) methodology for each building category will need to be defined. Industry consensus standards exist and cover the vulnerable building categories identified for Palo Alto. These include the 2015 *International Existing Building Code (IEBC)* and 2014 ASCE 41-13 *Seismic Evaluation and Retrofit of Existing Buildings*. Both are currently being updated by groups of engineers and building officials. For soft-story wood frame buildings, there is also the 2012 FEMA P-807 *Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings with Weak First Stories.* For steel moment frame buildings, there is also the 2000 FEMA 351 *Recommended Seismic Evaluation and Upgrade Criteria for Existing Welded Moment Resisting Steel Structures*. The following table provides recommended evaluation and retrofit standards.

D. *Provide detailed evaluation report submittal requirements* - Minimum submittal requirements for evaluation reports will need to be defined. The above evaluation and retrofit standards provide some guidance but a short clear set of requirements will be beneficial.

E. *Specify how past partial retrofits will be handled: In the past, some buildings have had partial seismic retrofits where only selected portions of the seismic force-resisting system have been upgraded; Some seismic deficiencies may still exist in these structures. If mandatory retrofit requirements are implemented that provide for comprehensive retrofitting of the full seismic load path, there may be buildings with previous partial retrofits that do not fully comply and need remaining deficiencies to* *be addressed. The seismic evaluation reports will help identify these cases.*

F. *Update both new and existing building permit submittal requirements: Review of City records found that basic information such as the building structural system, date of construction, and retrofit standard used (where applicable) are not readily available. It is recommended that submittals for permit for both new buildings and existing building renovations require this information. This will allow the city to have a much better understanding of its total building stock and its expected performance in an earthquake.*

G. *Write a new ordinance or set of ordinances to update the program: After the Council has provided direction and the above issues have been addressed, an updated ordinance will need to be written.*

H. *Carefully address program management and interdepartmental coordination needs: To successfully manage Palo Alto's updated Seismic Risk Mitigation Program, an effective management plan is needed so that progress is monitored by the City and community intent is achieved.*

I. *Delineate department and key staff responsibilities: For Palo Alto's updated Seismic Risk Mitigation Program, City staff will be responsible for several categories of activities. These will include the basic activities such as managing the notification and inventory process, reviewing evaluation reports and plan checking retrofit construction documents, and field inspections of retrofit work. Less obvious activities will include evaluating requested exceptions to the program or alternative means of compliance; managing feedback from design professionals, owners, and the public; tying pre-earthquake retrofitting to post-earthquake safety evaluations records; and managing post-earthquake safety evaluation, repair, and recovery plans. Depending on the scale of the updated program, it is possible that additional staff members, consultants, and/or an appropriately experienced structural engineer may be needed to provide advice on technical and program management issues, particularly as the program moves to final definition and to initial implementation. Later, as is done in some communities, it may be desirable to create volunteer review boards of local structural engineers who review questions on the evaluation and retrofit criteria and provide the City with technical opinions that staff can use.*

Table 10: Recommended Evaluation and Retrofit Standards.

Category	Description	Evaluation and Retrofit Standards
I	Unreinforced masonry	IEBC Appendix Chapter A1
II	Built before 1/1/35 with 100 or more occupants	ASCE 41
III	Built before 8/1/76 with 300 or more occupants	ASCE 41
IV	Pre-1977 soft-story wood frame	IEBC Appendix Chapter A4, ASCE 41, or FEMA P-807
V	Pre-1998 tilt-up	IEBC Appendix Chapter A2 and ASCE 41
VI	Pre-1977 soft-story concrete	ASCE 41
VII	Pre-1998 steel moment frame	ASCE 41, or FEMA 351
VIII	Other pre-1977 concrete	ASCE 41

ADVISORY GROUP INPUT

Summary Report of the Advisory Group

The purpose of convening an Advisory Group composed of members with local expertise and construction experience was not to create a consensus document or ratify particular recommendations by majority vote. Instead, the goal was to educate, solicit, and explore the range of issues and opinions among interested parties who participated. A summary report, reviewed by all the members of the Group, was prepared to document their input in to the study (Attachment G). The Advisory Group was a first step in community engagement regarding seismic hazard reduction in Palo Alto. It was intended that the information in the Advisory Group's summary memo would be provided to the City Council as they consider potential revisions to the City of Palo Alto's seismic risk management program and seismic hazard identification ordinance.

Preferred Policy Directions

In summary, discussions with the Advisory Group revealed little to no support for maintaining the status quo. Strong support did exist for retrofitting buildings already in the program, particularly URM buildings, and for addressing more building types, particularly soft-story wood frame buildings and older concrete tilt-ups.

For buildings addressed in the current ordinance, the group generally thought a mandatory retrofit requirement would be feasible and fair. Three decades later, market forces alone have clearly not been enough to motivate upgrade of these remaining structures. Because the barriers to retrofit work for these properties are not known, case-by-case management by City staff may be necessary. There was hesitance, however, about extending or increasing incentives for owners that had not voluntarily taken advantage of the FAR bonus available in the past.

More detailed conversations took place about other building category priorities and policy features focused on extending the vulnerable building types they addressed and the requirements for retrofit compliance. These program alternatives are incorporated into Options 3, 4, and 5 (see the "Survey of State and Local Seismic Policies" section). The Advisory Group was briefed on structural types generally known to be vulnerable that are common or significant to Palo Alto and estimated to have reasonable loss reduction to retrofit cost ratios. The Group's goal was to focus on a subset of categories that seemed to have high potential to benefit the owner, occupants, and the broader community. Some participants showed greater concern about residential properties, and debated whether commercial and residential properties should be treated the same or differently.

The Advisory Group showed high interest in addressing multi-family residential earthquake risks, in particular by starting a soft-story wood frame program as many other California cities have done. One soft-story wood frame program approach discussed was to have two phases: 1) owners following notification would be given several years to do a voluntary retrofit, along with more generous incentives; and 2) later a mandatory timeline would kick in and incentives would be phased out. The group noted that exemptions such as parking requirements, permission to add other unit(s), or the ability to transfer development rights for additional square footage would likely be attractive and useful incentives for the multi-family soft story building type.

Other vulnerable building categories of concern were also reviewed, including pre-1977 tilt-up concrete structures. There are a modest number of these buildings in Palo Alto, but Advisory Group members noted that their uses are changing. Many buildings previously used as warehouses are now being repurposed for office space. The higher occupancies increase the public safety stakes of any seismic deficiencies. Currently, there is no mandate in the regulations to address earthquake vulnerabilities while other upgrades and build out are being done to these structures. A substantial renovation trigger mandate might make sense, but the percent of the value of the structure used as a trigger might need to be lowered in order to get compliance. Such properties with more than one story should perhaps receive higher priority for retrofit.

Potential Issues for Future Study and Consideration

For some issues, based in part on Advisory Group discussions, additional information may be beneficial to help develop a strategy and to better understand potential impacts on key stakeholders and community concerns. Some of these issues are primarily economic and were outside the scope of the current study. The City Council may wish to direct staff and/or outside consultants to investigate some of these items in more detail as the seismic risk management program effort proceeds. These issues include the following:

A. *Occupants and tenants*
    a. How much would a typical retrofit add to the monthly rent of a multifamily

soft-story wood frame apartment tenant?

   b. Would some tenants be unable to afford a rent increase and seek housing elsewhere in Palo Alto or move outside the city (and if so, how many might be displaced)?
   c. If soft-story wood frame apartments in Palo Alto are retrofitted in time before the next major earthquake, how much less displacement of residents would occur as a result of the earthquake?
   d. What categories of buildings are most important to address in order to help maintain the commercial viability and vitality of the City's core business districts and tax base?

B. *Property owners, developers, and business owners*
   a. What are the characteristics of property owners that would be affected?
   b. How might small businesses be affected compared to larger ones?
   c. How many property owners are in need of lower cost capital or other substantial financial assistance to fund retrofitting?

C. *Impacts of Seismic Restoration on Retention of Historic Structures in the City*
   a. How can we ensure that the review of initial seismic evaluations identify those structures that are listed in the City's Historic Inventory or potentially significant and flag them for attention during subsequent review?
   b. How can we develop a clear process for reviewing proposed seismic retrofits to historic structures that is coordinated among responsible city departments and is consistent with current regulations and Community policies?
   c. How can we ensure that property owners take advantage of Seek out retrofit alternatives that are consistent with the Historic Building Code, historic characteristics of the structure, and provide the required most risk reduction?

D. *City departmental resources and budgets*
   a. What would be the loss in revenue to the Building Department if fee waivers were offered?
   b. What would be the staffing and budgetary needs over time to administer an expanded program that addresses additional building types?
   c. What kinds of interdepartmental cooperation and staff resources in other departments are necessary to ensure effective implementation and coordination with other city planning and public safety efforts?
   d. What would be the costs to provide and administer any incentives offered to property owners?

E. *Overall community economic health*
   a. What kind of benefits could accrue to Palo Alto in terms of maintaining community function and ability to recover if various building categories are retrofitted in time before the next major earthquake?

F. *Other related issues*

a. It was brought up in the Advisory Group that the Building Department needs flexibility and authority to take steps to get tough seismic mitigation projects done. One idea was to grant the Building Official the ability to classify certain projects (with well-specified criteria) as warranting a kind of "seismic safety" or "earthquake resilience" fast tracking, with city departments agreeing to coordinate on a specified accelerated project review timeframe.
b. Although outside the formal scope of this planning effort, several Advisory Group members commented that it would be desirable for the City to do some kind of assessment of any earthquake mitigation needs in public buildings and facilities serving the City.
c. Advisory group members recommended the community be informed of Palo Alto's overall potential seismic risk by providing a summary of potential impacts on the City's website, including the expected performance of vulnerable buildings.
d. The group also had a high degree of support for recommending that the City initiate and nest future earthquake mitigation programs within a broader disaster or community resilience initiative, as cities such as Los Angeles, Berkeley, and San Francisco have done. This could be incorporated into the update of the City's Comprehensive Plan Safety Element. There was insufficient time in the project's six advisory group meetings to consider potential initiatives to assess risks for cell phone towers, water supply, facades, private schools, post-earthquake shelter facilities, and/or other assets important to community recovery.

TIMELINE

The timeline for updating the current seismic mitigation regulation is dependent on Council's review of the Seismic Risk Assessment Study and directions to staff.

RESOURCE IMPACT

Implementation of the report recommendations would result in additional costs to private property owners and prior to any decision to proceed, staff is proposing additional public outreach at a cost of about $50,000. Technical requirements and design guidelines to support a new ordinance would require additional consultant services at an estimated cost of $50,000. If desired, an analysis of the fiscal impact on residents and business could be prepared for an additional $50,000. Any incentives offered to building owners could also have a cost to the City, which would not be known until those incentives are further defined.

ENVIRONMENTAL REVIEW

The preparation of the Seismic Risk Assessment Study is exempt from environmental review under the California Environmental Quality Act (CEQA) Guidelines Section 15306 (Information collection leading to an action which a public agency has not yet approved, adopted, or funded).

TABLE OF CONTENTS FOR ATTACHMENTS

A. Palo Alto Municipal Code, Chapter 16.42: Seismic Hazards Identification Program
B. Seismic Risk Assessment Study. The study includes the following items.
    a. Legislative Review Report
    b. Local Program Best Practices Assessment
    c. Building Inventory for Loss Estimate
    d. Conceptual Seismic Retrofits and Cost Estimate
    e. Loss Estimate of Existing Building Stock
    f. Loss Estimate of Retrofitted Building Stock
    g. Review of Past Retrofits
    h. Additional Recommended Program Features
C. Threat and Hazard Identification and Risk Assessment (August 2014)
D. Policy and Services Committee Staff Report 5293, Discussion of Updating the Seismic Safety Chapter of the Municipal Code for Hazardous Buildings (December 9, 2014)
E. Palo Alto Municipal Code, Chapter 18.18: Downtown Commercial (CD) District
F. Seismic Risk Management Program Advisory Group Members
G. Seismic Risk Management Program Advisory Group Summary Report on Process, Discussions, and Outcomes (November 21, 2016)
H. Advisory Group Meeting Minutes, Presentations and Handouts (contained at the Seismic Risk Management Advisory Group website at <http://www.cityofpaloalto.org/gov/depts/ds/srmag.asp>

Attachments:

- Attachments
- Attachment_A_-_PAMC_16.42_Seismic_Hazards_ID_Prgm[1]
- Attachment_B_-_Palo_Alto_Seismic_Risk_Assessment_Study_-_Final_Report_-_2016_12_21[1]
- Attachment_C_-_Palo_Alto_Threats_Hazards_Risk_Assessment_(August_2014.1)[1]
- Attachment_D_-_Policy_and_Services_Staff_Report_5293[1]
- Attachment_E_-_PAMC_18.18_CD_District[1]
- Attachment_F_-_Seismic_Risk_Management_Program_Advisory_Committee_Members_01.15.16[1]
- Attachment_G_-_Palo_Alto_Seismic_Risk_Mgt_Prog_AG_Summary_Rev_2016_11_21[1]
- Attachment_H_-_SRMP_Advisory_Group_Agenda-Minutes-Presentations-Handouts[1]

Attachments A - H have been removed for this reviewing process.

Print

Palo Alto Municipal Code

Chapter 16.42
SEISMIC HAZARDS IDENTIFICATION PROGRAM

Sections:

16.42.010 Purpose.

It is found and declared that in the event of a strong or moderate local earthquake, loss of life or serious injury may result from damage to or collapse of buildings in Palo Alto. It is generally acknowledged that Palo Alto will experience earthquakes in the future due to its proximity to both the San Andreas and Hayward faults. The purpose of this chapter is to promote public safety by identifying those buildings in Palo Alto which exhibit structural deficiencies and by accurately determining the severity and extent of those deficiencies in relation to their potential for causing loss of life or injury. The city council finds it desirable to identify the hazards that these deficiencies may pose to occupants of buildings and pedestrians in the event of an earthquake. Such a seismic hazards identification program is consistent with California Health and Safety Code Sections 19160 - 19169 and is necessary to implement the Palo Alto Comprehensive Plan's Environmental Resources Policy 14, Program 47.

(Ord. 3666 § 1 (part), 1986)

16.42.020 Definitions.

(a) "Bearing wall" means any wall supporting a floor or roof where the total superimposed load exceeds one hundred pounds per linear foot, or any unreinforced masonry wall supporting its own weight when over six feet in height.

(b) "Building," for the purpose of determining occupant load, means any contiguous or interconnected structure; for purposes of engineering evaluation, means the entire structure or a portion thereof which will respond to seismic forces as a unit.

(c) "Capacity for transfer" means the maximum allowable capacity of a structural system or connection to resist in a ductile manner the lateral forces it would encounter due to earthquake forces.

(d) "Civil engineer or structural engineer" means a licensed civil or structural engineer registered by the state of California pursuant to the rules and regulations of Title 16, Chapter 5 of the California Administrative Code.

(e) "External hazard" means an object attached to or forming the exterior facade of a building which may fall onto pedestrians or occupants of adjacent buildings. Examples of this type of hazard include, but are not limited to, the following:

(1) Nonstructural exterior wall panels, such as masonry infill or decorative precast concrete;

(2) Parapets;

(3) Marquees, awnings or other roof-like projections from a building;

(4) Masonry or stone wall veneer and wall ornamentation, including cornices or other decorative appendages;

(5) Masonry chimneys;

(6) Tile roofing;

(7) Wall signs and exterior lighting fixtures hung from a building exterior;

(8) Fire escapes or balconies.

(f) "Geometry" means a building's shape or configuration, including setbacks of wall/column lines, reentrant corners, discontinuities in vertical and horizontal lateral force diaphragms, open storefront and building stiffness variations due to the distribution of resisting elements or the use of materials of differing properties within the same structural element, or other irregularities in plan or elevation.

(g) "Occupants" means the total occupant load of a building determinedm pursuant to the Uniform Building Code, or the actual maximum number of occupants in that building if that number is less than seventy-five percent of the number determined pursuant to the code. The number of actual occupants may be documented by counting actual seating capacity if permanent seating is provided in the occupancy, or by employee and client counts which can be substantiated as a practical maximum use of the space in the building. The chief building official will establish the procedure for documenting occupant loads.

(h) "Solution" means any justifiable method that will provide for the transfer of lateral forces through a system or connection to a degree which will substantially eliminate a potential collapse failure. A general description of the methods and materials to be used shall be included in sufficient detail to allow for a cost estimate of the solution to be made (i.e., adding shear walls, overlaying horizontal diaphragms, strengthening critical connections, etc.).

(i) "Unreinforced masonry" ("URM") building means any building containing walls constructed wholly or partially with any of the following materials:

(1) Unreinforced brick masonry;

(2) Unreinforced concrete masonry;

(3) Hollow clay tile;

(4) Adobe or unburned clay masonry.

(Ord. 4642 § 28, 2000: Ord. 3666 § 1 (part), 1986)

16.42.030 Scope of program.

(a) Applicability. The following buildings in Palo Alto shall be required to have an engineering report submitted to the city's building inspection division, pursuant to Section 16.42.050, to determine: (i) the existence, nature and extent of structural deficiencies which could result in collapse or partial collapse of the building; and (ii) the existence, nature and extent of deficiencies in the anchoring of external hazards:

(1) Buildings constructed of unreinforced masonry (URM), except those of less than one thousand nine hundred square feet containing six or fewer occupants;

(2) Buildings constructed prior to January 1, 1935 containing one hundred or more occupants;

(3) Buildings constructed prior to August 1, 1976 containing three hundred or more occupants.

(b) Exemptions. The following buildings need not comply with this chapter:

(1) Buildings which have been structurally upgraded in substantial accordance with either the Los Angeles Division 88 Standard for URM buildings or the 1973, or later, edition of the Uniform Building Code;

(2) Buildings whose uses are subject to amortization under this code; provided that, upon the termination of the nonconforming use, such a building shall be required to be rehabilitated to the then current lateral force requirements in the Uniform Building Code prior to occupancy by a conforming use.

(Ord. 3666 § 1 (part), 1986)

16.42.040 Building categories and implementation schedule.

(a) Building Categories. The categories of buildings within the scope of this chapter are set forth in Table A, below.

(b) Owner Notification. The owners of buildings in categories I through III, except those designated as historic buildings, shall be notified within six months of enactment of the ordinance codified in this chapter by the building inspection division of the city of Palo Alto that their buildings are required to have an engineering report submitted to the city. Owners of designated historic buildings, as defined in Chapter 16.49, shall be notified within eighteen months of enactment of the ordinance codified in this chapter.

(c) Implementation Schedule. The owners of buildings in categories I through III must submit engineering reports within the time frame set out in Table A, below, from the date of mailed notice by the city.

Table A

Category	**Description**	**Engineering Report Submitted Within Date of Mailed Notice (in Years)**
I	All URM buildings.	1-1/2
II	All pre-1935 buildings other than URM with 100 occupants or more.	2
III	All buildings with 300 occupants or more constructed between January 1, 1935 and August 1976.	2-1/2

(Ord. 3666 § 1 (part), 1986)

16.42.050 Engineering reports.

(a) Preparation of Reports. Building owners shall employ a civil or structural engineer to prepare the investigation and engineering report outlined below.

(b) Purpose. To investigate, in a thorough and unambiguous fashion, a building's structural systems that resist the forces imposed by earthquakes and to determine if any individual portion or combination of these systems is inadequate to prevent a structural failure (collapse or partial collapse).

(c) General. Each building shall be treated as an individual case without prejudice or comparison to similar type or age buildings which may have greater or lesser earthquake resistance. Generalities or stereotypes are to be avoided in the evaluation process by focusing on the specifics of the structural system of the building in question and the local geology of the land on which the building is constructed.

(d) Level of Investigation. Some buildings will require extensive testing and field investigation to uncover potential structural deficiencies, while others will allow the same level of overall evaluation by a less complicated process due to simplicity of design or the availability of original or subsequent alteration design and construction documents.

It is the responsibility of the engineer performing the evaluation to choose the appropriate level of investigation which will produce a report that is complete and can serve as a sound basis for a conclusion on the collapse hazard the building may present.

(e) Format for the Report. The following is a basic outline of the format each engineering report should follow. This outline is not to be construed to be a constraint on the professional preparing the report, but rather to provide a skeleton framework within which individual approaches to assembling the information required by the ordinance may be accomplished. It also will serve as a means for the city to evaluate the completeness of each report.

(1) General Information. A description of the building including: (i) the street address; (ii) the type of occupancy use within the building, with separate uses that generate different occupant loads indicated on a plan showing the square footage of each different use; (iii) plans and elevations showing the location, type and extent of lateral force resisting elements in the building (both horizontal and vertical elements); (iv) a description of the construction materials used in the structural elements and information regarding their present condition; (v) the date of original construction, if known and the date, if known, of any subsequent additions or substantial structural alterations of the building; and (vi) the name and address of the original designer and contractor, if known, and the name and address of the designer and contractor, if known, for any subsequent additions or substantial structural alterations.

(2) Investigation and Evaluation of Structural Systems. All items to be investigated and the methods of investigation for each type of building under consideration are contained in Appendices A and B, attached to the ordinance codified in this chapter, available from the city's building inspection division.

(3) Test Reports. All field and laboratory test results shall be included in the report. Evaluation of the significance of these test results shall be made with regard to each structural system or typical connection being evaluated. This evaluation may be limited to a statement of the adequacy or inadequacy of the system or connection based on the lateral load demand it would be required to resist by calculation. If tests reveal inadequacy, a conceptual solution must be included in the report.

(4) Conclusions. Based on the demand/capacity ratio and the specific evaluation items contained in Appendices A or B attached to the ordinance codified in this chapter, a statement shall be provided explaining the overall significance of the deficiencies found to exist in the building's lateral force-resisting system regarding potential collapse or partial collapse failure.

(5) Recommendations. An appropriate solution, which could be used to strengthen the structure to alleviate any collapse or partial collapse threat, shall be specified.

(f) Exceptions and Alternatives. Exceptions to the specific items required to be included in an engineering report may be granted by the chief building official upon review of a written request from the engineer preparing the report. Such a request shall provide evidence that adequate information concerning the required item(s) can be determined by alternate means or that a conclusion can be made about the item without following the solution called for in the appropriate appendix. The purpose of granting such exceptions shall be to reduce the costs or disruption that would result from taking required actions, when it can be shown that they are unnecessary to provide information available by other equivalent means. In no case will an exception be granted which would result in an item not being completely evaluated. The decision of the chief building official in granting exceptions is final.

(Ord. 3666 § 1 (part), 1986)

16.42.060 Review of reports.

(a) The city shall utilize the services of civil or structural engineers to assist the building inspection division in determining if the submitted engineering reports conform to the requirements of this chapter.

(b) The cost of this review shall be recovered by a fee assessed from the building owner based on the time required for the review. This fee amount shall be deducted from the plan checking fee collected for any future construction work that deals directly with correcting any of the structural inadequacies specified in the engineering report.

(c) Copies of the engineering reports shall be available to interested individuals for a standard copying fee or may be reviewed at the building inspection division offices.

(Ord. 3666 § 1 (part), 1986)

16.42.070 Responsibilities of the building owners.

(a) Notification of Building Tenants. A building owner shall notify all tenants, in writing, that a structural investigation has been performed and that the report is available at the building inspection division offices. This notice must be sent within thirty days of the date the report is submitted to the city.

(b) Letter of Intent. A building owner shall submit a letter to the building inspection division within one year of the date the engineering report was submitted, indicating the owner's intentions for dealing with the potential collapse hazards found to exist in the building.

(Ord. 3666 § 1 (part), 1986)

16.42.080 Program status reports to the city council.

The chief building official shall submit a semiannual report to the city council on the status of the seismic hazards identification program. The reports shall include information regarding the number of buildings analyzed, the severity of the structural inadequacies discovered and any actions taken by individual building owners to correct these inadequacies.

(Ord. 3666 § 1 (part), 1986)

16.42.090 Remedies.

It shall be unlawful for the owner of a building identified as being included in the scope of this chapter to fail to submit a report on either building collapse hazards or external hazards within the time period specified in Section 16.42.040(c), Table A, or to fail to submit a letter of intent within the time period specified in Section 16.42.070(b). The following remedies are available to the city:

(a) The city may seek injunctive relief on behalf of the public to enjoin a building owner's violation of this chapter.

(b) Any building owner violating this chapter shall be guilty of a misdemeanor and upon conviction thereof shall be punishable as provided in Section 1.08.010 of this code. Such building owner is guilty of a separate offense for each and every day during any portion of which such violation of this chapter is committed, continued or permitted by such building owner.

(c) These remedies are not exclusive.

(Ord. 3881 § 9, 1989: Ord. 3666 § 1 (part), 1986)

Final Report

Seismic Risk Assessment Study
Palo Alto, California

21 December 2016
#2015-087S

Rutherford + Chekene
375 Beale Street, Suite 310
San Francisco, CA 94105

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PALO ALTO SEISMIC RISK ASSSESSMENT STUDY

Section / Subsection

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CHAPTER I.

INTRODUCTION

In 1986, the City of Palo Alto was one of the first cities in California to establish a comprehensive seismic mitigation program. It covers unreinforced masonry buildings, buildings built before 1935 with over 100 occupants, and buildings built before August 1, 1976 with over 300 occupants. After 30 years, 75% of the 89 buildings included in the program have been demolished or retrofitted. The 2014 South Napa Earthquake spurred the City to reevaluate its program. They engaged a team led by Rutherford + Chekene (R+C) to perform a comprehensive assessment of the expected performance of the City's building stock in potential earthquakes, and started a community engagement effort to help identify resiliency goals and associated mitigation policies and programs. The R+C project team includes Sharyl Rabinovici, a public policy and community engagement specialist; Hope Seligson (initially with MMI Engineering and now Seligson Consulting) for loss estimating; and Vanir Construction Management for cost estimation of building replacement cost and retrofitting.

The technical assessment covered over 2,500 buildings (single family and two-family residences were excluded) with a wide array of potentially vulnerable structural systems. The findings show that the estimated losses to Palo Alto buildings and contents in a M7.9 scenario event will be significant, on the order of $2.4 billion. Furthermore, this figure does not include business disruption, or ripple effects in the local economy or real estate market, nor does it include the economic value of loss of life. Among the categories of highest concern are pre-1977 "soft-story" wood frame, pre-1978 tilt-up concrete, pre-1977 cast-in-place concrete construction, and pre-1998 steel moment frames. The technical assessment revealed that the potential reduction in losses from retrofitting these buildings is over $1 billion in a M7.9 scenario event.

R+C's scope included a series of tasks and associated task reports and presentations. These included the following:

- A survey of state and local seismic policies and best practices;
- Development of a building inventory for Palo Alto using digital information and field surveys;
- Assignment of costs to buildings and contents in the inventory;

- Description of vulnerable building categories, including five additional categories not covered under the current ordinance;
- Conceptual seismic retrofitting of representative vulnerable buildings;
- Loss estimate findings in a major seismic event for the current condition and after retrofitting;
- Review of past seismic retrofits; and
- Discussion of additional recommended program features.

These task reports and presentation information have been compiled to form this Seismic Risk Assessment Study. Each chapter in the study addresses one or more of the project task efforts. Appendices provide additional details for selected tasks.

A Seismic Risk Management Advisory Group made up of community and industry stakeholders and City staff was appointed and was also an essential component of the overall project. The Advisory Group insured that local building experience and community priorities were considered as the study moved forward. The group met six times with City staff and the R+C team over a period of nine months. The Advisory Group was introduced to the findings regarding the community's earthquake vulnerability, impacts on vulnerable building types, as well as the 'best practices' used by other communities to promote community wide welfare and to encourage seismic retrofit of various vulnerable buildings types. The Advisory Group then discussed the assessment findings and formulated potential directions for City of Palo Alto leaders to consider going forward in updating the City's seismic mitigation programs. At the end of the Advisory Group process, a summary memo, reviewed by all members of the Group, was prepared to document their input to the study. The November 21, 2016 memo is entitled "Seismic Risk Management Program Advisory Group Summary Report on Process, Discussions, and Outcomes."

The following table summarizes the outcome of the seismic risk assessment and includes the Advisory Group discussions. The table is organized around eight vulnerable building categories or building types. Categories I, II and III encompass the identified vulnerable buildings for the 1986 ordinance and are primarily located in the downtown commercial district. Categories IV through VIII include additional buildings at risk, as identified in the Seismic Risk Assessment Study. These buildings are located throughout the city.

There was little to no support for maintaining the status quo within the Advisory Group. As shown in the following table, the Advisory Group favored requiring property-owner prepared seismic evaluation reports for all categories, except for Category VIII (other older nonductile concrete buildings). They also favored mandatory retrofit for the remaining Category I unreinforced masonry buildings identified in the 1986 ordinance that have not been seismically retrofitted or demolished. For the Category II and III buildings in the current ordinance, retrofit should be required when a certain event or “trigger” occurs such as when a substantial renovation occurs or the property is put up for sale. Among the new vulnerable building types, the greatest concern was expressed for soft-story wood frame buildings and older concrete tilt-up buildings. The Advisory Group thought that retrofit of these structures should be either mandatory or triggered by substantial renovation or sale. The Advisory Group was concerned about delay in the retrofit of these structures given the number of the vulnerable buildings, the number of people who could be affected should the buildings be significantly damaged, and the considerable cost to the community if the structures in these categories were lost because of an earthquake. The Advisory Group considered a timeline of 2-4 years for the mandatory evaluation report and 4-8 years to complete mandatory retrofit construction. The Advisory Group supported increasing disclosure measures on building status through website listing and tenant notification. They also suggested that the most beneficial financial and policy incentives to encourage compliance with the new requirements would be fee waivers, expedited permitting, and property-assessed financing tools.

Following the preparation of the Advisory Group summary, R+C assisted City staff in preparing a staff memo for an upcoming City Council meeting. It includes more detailed recommendations to the Council on proposed revisions to the City’s seismic hazard mitigation ordinance and recommends that the Council provide direction to City staff on revising and expanding the City’s building code and related ordinances.

RUTHERFORD + CHEKENE

Summary of Recommended Policy Directions from the Seismic Risk Management Program Advisory Group

Category	Approx. Number	Building Type	Date of Construction	Occupants	Evaluation Report	Voluntary, Triggered, or Mandatory Retrofit[1]	Deadlines for Evaluation Report and Retrofit Construction (years)[2]	Disclosure	Potential Incentives
Current Program (Potential Revision in *Italics*)									
I	10	Un-reinforced masonry	NA	Over 6 (and over 1,900 sf)	Required	*Mandatory*	Report: Expired Construction: *2-4*	*Website listing and tenant notification*	*Fee waiver, expedited permitting, FAR bonus/ transfer of development rights (TDR)*
II	4	Any	Before 1/1/35	Over 100	Required	Voluntary *or Triggered*	Report: Expired Construction • Voluntary: Not required • *Triggered: At sale or renovation*		
III	9	Any	Before 8/1/76	Over 300	Required	Voluntary *or Triggered*			
Expanded Program									
IV	294	Soft-story wood frame	Before 1977	Any	Required	Triggered or Mandatory	Report: 2-4 Construction • Triggered: At sale or renovation • Mandatory: 4-6	Same as above	Fee waiver, expedited permitting, TDR, parking exemptions, permission to add units
V	99	Tilt-up	Before 1998	Any	Required	Triggered or Mandatory	Report: 2-4 Construction • Triggered: At sale or renovation • Mandatory: 4-6	Same as above	Same as Categories I, II and III
VI	37	Soft-story concrete	Before 1977	Any	Required	Voluntary, Triggered or Mandatory	Report: 2-4 Construction • Voluntary: Not required • Triggered: At sale or renovation • Mandatory: 6-8	Same as above	Same as Categories I, II and III
VII	35	Steel moment frame	Before 1998	Any	Required	Voluntary, Triggered or Mandatory			
VIII	TBD	Other older nonductile concrete	Before 1977	Any	Not rec. at this time	Not recommended at this time	Report: NA Construction: NA	NA	NA

[1]Voluntary: Retrofit is voluntary.
Triggered: Retrofit is triggered when the building is sold or undergoes substantial renovation.
Mandatory: Retrofit is required per a fixed timeline.

[2]Deadlines provide a potential range. Timelines would vary depending on tiers or priority groupings of different subcategories.

CHAPTER II.

LEGISLATIVE REVIEW REPORT

Executive Summary

This chapter summarizes the seismic risk management policy context within the state of California to support Palo Alto's current effort to update its program. The report was prepared per Task 2 of the Consulting Agreement between Rutherford + Chekene and the City of Palo Alto, dated August 17, 2015. The scope of Task 2 is to:

- Review existing and pending State legislation related to soft-story buildings and other seismically vulnerable buildings and provide a brief summary.
- Provide a concise review of relevant and pending state legislation, with a summary that can be presented at community and staff meetings or in reports to Council.

The process of creating this legislative review included searches of legislative data bases, search and review of published and online reports and materials, several phone interviews with leaders in the engineering profession as well as local and state government staff, and development of insights from the consulting team based on their experiences in this arena.

High level findings include the following:

- **Palo Alto is affected by numerous relevant California existing laws and regulations dating from the 1930s through the present.** These laws regulate many aspects of Palo Alto's built environment, including certain classes of building uses such as hospitals, public schools, and essential facilities; setting code minimums for new construction; and mandating land use planning and real estate disclosure measures for natural hazards including earthquakes. Unreinforced masonry (URM) is at present the only *structural system type* for which the state requires local jurisdictions to have a program.
- **If it so chooses, Palo Alto has wide authority to expand or strengthen its approaches to seismic mitigation.** The power to do more about earthquake vulnerabilities is primarily in the hands of the local jurisdictions that have significant discretion in the kinds of policies they can adopt.

- **Palo Alto has many additional actions it can take to make sure it is complying and taking greatest possible advantage of state level regulations and opportunities.** In particular, opportunities exist now to align a new seismic program with two ongoing mandated planning efforts the City is already engaged in: Palo Alto's General Plan and its Local Hazard Mitigation Plan.

Based on what state laws allow and in some cases recommend, many broad policy directions exist for Palo Alto going forward in terms of updating its seismic mitigation program. For example, Palo Alto could choose to:

(1) implement measures to increase the effectiveness of its current program, for instance by offering additional or larger incentives or devoting more resources to program visibility and implementation;

(2) expand the City's current voluntary seismic mitigation programs to address additional building types or uses;

(3) add mandatory screening or evaluation measures for one or more vulnerable building types such as soft-story buildings or older concrete structures;

(4) upgrade the City's current voluntary URM program to make retrofitting mandatory;

(5) create a program that mandates seismic retrofits for one or more additional (non-URM) vulnerable building types;

(6) craft a program that combines any or all of the above measures. Local precedents for all these types of approaches exist and are described and discussed in a separate Task 3 report; or,

(7) continue the status quo current program.

Although formally outside the scope of the current effort, Palo Alto also has additional opportunities for strengthening and expanding its earthquake-related efforts in terms of land use planning, public education and awareness, and small residential structures, such as:

(8) develop partnerships with the private and non-profit sectors to promote insurance take up and business continuity planning; and,

(9) devote more resources to increasing awareness among its citizens about low cost or free ways to become more aware and prepared for disasters more broadly.

Ultimately, the recommended policy directions and action steps for Palo Alto will be informed by related efforts in this project to analyze the most current vulnerability information available, and later determined through an inclusive decisionmaking process going forward.

1. INTRODUCTION

This report surveys the public policy landscape in the state of California related to earthquake mitigation and describes each policy or program's relevance for Palo Alto and similar jurisdictions. The scope is intentionally broad so that it can serve as a primer or look-up resource for persons with varied levels of background knowledge about the topic. Section 2 organizes information about the reviewed policies, programs, and institutions based on the type of policy or program. These range from building codes and mitigation mandates to educational efforts and tax-based loan financing strategies.

Section 3 briefly provides information about current State level policy leadership and the small amount of earthquake-related recent and proposed legislation. Section 4 presents options for Palo Alto through a summary of the review's findings. Appendices A and B to this report provide detailed tables of current and pending or recent legislative proposals, respectively.

The process of creating this Legislative Review included searches of the California's *LegInfo* database,[1] search and review of published and online reports and materials, several phone interviews with state and engineering profession leaders, and development of insights from the consulting team based on their experiences in this arena. This review covered over 50 related individual existing laws or passed referenda, in addition to the state's Existing and Historic Building Code provisions.

2. CURRENT CALIFORNIA SEISMIC-RELATED BUILDING CODES, LEGISLATION, AND KEY INSTITUTIONS

This section presents legislation and programs in narrative format to address interrelationships among these laws and to present broader implications for Palo Alto. Relevant laws and programs related to Palo Alto's obligations and opportunities regarding earthquake mitigation are categorized by type and how each works. Specific laws referenced are shown in bold. The accompanying table in Appendix A lists the identified relevant current state legislation organized by year established.

State laws related to seismic safety can be categorized as relating to building codes, targeting of existing building types or uses, land use planning, real estate practice requirements, and financial policies such as the tax code, insurance, and incentives.

[1] http://www.leginfo.ca.gov (Accessed January 13, 2016).

Building Codes

New construction in Palo Alto is governed by the **California Building Code (CBC)** that is updated every three years. Updates are adopted by the City Council. The International Building Code (IBC) is the underlying model code on which the provisions of the CBC are based. Legally, every local jurisdiction in California is required to adopt the state building code and to enforce that code. Above and beyond the minimums of the CBC, each jurisdiction has flexibility if justified by local climatic, geological (including seismic), and topographical conditions. Several jurisdictions have done that as part of their seismic mitigation programs, as detailed later and in Chapter III.

Standards for rehabilitation, renovation, repairs, retrofits, or additions to existing structures exist in Chapter 34 of the CBC. The International Existing Building Code (IEBC) provides additional specific methodologies that jurisdictions may decide to adopt in whole or in reference to particular sections.

The City of Palo Alto has its own Historic Building Inventory of hundreds of buildings as well as several Historic Districts and both state and federally designated historic properties. Therefore, the **State Historical Building Code**[2] is also relevant, as administered by the Division of the State Architect (DSA) under the Department of General Services. Officially designated historic structures are subject to different rules for rehabilitation which are generally more flexible and permissive than those in Chapter 34 of the CBC. Local jurisdictions can specify enhancements for seismic reasons as long as the justifications and nature of such changes are fully public and documented on record with the State Historical Building Safety Board.[3] A detailed list of key provisions is given on the DSA website[4].

Targeted Building Types

Unreinforced Masonry (URM)

Inventories of specific building types have formed the backbone of California seismic policy towards existing buildings since at least the 1930s, but it was the **1986 Unreinforced Masonry (URM) Law** that firmly established the precedent of using inventories to promote retrofits of existing seismically vulnerable buildings. Through this policy, in Section 8875 of the California Government Code, the State Legislature required all 366 local governments in Seismic Zone 4 (the highest hazard level) to inventory their URM buildings, establish some kind of loss-

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2 Health and Safety Code, Division 13, Part 2.7, §18950-18961.

3 "Each local agency may make changes or modifications in the requirements contained in the California Historical Building Code, as described in Section 18944.7, as it determines are reasonably necessary because of local climatic, geological, seismic, and topographical conditions. The local agency shall make an express finding that the modifications or changes are needed, and the finding shall be available as a public record. A copy of the finding and change or modification shall be filed with the State Historical Building Safety Board. No modification or change shall become effective or operative for any purpose until the finding and modification or change has been filed with the board." [Health and Safety Code §18959.f.]

4 http://www.dgs.ca.gov/dsa/AboutUs/shbsb/shbsb_health_safety.aspx (Accessed January 23, 2016).

reduction or remediation program within four years, and report progress to the California Seismic Safety Commission (CSSC).

Each county or municipality was allowed to design its own program. In general, three main types of local programs were utilized: 1) mandatory retrofit, 2) voluntary retrofit, and 3) notice to owners that the structure is a URM building. When retrofits were encouraged or required, the local government set the standards to be met. Palo Alto already had an inventory and program in place for URMs at the time the law was passed, and thus it was mainly subject to the reporting requirements.

Mandatory signage was later required and is another controversial aspect of the State's approach to URM buildings. Section 8875.8 of the Government Code increased enforcement efforts on the requirement for warning placards to be posted at the entrances to un-retrofitted URM buildings. In 2006, URM building owners had posted 758 signs (see Figure 1 for required text); almost all jurisdictions report the signage had no noticeable effects (CSSC, Status of the Unreinforced Masonry Building Law, 2006).

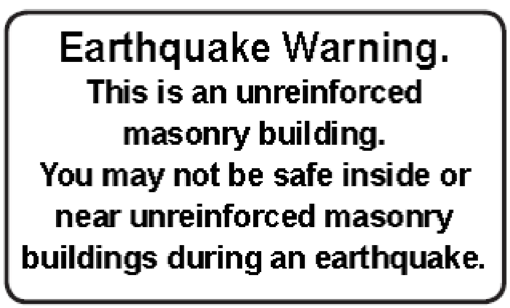

Figure 1: URM sign example text.

Reviews of the URM Law by the CSSC have shown it to be a success over the long term. In 2006 (the last comprehensive state survey available), compliance with the policy was 93%, and over 70% of identified URM buildings have been either retrofitted or demolished (CSSC, Status of the Unreinforced Masonry Building Law, 2006). More than half (52%) of affected jurisdictions adopted a mandatory program, which has proven by far to be the most effective type. Eighty-seven percent of identified properties have been retrofitted or demolished in jurisdictions with mandatory programs, compared to thirteen to 25 percent in jurisdictions with other program types.

Some of the URM law's influences are subtler. The state URM law is credited with creating greater awareness among community leaders and increasing practical experience and capacity to address seismic policy implementation in local jurisdictions. It set the precedent of preserving "local choice" in how to address the problems of seismically-vulnerable existing buildings. This law also brought some public attention to the issue, through exposure to warning signs at building entrances. In jurisdictions with highly effective programs, the URM law likely set the stage for greater willingness to adopt stronger, more proactive approaches for other building types.

Targeted Building Uses

Hospitals

Palo Alto is host to at least two major hospitals, the Palo Alto Veteran's Administration Hospital and the Lucile Packard Children's Hospital, as well as a number of urgent care clinics and other health care facilities, for instance related to Stanford Hospital. State-mandated seismic minimums and upgrade requirements for hospitals were put in place in 1973 through **SB 1953** and periodically amended since. The Office of Statewide Health Planning & Development (OSHPD) develops guidelines, administers the program, and oversees compliance.

Extraordinary resources have been spent to upgrade and develop new hospitals in response to SB1953, resulting in major improvements to both seismic safety and in patient care (OSHPD, 2005). However, progress has been slower than hoped, in part because of the costs of achieving the high levels of performance that the law demands but also because of program complexity and organizational difficulties in managing upgrade programs. A comprehensive study of SB 1953 implementation showed that even organizational leaders highly motivated to reduce risk in the context of strict mandates were not always able to achieve timely progress (Alesch, 2012).

Public Schools

Following the 1933 Long Beach quake that rendered over 230 Southern California schools unsafe, the Field Act was passed to require higher seismic design minimums in new public school construction. The **1939 Garrison Act** required school districts to retrofit or replace pre-Field Act schools. However, many schools did not comply until the mid-1970s.The Division of the State Architect (DSA) oversees this program, and since 2002 has done tracking via the "AB

300 List."[5] Further detail about Field Act implementation statewide can be found in formal state reports (See, e.g., CSSC, 2009).

The status of approximately six Palo Alto area schools that have buildings on the "AB 300 List," could be relevant to future policy development efforts depending on the extent to which the city relies on schools in its emergency response plans. Functioning schools are also known to play a large role in resumption of local business activity as part of recovery.

Essential Services Buildings
State law recognizes that buildings that house mission-critical jurisdictional services and administrative functions should be safe and functional after a major local event. Palo Alto is required by the **California Essential Services Building Seismic Safety Act of 1986** to follow enhanced regulations during the design, rehabilitation, and construction of essential service facilities, defined as fire stations, police, California Highway Patrol, or sheriff offices, or any buildings used in part or whole to conduct emergency communications and operations. As with hospitals, the DSA develops and maintains the design and construction requirements and tracks compliance for this law.

Land Use, Zoning, and Real Estate Disclosure Requirements

General Plan Requirements
According to the **State Planning and Zoning Law**, Palo Alto and other California jurisdictions have been required since 1971 to address earthquake vulnerabilities in their General Plans, currently in the Safety Element.[6] The Governor's Office of Planning and Research (OPR) provides General Plan Guidelines for what jurisdictions must do in creating and implementing their plans, mostly recently in 2011.[7] Typical earthquake-related provisions focus on avoiding development in hazardous areas (for instance near known faults) and adoption of zoning and use requirements that can reduce hazards (such as creation of retention and recharge basins to lessen the impacts of storms).

Palo Alto's last General Plan was adopted over ten years ago. Since 2008, staff have been reviewing and updating different elements in turn. An analysis should be undertaken of any relevant earthquake hazard-related aspects in it, and care should be taken to align and integrate future mitigation program efforts with the City's updated General Plan, which is

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[5] http://www.documents.dgs.ca.gov/dsa/ab300/AB_300_List.pdf (Accessed January 23, 2016). List described as up to date as of Thursday, September 10, 2015.
[6] Government Code §65300-65303.4.
[7] https://www.opr.ca.gov/docs/complete_pzd_2011.pdf (Accessed, March 6, 2016).

currently in development. As of 2016, Palo Alto is working on a comprehensive update to be in effect through 2020 to 2030. More detail is available on a city website designed specifically as part of a highly engaged community involvement process.[8]

Zoning

Palo Alto is on the list of California cities that contain some areas designated by the state as an "Earthquake Fault Zone" (Hart, 2010). The California Geological Survey (CGS) under the California Department of Conservation (DOC) oversees implementation of the **Alquist-Priolo Earthquake Fault Zoning Act of 1972**, a particularly important legacy policy in understanding California earthquake risk management policy. The CGS regularly conducts and updates studies that identify active faults. Buildings within an "Earthquake Fault Zone" face additional planning, use, and disclosure obligations. Additionally, the **1990 Hazards Mapping Act** gave DOC responsibility for mapping areas prone to liquefaction, earthquake-induced landslides, and amplified ground shaking. Within these mapped Zones of Required Investigation, geotechnical investigations to identify hazards and formulate mitigation measures are required before permitting most development.

Small Residential Real Estate Mandates and Disclosures

All sellers of real property in Palo Alto are required to disclose certain facts about the building location and its condition related to earthquake hazards. These requirements began with the **Natural Hazards Disclosure Act of 1990**, which has detailed provisions for what sellers of real property are obligated to do and what kinds of information they must provide prior to point of sale. Requirements are more extensive when the property being sold lies within one or more of the state-mapped hazard areas, including landslides, liquefaction, and Earthquake Fault Zones."[9]

Since 1993, all sellers of residential properties of four units or less must under Government Code Section 8897.1-8897.5:

- Inform the buyer about known home weaknesses related to earthquake risk;
- Properly strap the water heater;
- If the home was built before 1960, deliver a copy to the buyer of the *Homeowner's Guide to Earthquake Safety*[10] brochure produced by the CSSC *(The real estate agent is holds responsibility for this requirement being met)*;

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[8] http://www.paloaltocompplan.org/ (Accessed January 23, 2016).

[9] http://www.conservation.ca.gov/cgs/rghm/ap/Pages/disclose.aspx (Accessed January 20, 2016).

[10] Available at: http://www.seismic.ca.gov/pub/CSSC_2005_HOGreduced.pdf (Accessed February 1, 2016).

- Deliver to buyers a Natural Hazards Disclosure Form telling buyers whether the home is in an Earthquake Fault Zone or in a Seismic Hazard Zone*;* and,
- Complete and deliver to buyers a *Residential Earthquake Hazards Report*.

A similar document called the *Commercial Property Owners Guide to Earthquake Safety*[11] makes recommendations for commercial property buyers and sellers at the time of sale. The only requirement is that sellers must deliver a copy of the booklet to a buyer, "as soon as practicable before the transfer," (Government Code, Section 8893.2) if the property was built before 1975 and has precast (tilt-up) concrete or reinforced masonry walls and wood-frame floors or roofs.

Palo Alto currently features links to both the aforementioned guides on its Building Department website.

Legal Obligations to Tenants

California case law in *Green v. Superior Court* (1974, 10 Cal.3d 616) established that a rental unit must be "fit to live in," or "habitable." In legal terms, "habitable" means that the rental unit is appropriate for occupation by human beings and that it substantially complies with state and local building and health codes that materially affect tenants' health and safety (CA Civil Code §1941, 1941.1).

At time of writing, no common law precedents could be identified regarding thresholds related to seismic risk that would be actionable for tenants to reasonably claim breach of a landlord's implied warranty of habitability. California law is broad by stating that "other conditions may make a rented property not habitable" (CA Civil Code §1941, 1941.1). For example, a rented property may not be habitable if it does not substantially comply with building and housing code standards that materially affect tenants' health and safety (CDCA, 2012). This could be a lead or mold hazard, sanitation issues, or an endangering nuisance, but also potentially if the building is *substandard* because of a structural hazard.

In seeking to develop any new programs, Palo Alto should consider conducting a legal analysis of this important but untested aspect of seismic mitigation policy. Some housing and tenant rights groups have asserted that soft-story and other generally accepted seismic vulnerabilities may constitute a deficiency that a landlord has an obligation to repair, regardless of whether the local jurisdiction has required such work. Citizen complaints of this nature surfaced in Berkeley for instance in 2008 to 2010 (personal communication, 2010 with Jay Kelekian, City of Berkeley Rent Stabilization Board President).

[11] Available at: http://www.seismic.ca.gov/pub/CSSC_2006-02_COG.pdf (Accessed February 1, 2016).

Special Earthquake-Related State-Level Entities and Programs

Following are a few more important state-level entities and resources of which Palo Alto can take advantage.

California Seismic Safety Commission (CSSC)

The California Seismic Safety Commission (CSSC), established in 1975, advises the Governor, Legislature, and state and local governments on aspects of earthquake vulnerability and policy. Its staff offer technical assistance to cities in developing and carrying out seismic related programs. The CSSC is responsible for maintaining a five-year California Earthquake Loss Reduction Plan to establish strategy and coordination for state and local government actions to mitigate earthquake hazards. The most recent statewide Loss Reduction Plan was published in 2013 (CSSC, 2013). It contains detailed lists of policy issues and recommendations that, while comprehensive, prioritized, and sensible, have had limited traction owing to lack of elected official leadership and budget. Other duties include tracking progress on the state URM law and deriving policy lessons from earthquake events. Several CSSC publications are among the best resources for evaluating local mitigation programs.

California Earthquake Authority (CEA)

The California Earthquake Authority (CEA) is a privately-funded, publically managed non-profit entity that provides private insurance policies to homeowners and renters. Eligibility includes homes of four units or less through participating insurers. The earthquake insurance take-up rate statewide is around ten percent. As of January 2016, CEA-affiliated underwriters can now offer a premium discount up to 20% for mitigation investments made. The number of small residential buildings in Palo Alto whose owners carry earthquake insurance is not known, but those that do or that purchase it from hereon could be eligible for this discount. Palo Alto could potentially work to make sure this benefit is better advertised and utilized by building owners.

Additionally, a substantial portion of CEA's annual premium intake is legislatively required to be spent on efforts to achieve mitigation in one-to-four unit homes throughout the state. These funds have been invested in research as well as an important new mitigation grant program for small residential houses called Earthquake Brace and Bolt, which is further described in the Financial Incentives section on the California Residential Mitigation Program. Currently, enrollment for cities is closed but expansion is planned in the future.

Governor's Office of Emergency Services

Formerly known as the California Emergency Management Agency, the Governor's Office of Emergency Services (Cal-OES) coordinates statewide emergency preparedness and response activities. Palo Alto might have untapped opportunities to train City employees at CAL-OES's

Specialized Training Institute.[12] For instance, they have an "Essential Emergency Services Concepts – Earthquakes."

Financial Provisions, Tax Code, and Other Incentive Policies

The potential difficulty of affording retrofit work is universally recognized as a barrier for public and private owners alike. A variety of reports have attempted to catalog incentive, financing and in-kind assistance options that are relevant to city earthquake and resilience programs (See e.g., ABAG, 1992; ATC, 2010; ABAG, 2014; MMC, 2015).

This section highlights a few key pieces of enabling state legislation and federal tax programs that jurisdictions such as Palo Alto could utilize. Specific examples of how different jurisdictions have used specific financing and incentive programs are analyzed in the Task 3 Report.

General Obligation, Special District, and Mello-Roos District Bonds

Palo Alto is allowed to take on general obligation bond debt to help pay for retrofit or construction of new public buildings and to generate funds for providing loans to private owners for seismic work if doing so constitutes a compelling public purpose (Government Code §43600-43638; Government Code §29900-29930).

Advocates have also speculated that communities might be able to use the **Mello-Roos Community Facilities Act of 1982** (Government Code §53311-53317.5). This act allows localities in California to create special Capital Facilities Districts that can sell bonds to generate funds for infrastructure and community facilities and then levy additional property taxes on the real property owners in that district. Such taxes are not subject to Proposition 13 restrictions on property tax increases. Covered services may include streets, water, sewage and drainage, electricity, infrastructure, schools, parks and police protection in old or newly developing areas. The tax paid is used to make the payments of principal and interest on the bonds.

Historic Property Tax Reductions

Palo Alto has many historic structures and may be able to take advantage of the **Mills Act of 1972,**[13] which gives local governments the authority to enter into contracts with owners who restore and maintain historic properties. In exchange, the property owners could get significant property tax savings. Although cumbersome, St. Helena, California is one example of a city that used this tool to help owners of unreinforced masonry buildings to seismically retrofit (ABAG, unpublished soft-story report, 2015).

[12] See: http://www.caloes.ca.gov/cal-oes-divisions/california-specialized-training-institute (Accessed February 1, 2016).

[13] California Government Code, Article 12, §50280-50290, California Revenue and Taxation Code, article 1.9, §439-439.4. Further information available at: http://www.ohp.parks.ca.gov/?page_id=21412 (Accessed February 1, 2016).

Limits on Increases on Property Tax for Seismic Retrofit Costs

Existing state tax law (**California Revenue and Taxation Code** §74.5) provides that the cost of an earthquake retrofit should not increase the property assessment used to determine the amount of property taxes. The extent to which building owners take advantage of this benefit is unknown and might be low because of requirements to submit specific information to their County Assessor's Office *prior* to conducting retrofit work. Many Assessors' Offices do not have forms for this purpose and their staff is not trained to process this benefit. At this time, it is not known how Santa Clara County manages this issue. Palo Alto could potentially work to make sure this benefit is better advertised and truly available to building owners.

Property Assessed Clean Energy (PACE) Financing

New financing programs are starting to exist that could help owners in Palo Alto who might have difficulty securing financing on their own for a seismic retrofit. Based on the Property Assessed Clean Energy (PACE) model first pioneered for solar improvements, owners can apply for 100 percent financing for seismic retrofit work at competitive fixed rates over the useful life of the improvements, to be repaid over up to 20 years with an assessment added to the property's tax bill. The levy stays with the building upon sale and costs can be shared with tenants. Both Berkeley and San Francisco are participating in the open access AllianceNRG Program[14] that offer residential property owners this financing solution primarily for sustainability upgrades and seismic strengthening projects for soft-story construction are also eligible. The AllianceNRG program is offered through California's Statewide Community Development Authority (CSCDA) and partnerships with additional communities are now being offered state-wide since 2015.

After the concept was launched in Berkeley in 2008, PACE programs stalled in 2010 the country's two biggest home lenders, Fannie Mae and Freddie Mac, decided not to underwrite mortgages for PACE customers because it added too much risk in the event of a default because the PACE loan took precedence over the mortgage. Anecdotally, jurisdictions have had some difficulties implementing this type of program for energy improvements.[15] Challenges include setting up this complex financing instrument which has heavy involvement of third parties, barriers to owners that want to refinance, and barriers to the transfer of a PACE-financed properties to a new owner.

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[14] https://www.alliancenrg.com/retail/ (Accessed January 20, 2016).

[15] See e.g., http://www.voiceofsandiego.org/topics/science-environment/some-homeowners-looking-to-move-must-deal-with-a-change-of-pace/ (Accessed February 2, 2016.

California Residential Mitigation Program (CRMP)

Palo Alto and other cities can benefit if the citizens can stay in their homes and "shelter in place" following a major local quake. One new important effort on this front is the California Residential Mitigation Program (CRMP). It was formed in August 2011 to carry out mitigation programs to assist California homeowners who wish to seismically retrofit their houses. CRMP's goal is to provide grants and other types of assistance and incentives for these mitigation efforts. The California Residential Mitigation Program is a joint-exercise-of-powers entity (JPA) formed by two core members: the California Earthquake Authority (a public instrumentality of the State of California known as CEA) and the Governor's Office of Emergency Services (Cal-OES). CRMP is a legally separate entity from its members.

The first of these programs, **Earthquake Brace + Bolt**: Funds to Strengthen Your Foundation (EBB)[16] was launched as a pilot project in September 2013 in selected zip codes only. EBB offers a cash grant up of to $3,000 for qualifying bolts or sill anchoring installment. Homeowners must register and be accepted into the program, with a cap on the number of participants. The current registration window was open from January 20 to February 20, 2016. Participation is determined by lottery if more applications are received than funds are available. At present, no Palo Alto zip codes are in the program. The selection of the specific neighborhoods and zip codes was based upon analysis of U.S. Census data identifying areas of high seismicity and having a concentration of owner-occupied homes built in 1979 or earlier. According to personal communications with CEA mitigation program representatives, Palo Alto zip codes are not likely to be prioritized highly owing to the modest number of very old single family homes.

Federally Mandated Municipal Obligations and Opportunities

Even though the focus of this review is California, two particularly relevant federal programs for Palo Alto are described below. As with the state, no centralized governmental authority exists at the federal level to regulate issues of seismic safety. Instead, authorities and strategies are widely distributed among agencies at the local, state, and federal levels. For instance, the Department of Housing and Urban Development operates several initiatives related to safer homes and resilient communities,[17] and the General Services Administration must confront seismic risk concerns as it manages most federal facilities. The federal role is concentrated in FEMA and principally focused on emergency response and recovery, although mitigation is also addressed.

[16] https://www.earthquakebracebolt.com/ (Accessed January 23, 2016)

[17] See, e.g., the Smart Growth America Resilience States program, http://www.smartgrowthamerica.org/resilience/ (Accessed February 1, 2016).

Local Hazard Mitigation Planning Under the Disaster Management Act

The federal **Disaster Management Act of 2000** (DMA) and subsequent amendments specify that local jurisdictions and states must have approved Hazard Mitigation Plans in place in order to be eligible for aid following Stafford Act Disaster declarations and a variety of other benefits. The State of California Multi-Hazard Mitigation Plan of 2013[18] is a comprehensive source of information about state level requirements, mitigation strategies, as well as local and state progress and opportunities for coordination (CSSC, 2013b).

Palo Alto current complies with the DMA through its participation in the 2011 Santa Clara County's Office of Emergency Services Annex to a 2010 region-wide "umbrella" Local Hazard Mitigation Plan (LHMP) created by the Association of Bay Area Governments (ABAG). To create the plan, representatives from County departments, private sector businesses, stakeholders, and thirteen of the fifteen incorporated cities in Santa Clara County collaborated in identifying and prioritizing potential and existing hazards. Mitigation objectives were identified and prioritized and specific action steps are listed, many of which have been taken. Palo Alto is currently preparing its contributions for updates to the Santa Clara County LHMP which must be completed, submitted to the state, and approved by June 2017. The LHMP process creates an opportunity to build synergies between an updated seismic program and other mitigation efforts city and county-wide.

Federal Emergency Management Agency (FEMA) Pre-Disaster Mitigation Grants

Cities such as Palo Alto are eligible to apply to the **Pre-Disaster Mitigation (PDM) Grant Program**[19], created by Section 203 of the federal Robert T. Stafford Disaster Relief and Emergency Assistance Act, funded annually by Congressional appropriation. The program aims to assist States, territories, Federally-recognized tribes, and local communities in implementing a sustained pre-disaster natural hazard mitigation program. Cities must submit a detailed application during an open window to an annual competition. This program awards planning and project grants as well as providing assistance in raising public awareness about reducing future losses before disaster strikes. The program works on a 75%/25% cost share between FEMA and the local jurisdiction, respectively, with a maximum grant of $3 million. Cities can submit applications for multiple projects. Palo Alto could apply for support for future projects ranging from updating city owned structures, direct financing or grants to a private class of buildings or specific important structure.

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[18] Available at: http://hazardmitigation.calema.ca.gov/docs/SHMP_Final_2013.pdf (Accessed February 1, 2016).

[19] http://www.fema.gov/hazard-mitigation-grant-program (Accessed January 15, 2016).

The disaster occurrence that opens a funding availability window does not necessarily have to affect Palo Alto directly. For instance, *any* California jurisdiction with an active LHMP was permitted to propose projects based on the Presidential Disaster Declaration for the 2015 Valley and Butte fires.

Finally, if City of Palo Alto employees have not already taken advantage of it, training opportunities are available at the FEMA Emergency Management Institute in Maryland.[20]

3. Legislative Leadership and Recent Developments

Palo Alto citizens are represented in the state Senate by Jerry Hill (D) and in the Assembly by Rich Gordon (D), 24th District, both with terms ending in 2016. High earthquake exposure throughout coastal California has led legislators from a variety of districts to author legislative proposals. Most recently, leadership has come from elected officials Nazarian, Chiu, and Monning.

Several different committees in the California Assembly and Senate have jurisdiction over issues related to seismic safety and mitigation, building codes, and earthquake-related programs. In the Assembly, the Committee on Housing and Community Development has jurisdiction over building standards, common interest developments, eminent domain, farm worker housing, homeless programs, housing discrimination, housing finance (including redevelopment), housing, natural disaster assistance and preparedness, land use planning, mobile homes/manufactured housing, and rent control. The Assembly Committee on Local Government has authority over a range of General Plan, city finance, and housing policies. The most relevant Senate committee is Transportation and Housing, which governs issues such as transfer of ownership, financing districts, manufactured housing, building codes and standards, and common interest developments.

Through these committees, legislators have considered several pieces of legislation related to earthquake mitigation in recent years. This review identified around ten such pieces of legislation debated in the 2013 to 2015 California legislative sessions, including passed, pending, vetoed or never fully heard bills (see Appendix B). Three key legislative proposals of interest to Palo Alto are briefly described here.

Vetoed: Seismic Mitigation Tax Credits

In the most recent session, Assembly Member Adrin Nazarian (District 46 in the San Fernando Valley) has sponsored legislation to create a state-wide seismic mitigation tax credit. The 2015 version **AB 428** passed the legislature but was vetoed by the Governor based on funding availability, lack of technical and administrative capacity in the Franchise Tax Board, and the

[20] https://training.fema.gov/emi.aspx (Accessed February 1, 2016).

program's potential complexity. The law would create a first-come first serve state tax credit equal to 30 percent of a "qualified taxpayer's" "qualified costs" incurred for "seismic retrofit construction."

Pending: Permissions to Expand CEA Insurance Mitigation Discounts

CEA was active in promoting legislation last year to empower the CRMP to offer grants for small residential retrofit work. Currently pending are **AB 1429** (Chiu) and **AB 1440** (Nazarian) that will provide $3 million dollars to the CRMP for expanding its current EBB program.

Dead: Soft-Story and Older Concrete Mitigation Program Authorization

AB 2181 (Bloom)[21] would authorize each city, city and county, or county to require that owners assess the earthquake hazard of soft story residential buildings and older concrete residential buildings. It includes older concrete residential buildings constructed prior to the adoption of building codes that ensure ductility, and to initiates programs to inform owners, residents and the public about such dangers. There is no state law that forbids such programs, but this law if passed would remove any ambiguity that such programs are permitted and further justify local actions to that effect.

4. Conclusions

Palo Alto is affected by numerous California laws and regulations related to seismically vulnerable structures, dating from the 1930s to the present day. The requirements relate to many aspect of the city's built environment, including:

- Code minimums for new construction;
- Standards for seismic rehabilitation, including special provisions for historic properties;
- Special programs and expectations for certain classes of use such as hospitals and public schools, and essential facilities;
- Mandatory and voluntary unreinforced masonry programs;
- Mandated zoning and land use planning requirements that restrict use and add requirements;
- Grant and insurance programs available to one to four unit dwellings;
- Financing authorities such as issuance of general obligation bonds and provisions for handling of property taxes for the costs of needed seismic retrofit; and

[21] http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB2181 (Accessed February 1, 2016.

- Real estate disclosure requirements.

Beyond some recent and pending efforts related to funding small residential mitigation grant programs and Earthquake Early Warning, there is no apparent momentum at this time for new statewide initiatives. That being said, Palo Alto can take any of several actions listed below to make sure it is complying with and taking the greatest possible advantage of existing state laws and programs. For example:

- **Palo Alto could confirm that all its URM buildings maintain the required signage.**
- **Palo Alto could investigate the status of the approximately six Palo Alto area schools that have buildings on the State's "AB 300 List" related to the Garrison Act.**
- **Palo Alto could identify and review the status of public facilities covered under the Essential Services Building Seismic Safety Act and review its policies for guiding future planning for or rehabilitation of such structures.**
- **Palo Alto could take advantage of the current update process for its Local Hazard Mitigation Plan to develop a strong, coherent, shared vision for how the city is going to address earthquake risk, and encourage jurisdictions and special districts nearby to do the same.** Resources from FEMA Hazard Mitigation Grants and knowledgeable partners such as the Association of Bay Area Governments may be available to assist in this effort.
- **Palo Alto could work carefully to incorporate the most up-to-date assessment of local earthquake vulnerabilities as it revises the Safety Element of its General Plan.**
- **Palo Alto could make sure its employees have taken advantage of the best available state and federal emergency management training programs that are relevant to earthquake disasters and recovery.**
- **Palo Alto could develop partnerships and devote resources to more fully realizing the benefits of statewide offerings of tax relief and requirements regarding real estate disclosure in private sales.** These policies aim to empower buyers and sellers to be better informed and able to make better mitigation decisions for themselves but may be carried out incorrectly and are under-enforced. Palo Alto could, for instance, work to make sure building owners apply for relief from any property assessment increases that would otherwise result from investing in an earthquake retrofit.
- **Palo Alto could seek closer ties to the California Earthquake Authority to help in promoting mitigation and insurance coverage for one to four unit homes.** CEA has recently been one of

the lead entities in offering policy ideas and grant funding for earthquake mitigation of small residential structures.

- **Palo Alto could evaluate whether it contains any vulnerable historic properties that might be eligible for tax credits under the Mills Act.** This Act provides the most significant direct source of financial support from the state for local seismic retrofitting.
- **Palo Alto could investigate the issue of seismic habilitability minimums for suspected earthquake vulnerable buildings.** Legal uncertainty exists about whether tenants are already entitled under current state law to request that their landlord upgrade a structure for being "substandard."
- **Palo Alto could join with fellow jurisdictions in advocating for changes in state law to promote seismic mitigation.**
- **Palo Alto could develop partnerships and devote resources to bringing more awareness among its citizens about low cost or free ways to become more aware and prepared for disasters more broadly.** Cal-OES and many other state and non-profit institutions offer free online tools such as http://myhazards.caloes.ca.gov/ to help citizens understand their risks and take private action.

The power to address unmet seismic safety and recovery concerns clearly rests in the hands of cities, counties, and special districts. If it so chooses, Palo Alto has legal authority to widen and/or strengthen its structural mitigation program. Based on what state laws allow and in some cases recommends, this review revealed the following non-exhaustive list of policy directions Palo Alto could pursue going forward:

1. **Palo Alto could implement measures to energize and raise the effectiveness of its current program (outlined in City of Palo Alto Municipal Code 16.40), for instance by offering additional or larger incentives or devoting more resources to program visibility and implementation.** Making the current program more effective would likely require additional funding sources. Other jurisdictions are experimenting with some success in using tools such as the new state-wide PACE financing program. Palo Alto could investigate opportunities to establish special Mello-Roos or Mills Act districts to help finance local seismic mitigation.
2. **Palo Alto could expand its voluntary seismic mitigation program to address one or more combinations of additional building types, occupancy levels, or uses.** The State Legislature has

formally passed advisory legislation that encourages jurisdictions to adopt policies for building types like soft-story and older concrete.[22]

3. **Palo Alto could create mandatory screening or evaluation measures for one or more vulnerable building types such as soft-story buildings or older concrete structures.** Local precedents for these approaches exist and are described and discussed in a separate Task 3 report.

4. **Palo Alto could make its current voluntary URM program mandatory.** Mandatory URM programs in the State have been on average three times more effective than voluntary ones.

5. **Palo Alto could create a program that mandates seismic retrofits for one or more additional (non-URM) vulnerable building types.** The State Legislature has formally passed legislation that authorizes cities to adopt rehabilitation requirements for such programs This is important because cities must reference acceptable standards that state clearly how owners can comply with the requirement to retrofit.

6. **Palo Alto could craft a program that combines any or all of the above measures.** The Task 3 report shows that most leading local earthquake programs involve a customized mixture of goals, requirements, and features.

7. **Palo Alto could continue the status quo current program.** Nothing under current state law requires Palo Alto to change its current approach.

The City of Palo Alto is currently gathering up to date earthquake risk information about its building stock and engaging its citizens and local experts in order to develop and evaluate specific policy alternatives. The ultimate goal is to recommend to city leaders the best possible policy directions for Palo Alto moving forward.

[22] Health and Safety Code §19160-19168 http://www.leginfo.ca.gov/cgi-bin/displaycode?section=hsc&group=19001-20000&file=19160-19168

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CHAPTER III

LOCAL PROGRAM BEST PRACTICES ASSESSMENT

Executive Summary

This chapter summarizes the status of local seismic safety and mitigation programs in California with the purpose of informing Palo Alto's effort to update its own approach. It has been prepared per Task 3 of the Consulting Agreement between Rutherford + Chekene and the City of Palo Alto. The content builds on the state-level policy review presented in Chapter II. The scope of Task 3 is to:

- Review present best practices among jurisdictions and agencies in this area that require seismic retrofitting and provide incentives, and deliver a brief summary.
- Provide a concise and practical written summary of what other jurisdictions and counties have done legislatively and programmatically to increase awareness about, assess, and motivate mitigation of seismically vulnerable buildings, both listing and helpfully classifying various approaches that have been used.

The process of creating this review included search and review of published and online reports and materials, several phone interviews with community leaders as well as local and state government staff, and development of insights from the consulting team based on their experiences in this arena.

Palo Alto is currently laying a solid foundation for future program development by investing in new inventory and risk information as well as community outreach and internal staff discussions. In doing so, it is joining a group of leading coastal California coastal jurisdictions such as Berkeley, Oakland, San Francisco, and Los Angeles that have recently stepped up their earthquake risk reduction efforts. While there is much learning and information sharing going on, each jurisdiction has developed their own customized policy package, and there is no single best model that Palo Alto can straightforwardly adopt. Existing local approaches differ widely in the following ways:

- Policy mechanisms used to achieve progress;

- Scope of targeted building types or uses addressed;
- Prioritization and compliance timeframes; and
- Types of incentives offered.

Policy mechanisms in use range all the way from inventory only to mandatory retrofit with timeframes under five years. In between are more gradual approaches such as voluntary retrofit advocacy, incentives, provisions that make building deficiencies more visible to the public (disclosure measures), and mandatory screening and evaluation requirements. An important policy decision is whether any mandated actions are implemented on a fixed timeline or triggered at sale or at some renovation cost threshold.

Targeted building types and characteristics also vary. The most commonly addressed building type is ***unreinforced masonry (URM)*** construction due to state law SB 547, as discussed in the Task 2 report. Over half of URM programs in the state require mandatory retrofit, often but not always with a time frame on the order of ten to twenty years. By 2006, seventy percent of all identified URMs were either demolished or retrofit. Retrofit rates are on average three times higher in jurisdictions with mandatory retrofit compared to voluntary programs. Jurisdictions used a wide variety of both financial and policy incentives to assist URM owners. Some voluntary URM programs, including Palo Alto's, coupled with incentives, have achieved similar rates of success to mandatory programs.

Newer programs have focused on ***soft-story wood frame buildings***, including ten Bay Area jurisdictions and most recently Los Angeles as of 2015. Soft-story wood frame building programs also range in requirements from notification only to mandatory retrofit, but several jurisdictions have innovatively used intermediate mandatory screening and evaluation phases to further assess risk exposure and determine the final set of buildings that will be affected by retrofit requirements. Soft-story wood frame programs have largely been supported in the local community. Even voluntary soft-story wood frame programs can be effective at motivating retrofit action; one fourth of the soft-story wood frame buildings in the City of Berkeley were voluntarily retrofit within a few years after a mandatory evaluation ordinance was implemented. Compliance timeframes in soft-story wood frame programs tend to be short, on the order of two to seven years.

A comparatively small number of southern California jurisdictions have acted to address ***older concrete buildings***, including Los Angeles, Burbank, Santa Monica, and Long Beach. Nonductile concrete frame and tilt-up concrete structures in particular are known to pose serious risks. Programs aimed at older concrete range from voluntary guidelines to mandatory evaluation and full retrofit requirements. Timeframes here vary greatly, from years to decades. Information about the implementation and outcomes of these few programs is very limited.

Coming out of this local program review, alternative policy approaches for Palo Alto's consideration include:

Option 1: Status Quo. In this option, the existing ordinance with its mandatory evaluation, voluntary retrofit approach remains in place without changes. Floor area ratio bonuses are (were) available and could continue to be offered.

Option 2: Increase Scope, but Retrofit Remains Voluntary. Additional categories of structures are added to the mandatory evaluation requirements. These could include any or all of the building types discussed above, potentially also using additional location, use, or occupancy criteria.

Option 3: Similar to Option 2, but Additional Disclosure Measures are Incorporated. This option would be similar to Option 2, but with increased use of disclosure measures such as prominently posting the building list on the City website, notifying tenants, requiring signage, and/or recording notice on the property title.

Option 4: Increase Scope, Some Categories are Voluntary and a <u>Few</u> Categories are Mandatory, with Enforcement by Trigger Threshold

This option builds on Option 3, but retrofitting would be required for some building types *at whenever future time a building is sold or undergoes substantial renovation* above a set threshold.

Option 5: Increase Scope, Some Categories are Voluntary and a <u>Few</u> Categories are Mandatory, with Enforcement by a Fixed Timeline

This option would be similar to Option 4, but retrofitting is required *according to a fixed timeline*. Timelines and enforcement emphasis could vary depending on tiers or priority groupings to motivate prompt action for the most vulnerable or socially important structures.

Option 6: Increase Scope, but <u>More</u> Categories are Mandatory

This alternative is similar to Option 5, but retrofitting would be required for additional categories on a fixed timeline. Palo Alto can also make its programs more stringent over time. Explicit phasing has been successful in jurisdictions like Berkeley and San Francisco for generating political consensus and enhancing administrative feasibility.

Other program features and implementation factors should be considered in designing a future program. Palo Alto will need to decide whether location, occupancy type, and/or number of occupants should be included in the scope or just the timeline categories. Whether and which incentives to offer is an important issue from a political and economic feasibility perspective, one that affected community members will want to see inclusively addressed. The community should also be involved in discussing which if any disclosure measures are considered necessary and appropriate, such as signage.

Additionally, based on the work of cities such as Berkeley, San Francisco, and Los Angeles, Palo Alto has a variety of opportunities to expand and better connect its earthquake mitigation program efforts to other city efforts in support of community resilience goals more broadly. For instance, Palo Alto could encourage building occupancy and resumption program like San Francisco, encourage or fund installation of strong motion instruments, or pursue special programs or requirements for cell phone towers, facades, private schools, and/or post-earthquake shelter facilities. Several leading local program models and planning resources for these types of efforts are introduced in Appendix D.

1. INTRODUCTION

This document is meant to be a resource and guide for the Palo Alto community and city leadership as they weigh program needs and options for seismic mitigation policymaking going forward. It offers comprehensive information on many topics so readers with different backgrounds can advance their understanding, along with summary tables and conclusions specific to Palo Alto's present effort.

The approach taken was to document and assess existing and proposed programs that a selected set of other jurisdictions are using to address earthquake vulnerabilities in local buildings. This was done using analysis of city websites and documents, search and review of published and online reports, several phone interviews with local officials and engineering profession leaders, and development of insights from the consulting team based on their experiences in this area.

Focusing on a selected set of jurisdictions was appropriate for several reasons. First, relatively few jurisdictions are developing leading earthquake mitigation programs, and those are the most informative models to draw upon. Second, data about jurisdictional programs is very limited. Much of the information that does exist is anecdotal, and it was not within the scope of this review to collect comprehensive new data or to cover a large number of jurisdiction programs statewide or in other countries. Finally, this review emphasizes classification of similarities and distinctions among a range of leading jurisdiction earthquake structural mitigation efforts. Policies related to wider earthquake hazard science and awareness, emergency management, and longer term recovery programs that have local relevance are briefly mentioned, but are also beyond the scope of this report.

Following this introduction, Section 2 describes and compares a range of existing local policies and programs. The information is organized by key features (for instance, the types of buildings regulated, the kinds of requirements imposed on them, and the types of incentives offered).

Section 3 presents summary conclusions for Palo Alto. Figures throughout and two appendices provide further detail on a range of program elements. Formal recommendations for Palo Alto will evolve after completion of other project tasks, and through the process of Advisory Group and City staff discussions.

2. Analysis of Policy Features and Outcomes of Local Seismic Risk Mitigation Programs

This section analyzes the state of local earthquake policymaking in California by presenting major types, similarities, and differences in program features. The word "features" indicates here a wide array of program nuances, including but going well beyond the characteristics of the buildings being targeted and the basic policy mechanism used, namely voluntary or mandatory retrofit requirements. Woven throughout are examples of jurisdictional programs that exemplify certain of these features and distinctions, along with discussion of program outcomes and effectiveness. Analyzing programs this way highlights options and key factors that Palo Alto should consider and tradeoffs it may need to confront in developing its own seismic mitigation strategy going forward.

Much innovation in local earthquake risk reduction policy is happening in California from which Palo Alto can learn. This is particularly true in the case of soft-story wood frame residential buildings,[23] for which mandatory retrofit ordinances are now in place in Fremont, San Francisco, Berkeley, and Los Angeles. However, what makes one program different from or more successful than others cannot be understood simply by identifying the types of structures addressed. Also important are the specific set of requirements that owners must comply with, the timeframes in which requirements must be carried out, and the types and sizes of the incentives offered.

Comprehensive, summary information to inform this review are rare. In-depth California Seismic Safety Commission URM reports cover every city and county for URM law compliance up to 2006. But beyond URM programs, data to support this assessment was limited and largely anecdotal because comprehensive research on seismic mitigation programs is rare. An

[23] "Soft-story" refers to a condition where one of the stories in a multi-story building, usually a parking level that doesn't require partitions for functionality, is weaker and/or too flexible compared to the story above it. Another acronym sometimes used is "Soft-, Weak-, or Open-Front" buildings, or SWOFs. During strong ground shaking, concentration of damage in the soft or weak story can significantly increase the chance of collapse or damage sufficient to render the building unusable after the event. Many communities are concerned with soft-story wood frame buildings. Most of this type of construction can be found in apartment buildings built in the 1960s and 1970s with first floor garage openings and some mixed-use properties with ground floor commercial space. In that era, the safety risks of soft-stories were not yet fully understood. Vast numbers of these buildings exist in California communities that grew substantially prior to the 1980s and 90s when building code changes were introduced. Findings related to evaluating and improving soft-story wood frame performance can be found in FEMA P-807, available at: https://www.fema.gov/media-library/assets/documents/32681 (Accessed February 3, 2016).

Association of Bay Area Governments (ABAG) survey that collected program information from one third of California jurisdictions in the 1990s documented a wide variety of program implementation, effectiveness, and incentive approaches; however, its information is now significantly out of date. Policies of certain leading jurisdictions have been studied in depth at various windows in time, such as Palo Alto) (Herman et al, 1990), Berkeley (Rabinovici, 2012; Chakos, 2002), Oakland (Olson, 1999), and Los Angeles (Comerio, 1992). These studies reveal how unique and complicated local earthquake mitigation programs can be, not just in format but also implementation. Outcomes cannot be understood without considering the local building stock and economic context, concurrent policy developments, political support, local government resources and administrative capacity, how policy features are combined, community engagement strategies used, and emphasis put on enforcement.

At the outset, Palo Alto's unique current program and historic role in the evolution of earthquake mitigation program design should be recognized. Its 1986 law was among the first to require owners of suspected hazardous properties to have a qualified engineer *evaluate* their buildings. In addition, Palo Alto's Seismic Hazards Identification Program (Chapter 16.42) addressed three categories of buildings: URM buildings (Category 1), structures built before 1935 with over 100 occupants (Category 2); and structures built before August 1976 with over 300 occupants (Category 3). This demonstrates how ***occupancy level*** and ***year built*** can also be used in combination with other factors as the basis for inclusion in a program. The mandatory evaluation reports for these structures were due in 1990. The September 2014 status of affected properties is shown in Table 1.

Table 1: Status as of September 2014 of properties included under Palo Alto's current earthquake risk reduction ordinance.

	Category I – URM over 1900 sq.ft. and over six occupants	Category II – Built before 1935 and over 100 occupants	Category III – Built before 8/1/76 and over 300 occupants	All Categories
Retrofit	22	13	5	40
Demolished	14	2	5	21
Demolition Proposed	0	0	4	4
Exempt	1	0	0	1
No Change	10	4	9	23
Totals	**47**	**19**	**23**	**89**

Source: 12/9/14 City of Palo Alto Policy and Services Committee staff report.

Palo Alto's decision to focus on these three categories grew out of a broader earthquake risk assessment effort going on at that time. City leaders initiated a comprehensive search of paper records and a street walk-style inventory of a wide variety of seismically-vulnerable building types in 1984. They then engaged the community in a deliberative process to assess risk and determine priorities among building types and policy approaches (Herman, Russell, et al. 1990; CSSC 2006).

The following section describes alternative ways different jurisdictions have chosen which buildings to target.

Scope: Targeted Structural Systems, Year Built, and Other Characteristics

The primary feature that varies among jurisdictional programs is the types and characteristics of the structures that are addressed. As discussed in the Task 2 report, California's earthquake policy history started in the 1930s with laws that increased design requirements for buildings related to one particular *use*—public schools, and banned ***new construction*** of one particular ***structural system or type***—buildings with unreinforced masonry (URM) load bearing walls. Much later in the 1970s and 80s, both state and local new laws were passed targeting URMs built before 1933, certain ***locations*** (e.g., hazard zoning with prohibitions or heightened evaluation and design scrutiny for new construction or rehabilitation in those zones), a wider set of ***uses*** (e.g., hospitals and essential services buildings) and additional structural types (e.g., older concrete buildings and manufactured homes).

The choices jurisdictions make about which buildings to target are closely tied to the legal basis underlying earthquake mitigation policymaking. Laws that impose added burdens or responsibilities on certain properties or people must clearly specify which buildings are applicable and justify why for those particular buildings have been selected. A compelling, documentable, and actionable public purpose must exist to invoke a jurisdiction's police powers and responsibility for public wellbeing.

The central rationale for regulating seismically vulnerable structures is safety; a strong case for government intervention exists where there is an unacceptably high likelihood of collapse or damage that could lead to human entrapment, injury, or death. Technical research, evidence, and evolving standards of practice in structural engineering must exist for this to be considered reasonable. Once a new practice becomes embedded in a model building code, construction to former code standards is no longer allowed. Jurisdictions review permits and inspect construction work in progress, but lax compliance cannot entirely be ruled out.

For any particular structural system, year built (or age) is the most commonly used risk indicator because it reflects the building code version that was in effect when a structure was first constructed. What was once considered an acceptable construction practice may become obsolete or even be considered negligent years later. Code updates are usually made on a three-year cycle to keep up with changes in construction practices, technologic advancements, and improved understanding how buildings perform under loads, but adoption by jurisdictions can be uneven and lag behind many years.

Jurisdictions must also address which code year built they will use as inclusion criteria for their earthquake mitigation programs. Benchmarking to newer standards may be justified if it reaches more buildings that could experience significant damage in an earthquake, but a larger percent of building owners and tenants will be affected. Code changes are also proposed based on lessons learned from practical experience over time, in this case from earthquake performance outcomes in jurisdictions all around the world.

Unreinforced Masonry Buildings

URM buildings have been a concern for collapse and falling debris hazard ever since the 1933 Long Beach earthquake, after which new construction of URM structures in California was outlawed. The most significant contemporary law addressing a specific building type is the 1986 state legislation (Senate Bill 547). This state mandate, also summarized in the Task 2 report, required jurisdictions to identify and adopt programs for addressing existing URM buildings. Several jurisdictions (most prominently Long Beach, Los Angeles, Santa Cruz, Palo Alto, and San Francisco) had existing URM building ordinances and programs in place prior to the state mandate. Counties and municipalities were allowed to craft their own approach, resulting in a wide range of strategies.

In general, three main types of local programs were utilized: 1) mandatory retrofit, 2) voluntary retrofit, and 3) notice to owners that the structure is a URM building. When retrofits were encouraged or required, the local government set the standards to be met. More than half (52%) of affected jurisdictions adopted a mandatory program, which has proven by far to be the most effective type. Eighty-seven percent of identified properties have been retrofitted or demolished in jurisdictions with mandatory programs, compared to thirteen to 25 percent in jurisdictions with other program types.

Reviews of the URM Law by the CSSC have shown it to be a success over the long term. In 2006 (the last comprehensive state survey available), Compliance with the policy is nearly universal at 93%, and over 70% of identified URM buildings have been either retrofitted or demolished (CSSC, 2006). A comprehensive review of URM program formats throughout the Western United States is available from FEMA and the California Seismic Safety Commission (FEMA, 2009; CSSC, 2006).

Older Concrete Buildings

Older concrete structures (built pre-1970s and in some cases pre-1990s) exemplify the importance and difficulties of using code year as an indicator of seismic risk. Public awareness of older concrete risks may be lower than for soft-story wood frame buildings, but they are common in large numbers in the Western US and throughout California. The Concrete Coalition,[24] a network of engineers, research organizations, and policymakers, estimates that there are as many as 17,000 non-ductile concrete buildings in California (Concrete Coalition, 2011). The societal importance of older concrete structures can be significant, as they often have higher occupancies and are widely used for residential tall buildings, commercial, or even critical service facilities.

[24] Information about the Coalition can be found at the organization's website: http://www.concretecoalition.org/, Accessed March 18, 2016.

Poorly performing concrete structures can have devastating effects for occupants, owners, and communities, as numerous major quakes in California and abroad have demonstrated. The 1971 Sylmar earthquake brought down several concrete structures, killing 52, and the 1994 Northridge earthquake wrecked even more, including a Bullock's department store and Kaiser medical office. In the 2011 quake in Christchurch, New Zealand, two concrete office towers collapsed killing 133 people. Many of the 6,000 people killed in the 1995 earthquake in Kobe, Japan, were in concrete buildings.

A scenario report for the San Francisco Bay Area estimates that older concrete buildings in a repeat 1906-level event would contribute a large portion of the predicted deaths and injuries (ABAG, 1999). Also at risk are investors, the survival of occupying businesses, and livelihoods. Neighborhoods can be at risk too if a district has a high concentration of older concrete buildings, as they may be blighted or loose functionality or economic viability after an event.

Older concrete buildings of concern have a variety of features and are not always easy to characterize. One issue is nonductile (essentially too brittle, insufficiently reinforced) concrete, prior to enforcement of ductile concrete codes in the 1970s. Another is tilt-up structures, where a concrete is poured on the ground, cured, and then lifted (or “tilted”) up and connected to roof and floor framing where the ties between the roof and wall and floors and walls are often inadequate.

Vulnerable concrete structures can be difficult to spot and often complex to retrofit (ATC, 2012). These are factors in why only a small number of California jurisdictions have adopted policies for older concrete (Table 2). The City of Los Angeles (Building Code Divisions 91 and 96) recently required evaluation and upgrade if needed for nonductile concrete structures and since Northridge has required triggered upgrading on pre-1976 tilt-ups. City of Santa Monica (Municipal Code 8.80) requires evaluation and upgrade if needed for nonductile concrete structures, along with other structural types. In 2014 Santa Monica hired the engineering firm Degenkolb to inventory buildings that might be subject to its requirements—a first step in reviving efforts that had been stalled for more than 20 years.[25] Two jurisdictions, Long Beach (Chapter 18.71) and Burbank, have taken the approach of providing voluntary guidance. Burbank’s program addresses older reinforced concrete and concrete frame buildings with masonry infill.

[25] http://www.latimes.com/local/lanow/la-me-ln-santa-monica-will-hire-quake-engineers-to-id-all-vulnerable-buildings-20140527-story.html (Accessed March 20, 2016).

Table 2: Summary table of local programs for addressing older concrete building vulnerabilities.

Jurisdiction	Number of Older Concrete Buildings	Program Type	Targeted Building Characteristics	Deadline for Screening	Deadline for Evaluation	Deadline for Completion
Los Angeles	Unknown (Concrete Coalition inventory* = 1500)	Mandatory evaluation leading to mandatory retrofit	Pre-1976 tilt-ups and nonductile concrete	3 years	10 years	25 years
Santa Monica	Unknown (Concrete Coalition estimate* = 173)	Mandatory evaluation leading to mandatory retrofit	Pre-1978 nonductile concrete.	n/a	275 days	Deadlines vary from 1 to 4 years after evaluation report submission, depending on priority tiers. **
Long Beach	Unknown (Concrete Coalition estimate* = 396)	Voluntary guidance	Nonductile concrete		n/a	
Burbank	Unknown (Concrete Coalition estimate* = 132)	Voluntary guidance	Commercial pre-1977 reinforced concrete and concrete frame buildings with masonry infill		n/a	

* Source: (Concrete Coalition, 2011).
** Santa Monica’s Building Type definitions are: Type I: building that are vital in the event of an emergency; Type II: >100 occupants; Type III: 20 - 100 occupants; Type IV: < 20 occupants.

Soft-Story Wood Frame Buildings

Wood frame soft-story buildings are a good example of a vulnerable building type that gained widespread attention after performing poorly in specific earthquake events. In October 1989, the hazard and widespread presence of this building type were made evident by the dramatic and costly collapses and fires in the San Francisco Marina District in the Loma Prieta earthquake. Then again, in the Northridge event in 1994, widespread damage and several high profile collapses occurred. The Northridge-Meadows apartment complex collapse that led to sixteen deaths in particular captured media, public, and expert attention.

Following these events, soft-story residential buildings started to be viewed as not just a threat to the owner's pocketbook but to the surrounding community; tenant safety and local recovery could also be at stake. Given their prevalence, losing hundreds of soft-story apartment buildings could have large impacts on community. For example, soft-story buildings constituted about half (7,700) of the 16,000 housing units rendered uninhabitable in the Bay Area by the 1989 Loma Prieta Earthquake and over 34,000 of the housing units rendered uninhabitable by the Northridge Earthquake in 1994 (ABAG, 2003). Table 3 describes a wide range of local efforts to address soft-story wood frame buildings, highlighting key program features and distinctions (many of which are discussed in later sections regarding prioritization, timing, and policy mechanisms).

Table 3: Summary of local soft-story wood frame policy efforts showing key distinguishing program features.

(Sources: Rabinovici, 2012; ABAG, 2016).

Jurisdiction	Year	Number of Soft-story Buildings	Program Type	Targeted Building Characteristics	Priorities or Tiers	Deadline for Evaluation	Deadline for Permit	Deadline for Completion
Los Angeles	2015	unknown	Mandatory Evaluation leading to Mandatory Retrofit	Pre-1978 wood-frame structures with soft, weak or open front first floor conditions with two or more stories and five or more units. Only *enforcement* is prioritized by tiers.	**Priority I -** Buildings containing 16 or more dwelling units. **Priority II** - Buildings with three stories or more, containing fewer than 16 dwelling units. **Priority III** - Buildings not falling within the definition of Priority I or II.	1 year	2 years	7 years
Oakland	2015	1,380	Mandatory Screening (passed 2009) leading to Mandatory Retrofit	Pre-1985 multi-family wood frame structures with five or more units	n/a			

Table 3 (continued).

Jurisdiction	Year	Number of Soft-story Buildings	Program Type	Targeted Building Characteristics	Priorities or Tiers	Deadline for Evaluation	Deadline for Permit	Deadline for Completion
Berkeley	2014	310 (at time of 2005 ordinance)	Mandatory evaluation law (2005) leading to mandatory retrofit (2014)	Multi-family wood frame structures with five or more units	n/a	2 years (under previous soft-story evaluation ordinance)	2 years	4 years
San Francisco	2013	2,800	Mandatory evaluation leading to mandatory retrofit	Wood frame construction with five or more residential units and two or more stories with permit for construction submitted prior to January 1, 1978 and five or more units	**Tier I** - Any building containing educational, assembly, or residential care facility uses (Building Code Occupancy E, A, R2.1, R3.1, or R4)	1.5 years	2.5 years	4.5 years
					Tier II - Any building containing 15 or more dwelling units	2.5 years	3.5 years	5.5 years
					Tier III - Any building not falling within another tier	3.5 years	4.5 years	6.5 years
					Tier IV - Any building containing ground floor commercial uses (Building Code Occupancy B or M), or any building in a mapped liquefaction zone	4.5 years	5.5 years	7.5 years

Table 3 (continued).

Jurisdiction	Year	Number of Soft-story Buildings	Program Type	Targeted Building Characteristics	Priorities or Tiers	Deadline for Evaluation	Deadline for Permit	Deadline for Completion
Alameda	2011	70	Mandatory evaluation	Five or more units	n/a	2 years		
Fremont	2005	22	Mandatory retrofit	Apartment house with more than ten units or more than two stories	**Group 1** - Apartment house with more than ten units or more than two stories	n/a	2 years	4 years
					Group II - Apartment house with ten or less units and fewer than three stories high	n/a	2.5 years	5 years

Public Purpose, Occupancy, Location, and Other Considerations

Another stated goal of seismic mitigation laws is to promote continuity of vital services related to the community's social and economic viability. In addition to direct safety concerns, this further justifies targeting special uses and ***buildings that affect larger numbers of people*** such as schools, critical public buildings, and hospitals. Beyond critical community functions, however, it is less obvious where to draw the line between public and private risks and benefits. How many people need to live or work in a building before a suspected earthquake vulnerability becomes something an owner or tenant should not be allowed to make decisions about on their own?

The answer involves some sense of proportionality. In other words, local governments tend to seek a reasonable balance between the number of building owners that will need to comply and the burden of compliance, with the public benefits that will be achieved (which we can assume to be protection of health and preservation of community functionality). That is a key reason why buildings with higher ***occupancy*** or higher ***residential unit total*** are sometimes targeted. Such buildings not only have more human beings that work or live in them, but the fate of the buildings also has a larger impact on local housing availability, parking, and other community impacts. For instance, most existing soft-story wood frame programs are targeted at multifamily buildings with five or more residential units (see Table 3). Larger structures are also presumably worth more, so the owner is more likely to have sufficient equity in the property or cash flow to make capital upgrades.

A structure's ***number of stories*** may also relate to the degree of risk or perceptions of public importance. Problematically, more stories may not always translate into higher risk; for example, two-story soft-story buildings may not necessarily be less dangerous compared to three story ones, depending on the materials used and the positioning of occupied units (Bonowitz and Rabinovici, 2012).

A good example of a program that uses ***location*** or ***zoning*** as part of its targeting is Palo Alto's Municipal Code Chapter 18.18.070 Floor Area Bonuses incentive. The incentive is only available for buildings in Commercial Downtown (CD) District, which has sub-zones based on CD-C Commercial, CD-S Service, and CD-N Neighborhood designations. Zoning benefits are different for each of these designations, the square footage, and also if the building in question is ***historic property***.

Ownership structure is another potential scoping issue, for instance, whether condominiums should be included.[26] The City of Berkeley did not include condominiums in its soft-story wood frame building ordinance, but the jurisdictions of San Francisco and Fremont did. Condominiums often face additional barriers in both voluntary and mandatory retrofit policy settings, because homeowner association policies and practices can make it difficult to agree on what should be done and to obtain financing. Anecdotally, in Palo Alto and elsewhere, properties where a majority of owners want to retrofit have not been able to accomplish that work because of hold-out members that do not want to proceed or pay an additional assessment in order for the association to be able to afford it. The overall influence on retrofit behavior of either including or excluding condominiums is not known.

A final point that should be noted about program scope is that some properties that would otherwise be subject to a law can be classified as exempt for certain reasons. For instance, most jurisdictional ordinances offer exemptions for buildings that have had significant recent renovations or retrofit upgrades that addressed the hazardous condition. Some jurisdictions explicitly include protocols for hardship provisions such as extended timelines that might be made available for individual or institutional owners that can demonstrate an unusual degree of difficulty raising sufficient funds to comply.

Timelines, Pacing, and Prioritization

For several reasons, jurisdictions find it useful to both prioritize and pace their earthquake program efforts. Time is a powerful ally and policy variable. Once a jurisdiction commits to the idea of a new program, timeframes can be used to make implementation manageable and soften the economic impacts of the program on city staff and budgets, on owners, and on the local economy. Retrofitting is also a process that cannot be sped up beyond a certain point. Design, arrangement of financing, and completion of retrofit work can be an arduous process, naturally taking from months to years. Lengthier time windows allow owners to plan for how to comply in the way that works best for them. Longer time frames can also work to the advantage of jurisdictions, which rarely have sufficient administrative capacity, political will, and community tolerance to take on multiple seismic risk issues simultaneously over a short

[26] Keep in mind that condominium status can change. The City of Berkeley decided not to include condominium properties on its Suspected High Hazard Building list. However, owners in some apartment buildings in the process of being converted to condominium status when needing complying with the law experienced difficulty getting loans (Rabinovici, 2012).

period of time. Following are several examples of how different jurisdictions have used timing as part of their program structure.

Trigger-Enforced Timing

Some jurisdictions have opted to require earthquake retrofit to be done only when the property is sold and/or an owner submits plans for renovation, additions, or rehabilitation that meets certain criteria, for instance 50% of the assessed value. This is similar to triggers for energy upgrading, sewer lateral replacement for single family homes, modifications for Americans with Disabilities Act compliance, or sprinkler and other fire code changes.

A jurisdiction taking this approach does not need to inventory vulnerable structures in advance and may be able to do project reviews at current staffing levels. However, there are several downsides. Owners may resent encountering these potentially substantial “surprise” costs when initiating a project, and might strategically manipulate project valuation to avoid needing to comply, resulting in lower fees for the city. For those owners that are aware of the provisions, potentially important non-seismic renovation work that would have been done otherwise might be postponed as a result of increased project cost and complexity. Most importantly, critical safety and resilience retrofit work might go decades without being done.

Proactively-Enforced Timing with Phasing and/or Prioritization

Proactive enforcement means that a jurisdiction identifies, notifies, and actively seeks to help owners participate or comply in a program. It is common when these programs include mandates to use a ***variety of time frames for buildings with different characteristics***. For instance, Los Angeles’s 2015 ordinance requires compliance for soft-stories within seven years and older concrete within 25 years. Another common strategy is to classify buildings of a *single* targeted structural type into ***tiers* or *priority levels among a particular type of building,*** for instance based on age, number of stories, unit totals, or occupancy. Compliance can then be mandated sooner in order from most to least serious in terms of estimated risk and social importance. Time frames for soft-story programs, for instance, commonly relax deadlines by about one year per tier (See Deadlines by programs in Table 3). Both of these phasing approaches allows jurisdictions to set a feasible administrative pace and put an early focus on buildings with vulnerabilities and characteristics that most affect the public.

An overall pacing strategy can also be used to ***phase implementation of a larger set of resilience policies and programs*** that go beyond different building types to address other aspects of community earthquake vulnerability. For instance, San Francisco mandated soft-story wood frame building retrofitting, then mandated its 120 private schools to do seismic evaluations of their buildings regardless of structure type,[27] and then embarked on efforts to assess and create programs for poorly anchored façades and unreinforced masonry chimneys.

All three approaches – 1) phasing and compliance time frames that differ for structures, 2) in different priority tiers, 3) within a multifaceted comprehensive plan – were used in recommendations from San Francisco's decade-long Community Action Plan for Seismic Safety (CAPSS) project (ATC, 2010). Figure 2 shows an earlier version of how San Francisco thought about address different building types and uses more or less quickly and with gradually increasing requirements.

Later, these concepts were embedded into the jurisdiction's policies as part of San Francisco's 30-year Earthquake Safety Implementation Plan (SF ESIP, 2011). That plan represents a commitment by the city to phase in additional efforts over this extended period, and deliberately addressed a wide range of vulnerable structure types, uses, or occupancy combinations considered important to community resilience (e.g., private schools, façades). Additional advantages of long time frames are to allow more time for detailed studies or research if needed, for political or community consensus to develop, and give owners ample notice of bigger changes to come.

[27] Ordinance text available at: http://sfgov.org/esip/sites/default/files/FileCenter/Documents/12716-Ordinance%20No%20202-14%20Private%20Schools%20EQ%20Evaluation.pdf (Accessed February 3, 2016).

Figure 2: Excerpt of Table 5 from the summary San Francisco CAPSS Project report (ATC, 2010) showing recommended timelines for prioritizing and phasing different kinds of efforts to address a variety of building types and uses.

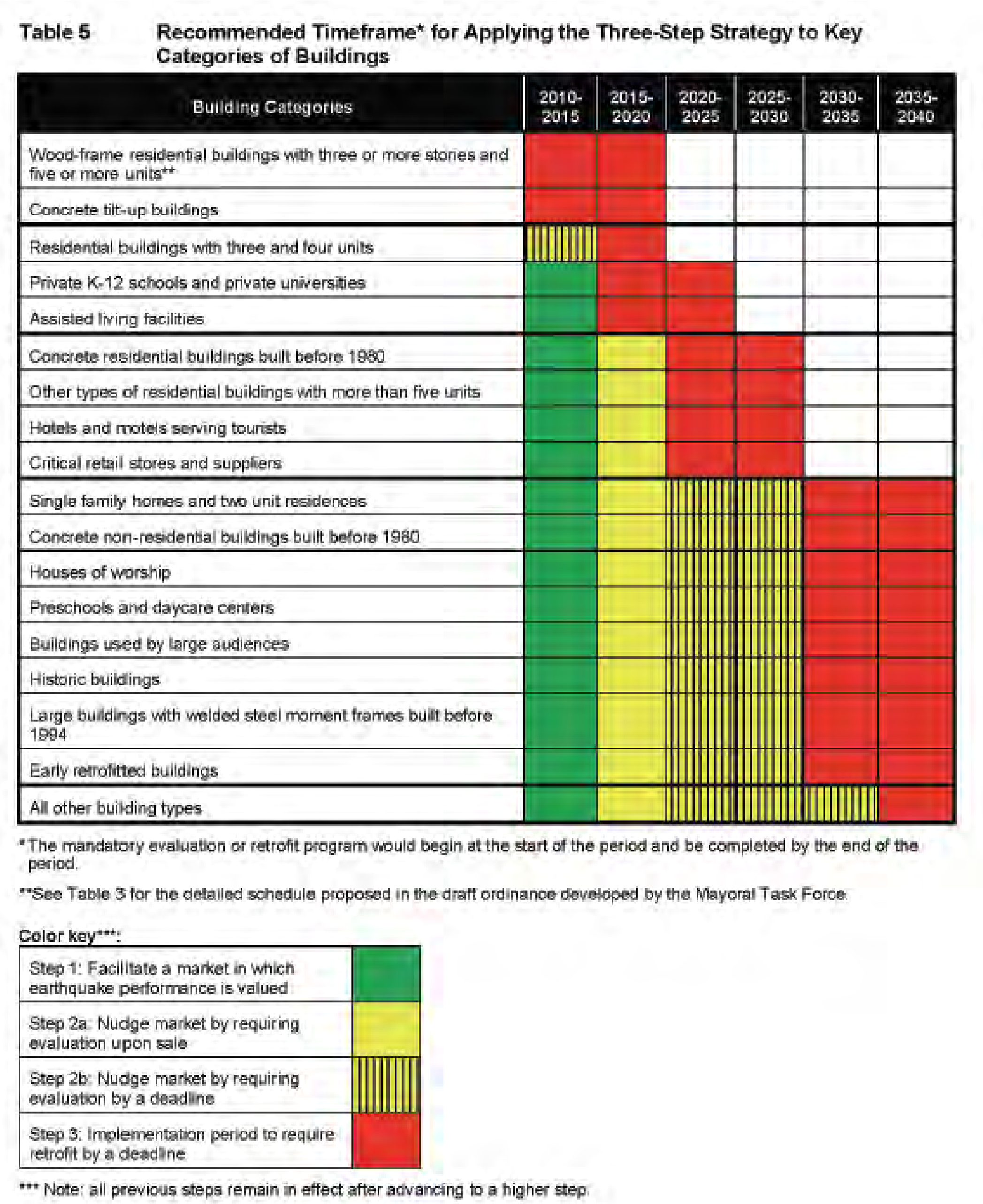


Table 5 Recommended Timeframe* for Applying the Three-Step Strategy to Key Categories of Buildings

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

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

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

Color key***:

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

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

Note: Categories represented in rows are not mutually exclusive. For instance, some private school facilities may be located in a house of worship or historic structures.

Policy Mechanisms and Requirements

In addition to creating a set of targeting and eligibility criteria, jurisdictions can use a variety of methods to motivate appropriate seismic upgrades to be done. Requiring owners to do retrofit work is only one approach. Other tools range from simple notification, disclosure measures,[28] offering incentives, voluntary retrofit initiatives, and mandated screenings or evaluations, each of which is described below in more detail. Another major distinction is whether a jurisdiction implements requirements only when triggered during rehabilitation projects that meet certain criteria, or proactively, such as doing an inventory to identify affected properties and imposed deadlines.

Figure 3 provides definitions of a spectrum of policy mechanisms that have been used. This view corrects the false impression that jurisdictional programs have to be either “voluntary” or “mandatory.” In reality, most jurisdictions create a *policy package* that combines several approaches. Furthermore, that package can evolve over time as more and more buildings are upgraded, new information or technical recommendations become available, or with changes in the political or economic climate.

Inventory

Identifying the number and locations of buildings of concern is an essential first step to finding out which buildings are the most vulnerable and how significant those issues may be for the community. Many jurisdictions launch their earthquake program development process with a special-purpose, one-time discovery effort meant to compile data about potentially seismic at-risk properties and to gauge the scope of the issues faced by the community. This can be difficult and time consuming, and jurisdictions often rely on outside consultants or professional organizations and academic volunteers for assistance. Existing property databases generally contain less than complete information to be able to draw conclusions, and some relevant information may only exist in paper form. Street-walks, side walk surveys, or visits to a selected sample of properties are common.

It is important to distinguish early investigation and risk analysis efforts that might involve only a subset of properties from the development of an exhaustive list of properties meeting certain criteria that could be officially noticed or subjected to a

[28] Disclosure policies are designed to increase the transparency and openness surrounding an issue of social importance. Examples include mandatory disclosure to tenants, freedom of information requirements, public signage, searchable online listing, or official notice placed on a title or deed. These are described in Table .

particular ordinance. The City of Berkeley is one jurisdiction that used a list created by staff and consultants as the basis for determining which properties should be included on that city's suspected hazardous properties list. Other cities have instead chosen to put buildings on an initial suspected hazard list based on zoning, number of units, or other generally available criteria.

Palo Alto's current investigation into updating its seismic risk management program involves review of digital records, paper records, and side walk surveys. The side walk survey portion includes approximately half of the buildings of interest. A similar detailed field effort would be needed on the remaining portion of buildings to develop a comprehensive inventory list.

No inventory list will be perfect, so no matter which approach is used, some kind of appeal, confirmation, or screening processes are needed before granting any exemptions or enforcing requirements. Depending on the building type, issues of improper inclusion or exclusion from a list may be more or less likely. For example, rapid visual determination is easier for wood frame soft-story conditions, but it would be hard for even an experienced engineer to identify a steel moment frame, braced frame building, or a concrete frame building when the structural elements are hidden from view by architectural finishes.

Figure 3: Diagram showing a spectrum of mitigation policy approaches ranging from least to most stringent.

Increasingly Stringent →

Inventory Only	***Notify Only***	***Voluntary Retrofit***	***Disclosure Approaches***	***Mandatory Screening***	***Mandatory Evaluation***	***Mandatory Retrofit***
Staff, consultants, and/or a volunteer organization has created an inventory of one or more suspected hazard building types, but the list is not officially released to the public or acted upon.	An inventory exists and a policy has been established to notify owners if their property is on a suspected hazard building list.	Owners of properties on a publically available list are formally encouraged to retrofit, possibly by offering of technical assistance, financial help, or policy incentives.	Properties on a publically available list are subject to one or more methods of forced information sharing, such as tenant notification, public signage, or recorded notice on the property title.	Owners of properties on a publically available list are required to submit a form within a fixed time window that is filled out by a licensed building professional. Typically, the goal is to determine whether the property has certain characteristics that *might* associate with risk.*	Owners of properties on a publically available list are required submit within a fixed time window a formal evaluation completed by a licensed engineer. Typically, a determination is then made about whether the property has certain risk features.*	Owners of properties on a publically available list are required to complete a retrofit by a certain date. This step may be implemented following a screening or evaluation phase.*

* Note: Implementation and enforcement might be either: 1) triggered by sale or a significant work threshold or 2) via a proactive compliance timeline.

Notification

Once an inventory is created, a jurisdiction either by default or deliberately chooses whether or not to make that list public or take further actions. Some jurisdictions have created a list then not acted on it for a decade or more. For example, in the case of soft-story wood frame buildings, Santa Clara County's list has remained dormant since 2003, and nine years passed between the creation of a list and when the City of Berkeley passed its soft-story ordinance.

The most basic step is to notify owners that their property is on some kind of suspected earthquake hazard list. This is currently the URM policy of a small number of California jurisdictions, and the soft-story wood frame policy in the jurisdictions of San Leandro, Sebastapol, and Richmond. Available data about notification only programs shows them to have little impact; for instance, seven percent of URM properties in jurisdictions with this type of program are retrofit as of 2006 (CSSC, Status of the Unreinforced Masonry Building Law, 2006).

Little evidence exists about potential liability and market value impacts from becoming a "listed" earthquake vulnerable building. However, concern exists that mere creation of a list could have negative impacts if it becomes public (see more about Disclosure Approaches below). A Freedom of Information Act (FOIA) filing (for instance, by a journalist or citizen) could be used to compel a jurisdiction to reveal a list that has remained dormant. This happened in the case of Los Angeles with the Concrete Coalition's inventory of suspected concrete structures.[29] Experts in the earthquake field believe that media coverage of the list contributed to eventual passage of that city's mandatory evaluation ordinance in 2015, which included concrete structures. In sum, notification programs may have several downsides for owners while offering little in terms of on the ground risk reduction for the community.

Voluntary Retrofit

Following an inventory and notification process, or even after a mandatory screening or evaluation phase (see below), jurisdictions can choose to let owners decide whether or not to retrofit their building. Simply urging building owners that own a potentially earthquake vulnerable building may be enough to lead some to voluntarily retrofit.

[29] Key Los Angeles Times articles can be found at: http://graphics.latimes.com/me-earthquake-concrete/ and http://www.latimes.com/local/lanow/la-me-ln-concrete-buildings-list-20140125-story.html (Accessed April 11, 2016).

Retrofit rates for jurisdictions with voluntary URM retrofit programs averaged 16% in 2006 (CSSC, Status of the Unreinforced Masonry Building Law, 2006), and likely much lower than that for soft-stories (though no systematic data currently exist).

Jurisdictions that take a voluntary route often do so because they have a small number (presumably less socially-significant set) of vulnerable buildings. Another factor can be a sense that public support is lacking among decision makers, residents, or other stakeholders for mandatory requirements, perhaps because of local economic conditions that would make it difficult for owners to afford or get financing. The anticipated cost of the retrofit work can also come into play, as it can be more palatable to require owners to make investments that are a smaller share of the building's overall value.

Despite perceptions of politically feasibility and some measurable voluntary retrofit response, programs without mandates are almost always much less effective at actually reducing earthquake risk in the community in a significant way. Several factors appear to contribute to the handful of voluntary programs that have worked well. First and foremost, voluntary programs vary in the level of resources devoted, sustained effort, and set of complementary measures taken by the jurisdiction. The more dedicated a jurisdiction is to having a successful voluntary program, the more likely it is to have one. One tactic is to provide case by case assistance to owners in taking steps over time, a tactic sometimes used by jurisdictions with a small number of affected buildings. Another is to offer significant financial or policy incentives (examples of which are discussed below). On the public awareness front, providing educational materials that explain the risks to an owner and to the broader community and the benefits of protecting their financial investment may help.

Another thing that can make voluntary programs more successful is to threaten to institute a mandatory program in the future. Historically, many jurisdictions did adopt a voluntary URM program first, and then shifted to mandates later on. In the past five years, this has also happened with soft-story wood frame policies in the case of Oakland, San Francisco, and Berkeley. An explicit multi-phased approach was particularly effective in Berkeley, where one fourth of building owners affected by a mandatory evaluation requirement invested in a voluntary retrofit within the first two years. Owner interviews showed this was partly because they wanted to get a head start on later mandates that appeared inevitable (Rabinovici, 2012).

Disclosure Approaches

Notification and many voluntary programs are based on the idea that information and communication by themselves can influence the opinions and actions of owners, renters, and buyers. Officially publicizing a city's concerns about deficiencies of a specific building type could, for instance, change public opinion about the resale or rental value of listed properties, an owner's eligibility for refinancing or future loan terms, or the cost of purchasing earthquake insurance.

Jurisdictions have used a variety of techniques to motivate attention to seismic risk concerns. As discussed in the Task 2 report, **mandatory disclosure at time of sale** is a key part of state laws for pre-1960 homes in earthquake fault zones (CSSC, 2005). The most prominent policy is the state requirement for **signage** on all URM buildings. Similar signage has been required since 2007 on soft-story wood frame buildings in the City of Berkeley (Figure 4), and non-complying soft-story wood frame buildings in San Francisco Figure 5.

In Oakland, Berkeley, and San Francisco **tenants must be notified in writing,** and **official notices are recorded on the deed** for all listed soft-story wood frame buildings.

Figure 4: Photo of the warning sign mandated to be posted on buildings on the City of Berkeley's Suspected Earthquake Hazard Building List (*Photo: S. Rabinovici, 2011*).

Figure 5: Required placard for soft-story wood frame buildings that failed to comply on time with the mandatory screening phase of San Francisco's mandatory retrofit program.

In the case of soft-story wood frame buildings, leading jurisdictions have also put a public, sometimes searchable ***list of affected properties on a jurisdiction's website***, based on the idea that renters should be entitled to easily accessible information before they sign a lease. Such lists include the street address and potentially also the compliance status of the property. Owner names or contact information are not given, although anyone could search for that information through public permit and property records. Table 4 describes each of these tools in more detail and gives examples of use as well as advantages and disadvantages.

What all these measures have in common is that they make seismic risk issues more transparent and visible to affected members of the public. Disclosure is different than and goes beyond general public awareness. These measures are also meant to inform people about *specific* seismically vulnerable buildings, with the idea that it might change offering prices, mortgage availability and terms, rental or purchase decisions, or even whether someone wants to enter or stay very long in a building. In theory, as owners, tenants, bankers, and potential buyers become more informed, they can better incorporate seismic risk in their mitigation decisionmaking and assessment of property values.

Evidence suggests that notification, notices, and public lists can and do influence beliefs and behavior. For example, some soft-story wood frame condominium owners in Berkeley reported difficulty refinancing (Rabinovici, 2012). Even *perception* of market awareness can change opinions, even if there is little to no documented impact. In Berkeley, some owners said the worried at first about reduced demand or market price for units in their buildings and this motivated them to retrofit; however, these same owners years later did not report experiencing any problems with tenant recruitment or lost rental income (Rabinovici, 2012).

Earthquake warning signage was a prominent part of the state's URM program requirements; however, there is little evidence to show that such warnings are effective. A study of California Proposition 61 carcinogen and reproductive health warnings suggests that signs are not very powerful and become less influential on behavior over time as people become used to them. Some building users may even be personally annoyed by warning signs, because it reminds them of a risk that they can personally do little about. Some owners of soft-story wood frame buildings in Berkeley reported having *tenants* that actively complained about or repeatedly ripped the required warning signs off the walls (Rabinovici, 2012).

Table 4: Description of disclosure approaches used in local earthquake risk reduction programs.

Name	Description	Examples of Use	Advantages	Costs, Issues or Concerns
Mandatory Disclosure at Time of Sale	Sellers of property are required to disclose features that could relate to earthquake performance.	California Earthquake Fault Zone disclosure; Sellers of pre-1960 homes are required to fill out to the best of their knowledge and provide buyers with Residential Earthquake Hazards Report.	Empowers buyers to be aware of any known existing hazard issues.	Anecdotally, many buyers do not pay enough attention to these disclosures, which occur during emotional, busy decisionmaking periods. They may not seek expert information to interpret the reported information. It is also possible that sellers shirk on the disclosure requirements if buyers do not know that they are supposed to receive them. Difficult to enforce.
Recorded Notice on Deed	Jurisdictions can record on the property title or deed the fact that the building is subject to additional requirements related to its earthquake vulnerable status.	For soft-story wood frame: Oakland, Berkeley, and San Francisco.	Relatively low cost for jurisdictions to implement. Empowers buyers but also mortgage companies to be aware of any known existing hazard issues.	Anecdotally, it is not clear how many buyers or mortgage companies pay attention to these notices. Such notices are primarily effective only at time of sale or refinance.

Table 4 (continued)

Name	Description	Examples of Use	Advantages	Costs, Issues or Concerns
Public Listing of Affected Properties	Jurisdictions that operate web sites to describe their programs can feature a full list of property addresses, potentially also including also the compliance status of the property. In general, owner names are not listed, though that information is available if a member of the public searched for it separately.	For soft-story wood frame: Oakland, Berkeley, and San Francisco.	Relatively low cost for jurisdictions to implement. Could be used by tenants and buyers when searching for properties, thus empowering well-informed market negotiations over pricing.	Website information needs to be updated on a regular basis in order to be perceived as fair and useful. Public lists work better if the property addresses are searchable, rather than static (e.g., on a pdf).
External Signage	Jurisdictions that operate web sites to describe their programs can feature a full list of property addresses, potentially also including the compliance status of the property. Some lists are searchable, while others are static.	California state requires a sign on all URM buildings. Similar signage has been required since 2007 on soft-story wood frame buildings in the City of Berkeley.	Advocates argue that signs are justified based on the public's right to know. The physical presence and repeated viewing of signage may make the issue more salient for visitors, employees, lease holders, and owners alike.	Owners may view the signs as stigmatizing or threatening to property value or business revenues, but anecdotally, it is not clear how much visitors, employees, residents, and other users of a building pay attention to signage when entering or leaving a property.

Table 4 (continued)

Name	Description	Examples of Use	Advantages	Costs, Issues or Concerns
Tenant Notification	Owners are required to present straightforward, standardized information about the listed status of the property. Some jurisdictions require proof of notification (e.g., tenant signature) to be returned and kept on file with the city.	For soft-story wood frame: Oakland, Berkeley, and San Francisco.	Tenant notification may be more influential than signage because it is personalized and the information is delivered at a useful time in that person's decision process. Advocates claim that tenant notification is justified based on the public's right to know.	To be effective, tenant notification should be required to occur well before the potential tenant is ready to sign the lease.
Earthquake Performance Rating Systems	Owners can be either encouraged or required to have their building rated on a standardized scale that classifies expected building performance in an earthquake in an easier to understand format, for instance from one to five stars. Viable rating systems exist for many building types.	The City of Los Angeles in 2015 officially launched a voluntary effort to encourage owners to rate their properties using the US Resiliency Council system and pledged to rate its own public buildings as well.	Rating system use is common for institutions like universities and hospitals. Mechanisms for implementing performance ratings for commercial use have recently matured and are now viable. Ratings have the potential to inform owner, renter and buyer decisions, creating a market effect.	Obtaining a rating potentially adds cost to a design project. Ratings systems such as USRC's are relatively new and not yet widely implemented.

An advantage of disclosure measures is they tend to be relatively inexpensive for jurisdictions to administer. Up to date website posting of the list of affected properties and their compliance status encourages people to visit the site as needed over time, people see signs every time they enter or exit, and properties may exchange hands many times. Eventually, a tipping point in community awareness and opinion about a class of properties can occur, as it did in the case of Berkeley for soft-story wood frame buildings.

The use of *positive* disclosure remains an untapped potential influence on market value of retrofitted properties as well as owners' retrofit decisions. This review did not identify any city programs that have taken the positive approach of recognizing or rewarding owners or announcing buildings that have been retrofit. One recent development is the existence of viable ***earthquake rating systems***. In November 2015, the non-profit US Resiliency Council[30] launched a non-profit credentialing and verification service through which owners can obtain externally checked, state-of-the-art assessment of the expected safety levels, repair costs, and time to regain function for their property. USRC ratings have the potential to play the same kind of role that the US Green Building Council did in promoting sustainable design, both for new construction and for retrofits.

USRC's system has already been adopted one California jurisdiction's policy. Los Angeles Mayor Eric Garcetti cited USRC ratings in that city's Resilience by Design report (City of Los Angeles, 2015), asking building owners to voluntarily use it, pledging to educate the public about seismic performance rating systems and how the information can be used, and announcing the intention to use it or some similar system to rate all city-owned buildings.

Mandatory Screening

Screening programs help jurisdictions collect more information about targeted potentially vulnerable buildings in a community, usually as a first step to later more stringent requirements for the subset that are found to have features indicating significant deficiencies. With relatively low cost and difficulty for owners, the jurisdiction can both make the issue visible and filter out properties that do not meet the eligibility or targeting criteria, thereby reducing the burdensome handling of errors and omission at a later stage. They also help jurisdictions determine the overall scope of the problem—how many buildings exist that have certain risk characteristics and how significant of a threat they pose in aggregate. This can help build the case for further legislation.

[30] The organization's website is: www.usrc.org (Accessed April 13, 2016).

For soft-story wood frame buildings, Oakland was a pioneer of the mandatory screening approach. An inventory of multifamily apartment buildings was created in 2008 with the help of volunteers and non-engineers under a contract with ABAG. This survey identified 24,273 residential units in 1,479 buildings with five or more units, between two and seven stories, built prior to 1991, that had wide open spaces for parking or commercial uses on the ground floor (ABAG, 2014). Spot testing suggested the list might have error rates that could potentially undermine future program effectiveness, and might be politically unacceptable (personal communication, Jeannie Perkins, 2008). Therefore, in 2009 the City passed ordinance Number 12966 which declared these buildings “potential soft-story buildings” and mandated submittal of a *Level 1 Screening–Non-Engineered Analysis*. The screening had to be performed by a registered design professional, licensed contractor or certified inspector, to provide some assurance of accuracy regarding features that might related to risk. Anecdotally, the cost to owners for this was generally around $200 to $500. This can be summarized as a *rule-in* screening approach.

Persons involved with analyzing Oakland’s program (personal communication, Danielle Hutchings-Mieler, 2011) concluded that many owners were confused, compliance was lower than hoped, and exemptions may have been given without adequate quality control of the reported data. This later contributed to the decision to incorporate mandatory evaluation phase when the city of Oakland was ready to move towards a mandatory retrofit program. In other words, a less than satisfactory implementation of a screening phase can slow down progress towards and increase the effort required in future retrofit programming.

In its approach to soft-story wood frame buildings, San Francisco opted for a screening phase to weed out obviously non-affected properties, for instance those misidentified as having the correct number of units, stories, or first floor uses (primarily focusing on *ruling out* inappropriately included properties). Similar to Oakland, the screening had to be performed by a registered design professional, such as a licensed contractor, engineer, or architect. Compliance in filing screening forms by the initial deadline was 98%, a success which was helped by a suite of outreach activities including four waves of post card reminders, a retrofit fair, a weekly updated website, an advisory group process, and multiple public meetings. The compliance postcards used took advantage of real-time information sharing to “nudge” owners to respond, such as mentioning how many other owners had already taken action by that point (see Figure 6).

RUTHERFORD + CHEKENE

SEAL OF THE CITY AND COUNTY OF SAN FRANCISCO

NOTICE

YOU ARE REQUIRED BY LAW

TO COMPLETE A SOFT STORY SCREENING FORM BY SEPTEMBER 15, 2014

Nearly 3000 buildings like yours have already returned their screening forms. Many owners have begun their required upgrades, while many are not required to retrofit at all. Act now to avoid penalties!

Dear Property Owner,

A building you own was noticed on September 15, 2013 as part of the **Mandatory Soft Story Retrofit Program**. All property owners noticed under this program are required to have a licensed design professional complete a screening form, though not all owners will be required to retrofit. This completed form must be submitted to the Department of Building Inspection by September 15, 2014. If this form is not returned the property will be in violation, resulting in fines, a hearing, and the posting of a placard notifying building occupants. Visit the DBI website to see the status of properties. Act today!

For another copy of this form or if you have any questions, please call 415-558-6699, email *softstory@sfgov.org*, or please visit *www.sfdbi.org/softstory*.

Figure 6: Front and back of a compliance reminder postcard sent to affected owners in the City of San Francisco's soft-story wood frame program.

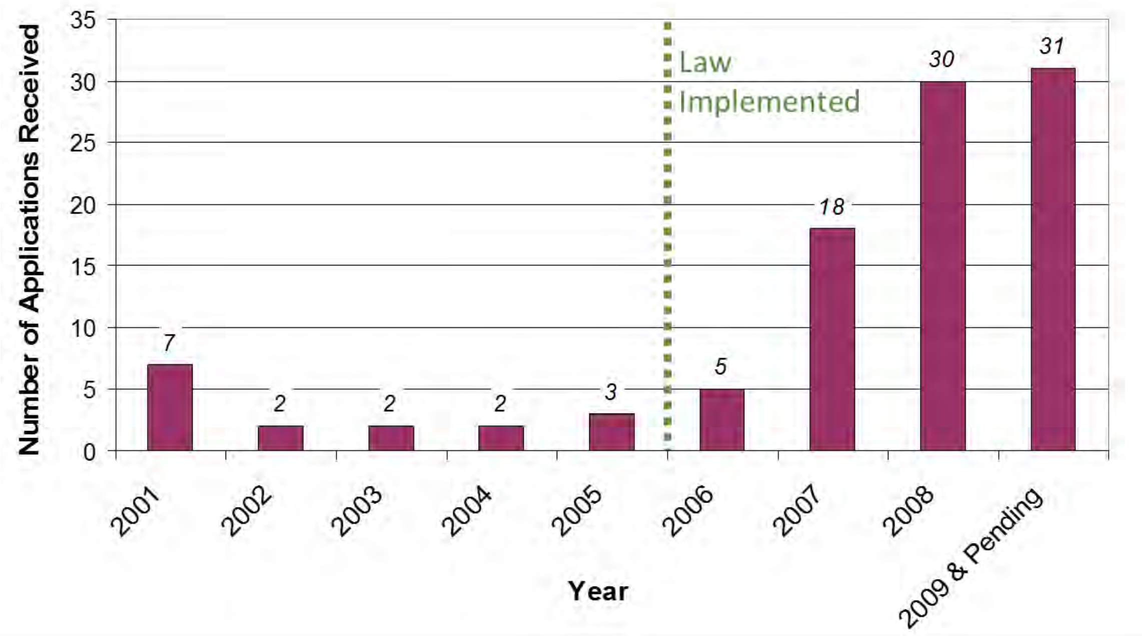
Mandatory Evaluation

In the 1980s, Palo Alto was an early innovator with the technique of requiring owners of certain buildings in a community to file a formal engineering evaluation (Herman et. al., 1990). Because a licensed engineer (or structural engineer) must perform this work, such evaluations are approximately an order of magnitude more expensive than screenings. Evaluation costs for soft-story wood frame buildings in Berkeley, for example, were approximately $2,000 to $5,000 (Rabinovici, 2012). However, evaluation costs may vary substantially for other building types that are more difficult to assess, in other jurisdictions, and/or where evaluation requirements are more extensive or complex.

Evaluation programs are costlier for jurisdictions to administrate than screening programs for a variety of reasons, but provide several advantages. Jurisdictions typically give owners more time to comply longer, owners need more guidance on how to comply, and there is increased need for processing time and more qualified reviewer labor. In Berkeley, report review was contracted out to plan checkers for a flat fee of $583 per evaluation report, and this did not cover jurisdiction staff time.

On the benefits side, evaluations offer greater hope of achieving tangible risk reduction. As noted, a remarkable one in four soft-story wood frame building owners voluntarily retrofit in the wake of mandatory evaluation policy implementation in Berkeley, which meant over 2,000 of its residents now live in buildings that likely would not have been retrofitted otherwise. Interviews with soft-story wood frame owners in Berkeley also showed that many considered mandatory evaluation more fair than a voluntary retrofit program because it "leveled the playing field" (Rabinovici, 2012). Rather than having retrofit practices in their community determined *ad hoc*, all owners of similar properties were now being treated alike.

However, the benefits of mandatory evaluation are undeniably uncertain and dependent on whether community circumstances are conducive to create a significant voluntary retrofit effect (Figure 7).



Note: Data collected April 2010, Source: D. Lambert, personal communication.

Figure 7: Graph showing a seven-fold increase in permit applications in the four years immediately following passage of Berkeley's 2005 mandatory evaluation law for soft-story wood frame buildings.

Mandatory Retrofit

Through California's URM law, hospital, and school programs as well as soft-story wood frame buildings at the local scale, there is clear precedent for imposing earthquake retrofit work to be done for certain buildings. This is the most effective type of program for ensuring that on the ground risk reduction will be done. As discussed in the Task 2 report, on average over four times as many URM building cases have been retrofit in California in mandatory programs (70%) compared to voluntary ones (16%). However, because mandatory programs require all buildings to be addressed, owners with the most marginal properties cannot avoid taking action, in some cases leading to higher demolition rates (Comerio, 1992). In the case of URM buildings, mandatory retrofit programs did have higher demolition rates than voluntary programs, 17% compared to 8% respectively (CSSC, Status of the Unreinforced Masonry Building Law, 2006).

Depending on the program timeline, it may take years to decades for tangible risk reduction to be realized. Retrofit projects naturally occur in steps, and can only be carried out as quickly as financing, contracting, any tenant relocation, or construction logistics allow. Thus, compliance periods for mandatory retrofit programs need to be longer than for mandatory screening or evaluation programs. For URM buildings, many jurisdictions tended to set deadlines of ten years or more, followed by generous extensions. For soft-story wood frame programs, jurisdictions have given owners one to three years for first steps such as appeals, hiring an engineer, complete an acceptable engineering report, or submit a permit application and retrofit plan. Following that, owners are typically given another one to three years to complete construction (see Table 3), in part to secure financing, time to work around planned vacancies, and for adequate design. Longer timelines or exemptions can be offered for complex buildings that may require costlier or innovative engineering solutions (for instance, historic properties). Again, this is where phasing or tiers can be helpful.

Another difficult aspect of retrofit programs (even voluntary ones) is that jurisdictions need to set specific expectations for what constitutes an acceptable retrofit. Jurisdictions have handled this in a variety of ways. Retrofit ordinances typically directly reference one or more particular standards (or equivalent criteria). The table of soft-story wood frame programs (Table 3) shows that five or more standards have been referenced recently and several jurisdictions reference more than one, which can increase compliance ambiguity and the level of reviewer skill required but also an engineer's discretion to use the one most appropriate for their client's situation.

Also at issue is how much and how far a building's vulnerabilities should be retrofit. For instance, in the case of soft-story wood frame buildings, a retrofit can be designed to address only the first story weaknesses, rather than all seismic vulnerabilities that are identified. Jurisdictions such as San Francisco and Berkeley have chosen this route, in part because it lessened political resistance to creating a mandate and addressed the most severe deficiencies. Other deficiencies above the first story may remain and may lead to damage in an earthquake.

In the case of mandatory evaluation or retrofit programs, owners and their engineers will also need guidance about how to prepare an acceptable evaluation, and how to submit a concurrent retrofit permit application. Owners in Berkeley realized a major financial advantage to paying their engineer to do both an evaluation for the jurisdiction and a full set of retrofit plans at the same time (Rabinovici, 2012), so having clear retrofit standards in place already was a major boon to those owners.

The potentially negative effects on public safety and on owners of choosing a longer compliance timeline should be noted. Earthquakes can occur at any time, so a program that offers longer compliance windows in effect allows people in the community to spend more time using and owning buildings that the jurisdiction has deemed unacceptable in the long run. Also, real liability consequences may exist for owners that delay in doing mandated retrofit work, even before an accepted compliance window has elapsed. A California Appellate court awarded $2 million to family members of two women who died in a URM collapse in the 2003 San Simeon earthquake.[31] In doing so, the court rejected the defendant's claim that they had no duty to retrofit the building until 2018, the deadline established by the San Louis Obispo mandatory retrofit ordinance.

Incentives

To complement any of the above program formats, jurisdictions can offer either financing- or policy-oriented incentives. Many ways exist to encourage and ease the path for owners to complete either voluntary or required retrofit work, or even to help them submit timely screening forms or engineering reports. Financial incentives and tools provide monetary assistance, either directly to an owner or via the jurisdiction. ***Financial incentives*** include measures such as tax credits, tax rebates, grants, or fee waivers that make a retrofit less expensive to complete. ***Financial tools*** (e.g., special low-interest financing programs) provide a mechanism for an owner to obtain the necessary funding, potentially at lower cost or paid back in ways other than for a traditional loan. ***Policy incentives*** are meant to encourage private funding of mitigation, and include for example expedited review, exemptions, development bonuses, or technical assistance. These measures offer owners indirect but potentially valuable benefits as they take each mitigation steps.

Figure 8 provides a summary list of potential incentive types, while Appendix C gives details about example uses, advantages, and disadvantages of each.

A group of agencies completed an inventory of jurisdiction incentive strategies using a survey of California local governments in the mid-90s (ABAG, Seismic Retrofit Incentive Programs: A Handbook for Local Governments, 1996). Though outdated and only 35% of contacted jurisdictions participated, the report summarizes the types of URM and other earthquake programs that different jurisdictions adopted and the kinds of assistance that owners could receive. The researchers also did interviews to collect detailed information about fifteen illustrative cases at the time, including Palo Alto.

[31]See press coverage: http://calcoastnews.com/2010/06/court-finds-paso-robles-business-owners-liable-for-earthquake-deaths/ Accessed April 13, 2016.

COST AND IMPLEMENTATION DIFFICULTY	FINANCIAL TOOLS AND INCENTIVES (mechanisms that make financing more accessible or directly reduce project costs)	POLICY INCENTIVES (mechanisms that deliver indirect benefits to owners)
Lower	Waivers or Reductions of Building Department Fees	Exemption from Future Retrofit Requirements
	Pass Through of Retrofit Costs to Tenants (for jurisdictions with rent control)	Expedited Permits, Inspections, and Reviews
	Property-Assessed Financing Loans (PACE)	Exemptions or Relief from Standards or Non-Conforming Conditions
	Subsidized or Special Term Loans	Condominium Conversion Assistance
	Real Estate Transfer Tax Rebates	Technical Assistance for Retrofit Projects
	Special District or Historic Designation Tax Reductions	Zoning Incentives (e.g., relief from use restrictions)
	Tax Credits	Transfer of Development Rights (TDR)
	Grants	Density or Intensity Bonuses (e.g., Floor Area Bonus)
Higher	General Obligation or Special Purpose Bonds	

Figure 8: Types of financial incentives and tools as well as policy incentives that have been used in local earthquake risk reduction programs in California, in approximate order top to bottom from lowest to highest cost and difficulty of implementation.

Several points stand out in the ABAG report regarding incentive use and effectiveness. First, most jurisdictions offer a number of different incentives, rather than just one approach. This makes sense because building and owner circumstances vary widely; what may help one owner might be irrelevant or inappropriate for another and *vice versa*. Second, jurisdictions have taken widely different approaches with incentives, from offering almost nothing to offering substantial loans and grants. Jurisdictions tend to come up with incentive offerings closely tailored to their own goals and circumstances, based on economic conditions, building stock vulnerabilities, political will, and other factors. As a result, there is no single best incentive package to offer.

Another key point is that creation and operation of incentive programs is intense and must be locally customized. Extensive community education and involvement are required to assess needs, design and advertise the incentive offerings, and to help owners take advantage of them. Guiding community members through the mitigation process is time consuming and difficult, usually requiring at least one full time staff member who also has to coordinate with staff across several departments. That means the personalities, technical skills, and political savvy of the internal team will be critical, and likely variable over time, due to natural staff and political turnover issues.

The effectiveness of different incentive approaches, individually or in packages, has not been systematically studied. Both ABAG and the San Francisco CAPSS project have produced high level lists of potential incentive tools (ABAG, 2014; Samant & Tobin, 2008) but do not specify which tools are being used where and to what effect. Many listed approaches are rarely or no longer being used. All the variety makes it difficult to draw overall conclusions as to which incentives have worked "best" where and why.

3. Implications and Potential Policy Directions for Palo Alto

Palo Alto is a medium sized, compact city with a diverse population and vibrant local economy. Nested in the heart of Silicon Valley, the cost of living and development pressures are high, and space for growth is limited. A high degree of interconnectedness with surrounding communities and a dynamic natural environment is also evident.

As a community, Palo Alto cannot ignore its proximity to several major faults and the fact that it has many different vulnerable building types. The estimated losses in a major event are significant. Fortunately, Palo Alto has a legacy of proactive policy leadership in addressing earthquake risks, and a relatively high degree of citizen and local government capacity. The potential benefits from retrofitting are large. City leaders, by investing this year in risk assessment and a policy development dialog, have demonstrated their capability and will to act.

This review found no simple best local earthquake mitigation policy model for Palo Alto to follow. Each of the jurisdictions mentioned in this report has crafted, often over a decade or more, a unique package of measures suited to their own local economic, social, political, and risk realities. Palo Alto must do the same.

In developing its own strategy, Palo Alto can learn from this variety among local mitigation programs. It can build on the successful framework of its own existing program while also combining and tailoring new elements that are working for other jurisdictions.

Choosing Goals and Desired Outcomes

One way to measure success is in relation to program goals and resource realities. From that standpoint, each of the programs mentioned in this report is successful to some degree.

Some jurisdictions set out to do what they could with limited resources, progressing only the first steps of developing an earthquake mitigation program. The City of Richmond, for example, developed an inventory, hosted a community meeting, and notified owners as part of creating a very low cost voluntary approach to soft-story wood frame buildings. The good news is that by doing so, it achieved meaningful progress relative to jurisdictions that have done nothing. Public leaders and the broader community are more aware, city reputation and visibility have been enhanced, and city staff are now better connected to a network of local earthquake professionals that can help facilitate future action if and when that becomes possible. The bad news is that Richmond has been stymied so far by the departure of key staff, limited jurisdictional resources, and the limited resources of its soft-story wood frame building owners and tenants; a more aggressive retrofit program is not realistic until an outside source of funding is found.

At the other extreme, a few leading jurisdictions set out to comprehensively assess earthquake vulnerabilities and risk reduction opportunities community-wide through a lengthy, relatively expensive, and collaboratively-informed processes. San Francisco and more recently Los Angeles are the most prominent users of this approach, producing in-depth reports and resilience plans intended to guide city efforts for decades. Importantly, these plans encompass many city activities and roles, types of buildings and building uses, different phases of the disaster cycle, and explicitly seek to connect earthquake mitigation efforts to a host of other community resilience concerns, from sea level rise to water supply reliability to telecommunications operations (Several leading local program models and planning resources for these types of efforts are introduced in Appendix D).

In between are jurisdictions where program goals are *either* narrower in scope with more vigorous requirements (such as the City of Fremont's mandatory retrofit program for soft-stories) or wider scope with less vigorous requirements (such as the City of Santa Monica, which mandates retrofits for soft-story wood frame buildings and nonductile older concrete structures but only when triggered by a substantial renovation).

The City of Berkeley took a phased, relatively aggressive approach to soft-stories, but has yet to put in place a program to address the 50 or so tilt-up concrete structures it has identified. Oakland is also somewhat unique in being a larger city that has mandated soft-story retrofits without initially taking a comprehensive approach. However, both Berkeley and Oakland benefited first from substantial volunteer professional involvement and later from sizeable, multi-year Rockefeller Foundation 100 Resilient Cities grants. Through the early help of both volunteers and consultants, Berkeley and Oakland laid the groundwork for mandatory programs that likely helped to attract the additional philanthropic attention and assistance. Berkeley has now produced, and Oakland is on its way to producing, a comprehensive resilience assessment and plan similar to what was done by San Francisco and Los Angeles.

In this light, Palo Alto is currently in the “middle” group in terms of its scope and requirements for seismic safety compared to other leading jurisdictions. Palo Alto set new policy precedents in the 1980s with its community engagement, mandatory evaluation, and voluntary retrofit programs for three different categories of structures. However, this only addressed a small subset of its overall vulnerable building stock. By investing in data collection and community discussions this year, Palo Alto is now poised to move forward into a new position of seismic policy leadership.

It is critical to first clarify community values and goals before designing a program to try to achieve them. All stakeholders should be invited to participate in discussions of what matters most to the City and the people who live, work, and invest in it. Common broad goals include increased public safety, reduced private property damage, and reduced downtime and displacement of businesses, consumers, and residents. However, addressing of different building types may advance these goals to different degrees and with different levels of certainty and speed. For instance, addressing soft-story wood frame housing may have little direct benefit for local businesses but would reduce renter displacement. Retrofit of older concrete structures might address concerns about provision of basic services after an event, but would have little or no benefit for housing.

If the goal is to achieve the greatest reduction in losses, Palo Alto should address building types known to be potentially hazardous *that occur in large numbers*. Once community discussions lead to a sense of priorities and preferences, trade-offs and alternatives for pursuing each goal can be understood and considered.

Wherever Palo Alto chooses to focus, it should strategically combine policy features to promote risk reduction. As this report revealed, regardless of scope, the most effective programs use a package of measures to tip the balance away from the status quo by publicizing and increasing the consequences of not retrofitting while also publicizing, easing the costs, and increasing the benefits of retrofitting.

Potential Policy Directions

Coming out of this local program review is a list of alternative approaches for Palo Alto to consider:

Option 1: Status Quo

In this option, the existing ordinance with its mandatory evaluation, voluntary retrofit approach remains in place without changes. This covers 89 buildings and has three categories: Category I—unreinforced masonry (except for under 1,900 sf with 6 residents), Category II—built before 1/1/1935 with 100 or more occupants, and Category III—built before 8/1/1976 with 300 or more occupants. As of 12/9/14, City records indicated that sixty-six of the buildings had been either retrofit, demolished, planned to be demolished, or found exempt, while 23 remained unaddressed. Evaluation was mandatory, and owner funded but retrofit is voluntary. The list is publically available by request, but not advertised. Floor area ratio bonuses are (were) available.

Option 2: Increase Scope, but Retrofit Remains Voluntary

Additional categories of structures would be added to the mandatory evaluation requirements. Palo Alto can consider programs for soft-story wood frame buildings, older concrete buildings, older tilt-up buildings, and older steel moment frame buildings. Precedents exist for programs addressing each of these structural types that pose well-identified, publicly important risks. Completion of an evaluation report could be separated into different timelines, for instance three to ten years, depending on degree of hazard. Palo Alto could also use location, occupancy type, and/or number of occupants as criteria in defining the scope or compliance timelines.

Option 3: Similar to Option 2, but Additional Disclosure Measures are Incorporated

This option would be similar to Option 2, but the list of buildings and status could be prominently posted on City website, tenants could be notified, signage could be required, and/or a recorded notice could be added to the property title. These options enhance transparency with the public and reward owners that retrofit by increasing the perceived benefits of retrofitting among potential tenants and buyers. Relatively inexpensive measures like these have been shown to be effective in increasing public awareness and motivating greater consideration of earthquake risk in private decisionmaking, including voluntary retrofits.

Option 4: Increase Scope, Some Categories are Voluntary and a Few Categories are Mandatory, with Enforcement by Trigger Threshold

This option builds on Option 3, but retrofitting would be required for some building types *at whenever future time a building is sold or undergoes substantial renovation* above a set threshold.

Option 5: Increase Scope, Some Categories are Voluntary and a Few Categories are Mandatory, with Enforcement by a Fixed Timeline

This option would be similar to Option 4, but retrofitting is required *according to a fixed timeline*. Timelines and enforcement emphasis could vary depending on tiers or priority groupings to motivate prompt action for the most vulnerable or socially important structures. In some cases, longer time frames are adopted for some building types such as older concrete, to ease the burden on owners and allow for technical advancement in retrofit techniques.

Option 6: Similar to Option 5, but More Categories are Mandatory

This alternative is similar to Option 5, but retrofitting would be required for additional categories. Palo Alto can also make its programs more stringent over time. Explicit phasing has been successful in jurisdictions like Berkeley and San Francisco for generating political consensus and enhancing administrative feasibility.

This array of options can be also be shown in diagram format (Figure 9), which shows how a number of jurisdictions in this report have positioned themselves in terms of the relative strength of their requirements and the number and scope of the building types addressed.

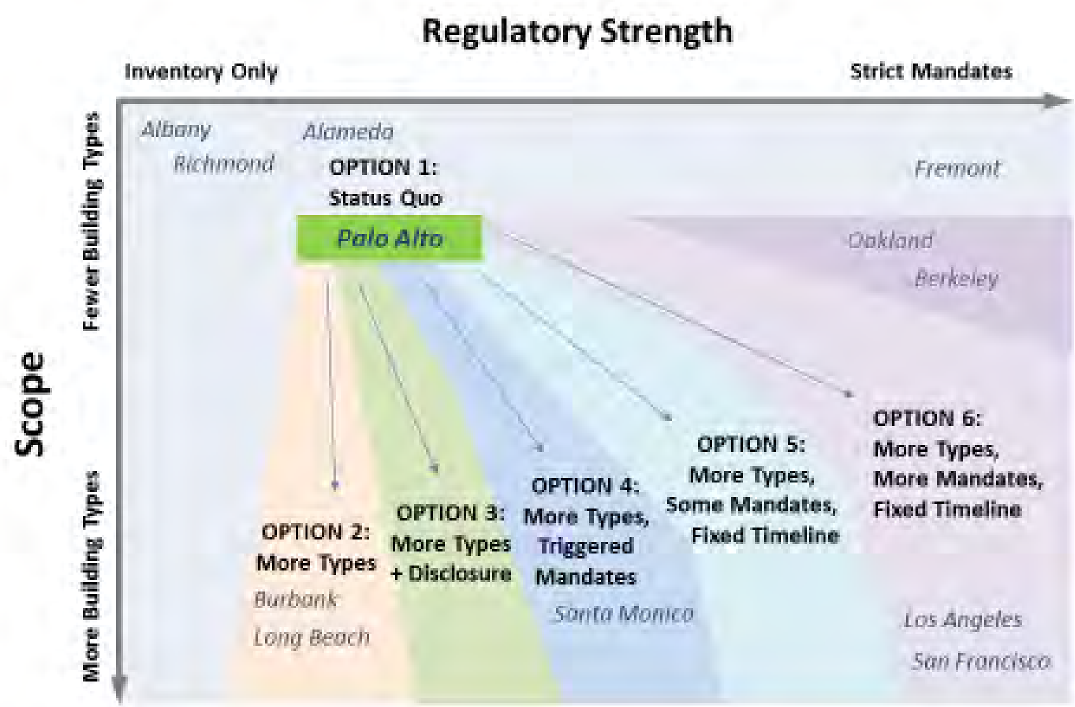


Figure 9: Diagram showing alternative policy directions for Palo Alto in the context of other jurisdictional earthquake mitigation programs.

When considering options, Palo Also leaders and community members should keep in mind the following additional findings from this review:

- Mandating retrofit is the surest way to achieve risk reduction.
- Jurisdictions are increasingly using disclosure measures to motivate retrofits in both voluntary and mandatory programs, and such approaches have been shown to be powerful and relatively low cost to implement.
- Many mandatory programs use intermediate mandatory screening and/or evaluation phases to better gauge the risk and filter out properties that need not comply before implementing retrofit requirements.
- Fixed timelines allow a jurisdiction to prioritize and control the pace of risk reduction, provide a predictable planning horizon for owners.

Incentive Options and Considerations

By offering a strategic set of incentives and devoting a steady, adequate program budget, Palo Alto can create a program that eases the financial and logistical burdens on owners and provides adequate technical assistance to support retrofit project completion. Small incentives are meaningful and helpful to owners, while larger incentives may be critical for a subset of owners that face particularly complex or costly projects.

Palo Alto has several traits that could make policy incentives (non-monetary assistance) particularly effective. One is a relatively manageable number of affected buildings for some building types. This means city staff might be able to provide high quality assistance to owners in complying and taking advantage of any special programs. Palo Alto is a highly desirable locale with a highly educated, real estate savvy population, and robust real estate market. Palo Alto has experience using policy incentives in the past, so staff and many owners are familiar with them.

Despite limited data on their use or effectiveness, incentives can be politically important and provide a variety of benefits. Below are some specific ways incentives could play a role in Palo Alto's future program and some steps that Palo Alto can take to create a package of incentives effectively tailored to its own goals and circumstances.

- **It is good to offer small incentives to all owners because it fosters positive interest in the program and builds community good will.** Modest incentives, on the order of a few hundred dollars, help acknowledge the public value that is being created by the efforts undertaken by owners. For example, offering fee waivers is a gesture that owners will appreciate, if not expect. Expedited permitting is likely to be viewed similarly, because time equates with money. Policy incentives tend to be in the direct control of the City to implement, and are often cost-effective and very helpful for owners in smoothing the path and easing the hassle of doing retrofit work.
- **Incentives are especially important to the outcomes of voluntary programs. Incentives play slightly different roles in mandatory compared to voluntary programs.** In the case of mandated upgrades, incentives essentially ease the burden of doing what has to be done or to make it happen more quickly. In the case of, voluntary programs, the goal of incentives is to motivate retrofit work to occur that might not have otherwise. In this way, incentive offerings are more critical to the *degree of risk reduction achieved* in the case of voluntary programs, and to *political viability, perceptions of program fairness, and speed* of risk reduction achieved in the case of mandatory programs. Bottom line, in the case of URMs, a small number of voluntary programs with substantial incentives have achieved similar

success compared to mandatory programs. With soft-story wood frame buildings, voluntary programs in the absence of incentives alone have not been enough to motivate retrofit work to be done. An exception is for owners in financial hardship, where incentives are most meaningful in mandatory programs.

- **Design the incentive strategy to match the circumstances of the locally targeted building stock.** FAR bonuses are likely irrelevant for soft-story wood frame buildings which are seldom renovated to include more units or changes of use, but relaxing of parking requirements or special provisions for condominiums may help. Mixed-used and historic buildings may require deeper financial assistance when they face high costs associated with retrofitting due to complex design issues, ADA compliance, and imposed restrictions on changes in use.

- **Take time to assess actual need for incentives and the types that will make the most difference to affected Palo Alto owners.** Larger *policy* incentives like FAR bonuses can be very effective, especially in higher income, higher growth communities like Palo Alto. In contrast, larger *financial* incentives can be difficult to orchestrate and have not always been as necessary or useful as hoped. Surprisingly, jurisdictions have sometimes found they have to "sell" incentives programs to owners. Certain strategies tend to be very challenging and costly to get the incentive to work compared to the amount of good they seem to do. Such may be the case with PACE financing,[32] as seen through the experiences of San Francisco and Berkeley for soft-story wood frame buildings. When private market capital is affordable, loan programs may not be needed or utilized. Use of larger, more complex incentive instruments in general increases the amount of hand holding that is needed and the amount of time until retrofits are completed.

- **Consider offering larger incentives to only those owners or properties that qualify or meet certain social importance or hardship criteria.** Interviews in Berkeley (Rabinovici 2012) showed that soft-story wood frame building owners were open to the possibility of need-based financial help. They did not want financing programs to reward ignorance or risky business practices, but as long as the criteria are clear and the process is fair and transparent, many expressed support for programs that would help fellow owners that are truly burdened or in need. There was also support for using social or resilience importance as part of the criteria for special financing eligibility.

[32] Information about San Francisco's PACE program can be found at: http://www.sfgov.org/esip/seismic-retrofit-financing Accessed April 11, 2016. Information about Berkeley's PACE programs can be found at: http://www.ci.berkeley.ca.us/PACE/ (Accessed May 2, 2016.)

- **Integrate incentives as seamlessly as possible into the overall compliance process.** Incentives work best when they are delivered in a timely way, right when people are already making important property or financial decisions. One notable example is the City of Berkeley's transfer tax rebate for single family home seismic improvements, which is available retroactively two years before through two years after time of sale. Another is Palo Alto's floor area ratio (FAR) bonus for retrofit of designated vulnerable structures, which allowed owners the chance to plan in additional space at the same time a retrofit is being designed.
- **Beyond money, it will be important to offer technical assistance, and this can be very helpful and even critical for some owners and engineers.** Retrofitting is not a simple process, and ironically it can become even harder for an owner if it happens as part of a jurisdictional program that requires or is intended to encourage it. Obtaining financing, especially through special programs, may also require intense staff effort.
- **Beware of the timing and costs of seeking public support for new bond financing.** In Berkeley, attempts were made to make a pool of funds available to owners through a transfer tax increase measure on the November 2002 ballot, but it failed to get the required two thirds vote. Participants in retrospect considered the campaign poorly run, but the state of the local economy probably played more of a role than any decrease in support for mandatory retrofit in concept.
- **Consider creation of formal cost-sharing arrangements between tenants and owners.** Part of the financial equation surrounding any upgrade work is the owner's ability to capitalize on the value added to the structure. In the case of rent control, the rate for pass through of capital improvements is a matter of law. Jurisdictions like Oakland, Berkeley, and San Francisco have negotiated cost-sharing arrangements ranging from 50 to 100% that allow owners to increase rents up to a certain percent of the retrofit cost, over a specified time period (usually 10 years). Even though Palo Alto does not have a rent control ordinance, it could establish a permitted amortization schedule into any new retrofit law, which could lessen the impact for tenants of any resulting rent increases.

Disclosure Measure Options

With relatively modest expense for a jurisdiction, disclosure measures can inform the populace and leverage social and market awareness to amplify program effectiveness. In effect, signage, tenant notification, internet lists, and other disclosure tactics make more transparent both useful risk information and the policies a city is using to address risk.

Public perception of disclosure policies has been on balance positive but not without critique. On the one hand, revealing property addresses that are subject to an ordinance can be thought of as making more accessible information that is already public. It spares all parties of going through the time and hassle of formal information requests. It is also consistent with a philosophy of the public's right to know, and may be legally protective for both owners and jurisdictions against accusations that important risk information is being held back. On the other hand, the media has at times portrayed signage as a shaming device, though this may depend on a sign or placard's particular graphic design and wording. Soft-story wood frame owners in Berkeley described the overall suite of disclosure measures imposed there as a "scarlet letter."

San Francisco included disclosure practices as part of its first "nudging" phase in their program plan. In essence, before and in complement to implementing mandates, San Francisco's plan called for trying to increase understanding in the real estate market empower tenants, buyers, and even owners (who could now more credibly and prominently claim credit for early compliance, retrofitting ahead of schedule, or voluntarily taking extra steps).

Evidence about the effectiveness of disclosure, either together with other policy requirements or separately, is quite limited. In at least one case, voluntary retrofit programs combined with disclosure measures have achieved significant risk reduction. Berkeley's mandatory soft-story evaluation program had several prominent disclosure features and resulted in a 25% voluntary retrofit rate in the first four years (Rabinovici, 2012).

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CHAPTER IV.

BUILDING INVENTORY FOR LOSS ESTIMATE

One of the first steps in the study was to develop a digital inventory of buildings in Palo Alto that includes all the information necessary to build the exposure model for the loss estimate. Information sources used to develop the inventory included county tax assessor files, City GIS files, a survey done by the Palo Alto Fire Department and San Jose State University of soft-story wood frame buildings, field notes from the building department files of selected buildings when the 1986 ordinance was being developed, Google Earth and Street View visual reviews, and an extensive sidewalk survey.

The Santa Clara County tax assessor's files, which included 21,187 parcels of real estate in the City of Palo Alto, were used as a starting point to develop the building inventory. The 15,198 parcels designated as single family or two-family residences were first removed, as these were excluded from the study, leaving 5,989 parcels of interest. A parcel is not always equivalent to a building. On one hand, there are some sites where there is one owner and one tax parcel, but there are multiple buildings. Sometimes, it is easy to distinguish the separate buildings from an application like Google Earth or Street View as there is sufficient separation between the structures; in other cases, a field survey is needed when the seismic separation is small (or not present). On the other hand, condominiums can be a single structure, but have multiple owners and thus multiple separate taxpayers and parcel numbers. For the 3,630 residential parcels with three or more units, we found 1,324 distinct buildings. Of the remaining 5,989 – 3,630 = 2,359 tax parcels, we found that 961 tax parcels were identified as "possessory interest." They are used at the city-owned Palo Alto airport for administration of property taxes for concessionaires and for other purposes at other locations in the city, and they do not represent buildings. When they were removed, there were 1,398 non-residential buildings. They were combined with the 1,324 residential buildings for a total of 2,722 buildings.

The assessor's data typically included parcel number (APN), year built, occupancy type, square footage, and number of stories. These data were supplemented with ArcGIS shape files of building and parcel outline from City GIS files, providing the geospatial location of each parcel (by latitude/longitude).

In addition to this information, the exposure model requires basic data on structural system needed to classify each building into a Hazus Model Building Type. For some buildings, this information was available from earlier inventory efforts, including a select set of inventory forms used in developing the current seismic mitigation program, and a survey by SJSU and the City's Fire Department of soft-story wood frame buildings. However, for many buildings no structural system could be assigned based on available records.

The field survey was used to assign the seismic force-resisting system (using the basic FEMA Model Building Type classification system), and to confirm and supplement information acquired from the digital files for number of stories, occupancy (using the Hazus occupancy categories), building area, and year built. In addition, buildings were surveyed for vertical and plan irregularities.

After the sidewalk surveys and additional quality assurance refinements, we identified a total of 2,632 buildings in the study group for Palo Alto. This included 66 buildings subject to Palo Alto's current seismic mitigation ordinance, because 23 of the original 89 buildings subject to the ordinance have been demolished.

Not all buildings were field surveyed and not all key attributes needed for loss estimation were available for all buildings. For buildings that were not surveyed and were missing information, the missing attributes were developed using statistical comparisons with buildings that were surveyed on a sector by sector basis. A multi-step procedure was developed to fill in other missing attributes based on the best available comparative information. For example, buildings with missing occupancy and number of stories were assigned occupancies and number of stories with the same distribution of occupancies for surveyed buildings in that sector. For buildings with missing square footage data, the median values in the sector for residential and non-residential buildings were used. In assigning missing seismic force-resisting system information and year built, some rules were applied based on typical building practices. As a result, while the information for buildings that were not surveyed may not be fully accurate at the individual building level, the overall data set is seen as sufficiently representative for the type of loss estimates used in the project and relative comparisons made between different building types that are discussed ahead.

In addition to the information discussed above, a replacement cost had to be established for each building. Standard 2014 RS Means Replacement Cost values included in the loss estimation software (Hazus) used were reviewed as a starting point, but not considered representative for Palo Alto. R+C and Vanir Construction Management prepared adjustments to RS Means values to capture 2016 data and local factors. These were reviewed by a task group of the City's project Advisory Group that included local design professionals and developers familiar with the local cost climate. The group recommended an increase of the values in general, and identified target values for selected common occupancies. Based on these recommendations, R+C updated the values and Vanir reviewed them and revised the non-targeted occupancies for estimating consistency. The resulting replacement costs are shown in Table 5, and were used in the loss calculations. It is noted that resulting costs are 1.7-2.6

times the RS Means-based Hazus default values (2014 cost data), and that costs are intended to be representative of averages across the town.

Table 5: Average $/SF replacement building cost by Hazus occupancy class.

Occupancy Class	RS Means 2014 Average Palo Alto Cost[1] [$/SF]	Market Factor for Palo Alto	Escalation Factor from 2014 costs to 2016 costs	Demo & Minimal Sitework (5' around building) [$/SF]	Soft Cost Premium[2]	Average 2016 Palo Alto Cost w/ Soft Costs [$/SF]	Multiplier (Replaced with Soft Costs / RS Means)
Multi Family, duplex	$130.75	40%	10%	$17.50	20%	$263	2.01
Multi Family, triplex/quad	$114.94	40%	10%	$17.50	20%	$233	2.03
Multi Family, 5-9 units	$206.41	40%	10%	$17.50	20%	$402	1.95
Multi Family, 10-19 units	$194.12	40%	10%	$17.50	20%	$380	1.96
Multi Family, 20-49 units	$212.26	40%	10%	$17.50	20%	$413	1.95
Multi Family, 50+ units	$199.90	40%	10%	$17.50	20%	$390	1.95
Temporary Lodging	$217.83	40%	10%	$17.50	20%	$424	1.94
Institutional Dormitory	$234.44	50%	14%	$25.00	20%	$511	2.18
Nursing Homes	$238.07	50%	12%	$25.00	20%	$510	2.14
Retail Trade	$121.66	80%	10%	$17.50	20%	$310	2.55
Wholesale Trade	$118.13	60%	10%	$17.50	20%	$$270	2.29
Personal & Repair Services	$143.47	60%	10%	$17.50	20%	$324	2.26
Professional/Technical/ Business Services	$194.52	65%	12%	$17.50	20%	$452	2.33
Banks	$281.88	40%	12%	$25.00	20%	$560	1.99
Hospitals	$372.59	50%	14%	$35.00	20%	$807	2.16
Medical Office/Clinics	$267.85	20%	10%	$17.50	20%	$445	1.66
Entertainment/Recreation	$248.61	25%	12%	$25.00	20%	$448	1.80
Theaters	$186.45	35%	12%	$25.00	20%	$368	1.98
Parking	$84.59	20%	10%	$17.50	20%	$155	1.83
Heavy	$144.71	25%	10%	$17.50	20%	$260	1.80
Light	$118.13	25%	10%	$17.50	20%	$216	1.83
Food/Drugs/Chemicals	$229.48	30%	12%	$17.50	20%	$422	1.84
Metal/Minerals Processing	$229.48	30%	12%	$17.50	20%	$422	1.84
High Technology	$229.48	40%	14%	$17.50	20%	$461	2.01

Table 5: Average $/SF replacement building cost by Hazus occupancy class.

Occupancy Class	RS Means 2014 Average Palo Alto Cost[1] [$/SF]	Market Factor for Palo Alto	Escalation Factor from 2014 costs to 2016 costs	Demo & Minimal Sitework (5' around building) [$/SF]	Soft Cost Premium[2]	Average 2016 Palo Alto Cost w/ Soft Costs [$/SF]	Multiplier (Replaced with Soft Costs / RS Means)
Construction	$118.13	30%	10%	$17.50	20%	$224	1.89
Church	$118.13	50%	12%	$25.00	20%	$268	2.27
Agriculture	$199.08	10%	12%	$17.50	20%	$315	1.58
General Services	$152.63	40%	10%	$17.50	35%	$341	2.23
Emergency Response	$259.52	40%	14%	$25.00	35%	$593	2.28
Schools/Libraries	$193.00	40%	12%	$25.00	35%	$442	2.29
Colleges/Universities	$214.91	60%	12%	$25.00	35%	$554	2.58

Notes:

1. RS Means average cost includes RS Means default location factors to adjust national average to Palo Alto of 15% for residential and 11% for commercial.
2. Soft costs include architect and engineer design fees, testing and inspection, utility connection fee, permits, and an allowance for owner change order contingency.
3. Costs are intended to be representative of average in Palo Alto across the town, including downtown areas together with other areas in the city.
4. Costs were previously prepared following a 3/7/2016 discussion with the Palo Alto Seismic Risk Program Advisory Group Technical Advisory Committee. Table includes minor updates based on internal review between Rutherford + Chekene and Vanir Construction Management to achieve improved relative ratios between different occupancy types.

Table 6 shows how the number and aggregate value of Palo Alto's buildings is distributed by structural system, using the FEMA Model Building Type classification system for structural system. The table is sorted by aggregate building value. Wood frame buildings make up about 60% of the number of buildings, and represent 35% of the total value. About 20% of the buildings are concrete, and they represent over 40% of the total value. Of the remaining 20%, about two-thirds are masonry buildings, and one-third steel. However, the steel buildings represent about twice the value of the masonry buildings.

Table 6: Distribution of number of buildings, building area, and building value by Model Building Type.

Model Building Type	Number of Buildings	Aggregate Square Feet (1,000)	Aggregate Building Value ($M)
Concrete shear wall (C2)	318	9,699	4,082
Concrete tilt-up (PC1)	242	8,054	3,368
Wood frame larger residential (W1A)	331	8,403	3,232
Wood frame commercial/industrial (W2)	307	6,209	2,369
Steel braced frame (S2)	50	3,116	1,391
Wood frame smaller residential (W1)	898	3,821	1,278
Steel moment frame (S1)	75	3,005	1,242
Reinforced masonry, wood floor (RM1)	285	2,806	1,209
Reinforced masonry, concrete floor (RM2)	30	574	211
Steel light metal frame (S3)	41	533	177
Precast concrete frame (PC2)	5	334	125
Concrete moment frame (C1)	18	325	117
Steel frame with concrete shear walls (S4)	13	162	72
Unreinforced masonry bearing wall (URM)	9	274	15
Concrete with masonry infill (C3)	8	26	8
Steel frame with masonry infill (S5)	2	6	3
Totals	**2,632**	**47,346**	**18,899**

The study group can be further divided into age groups separated by significant milestones in building code implementation. The following age groups were selected: pre-1927, 1927-1961, 1962-1976, 1977-1997, and 1998 until now. The milestones reflected include the first earthquake code in Palo Alto in 1926, adoption of the 1961 Uniform Building Code (UBC) and associated higher forces, code changes in the 1976 UBC following the 1971 San Fernando Earthquake, and code changes in the 1998 UBC following the 1994 Northridge Earthquake. Figure 10 shows a histogram of the year built of the buildings in the study group.

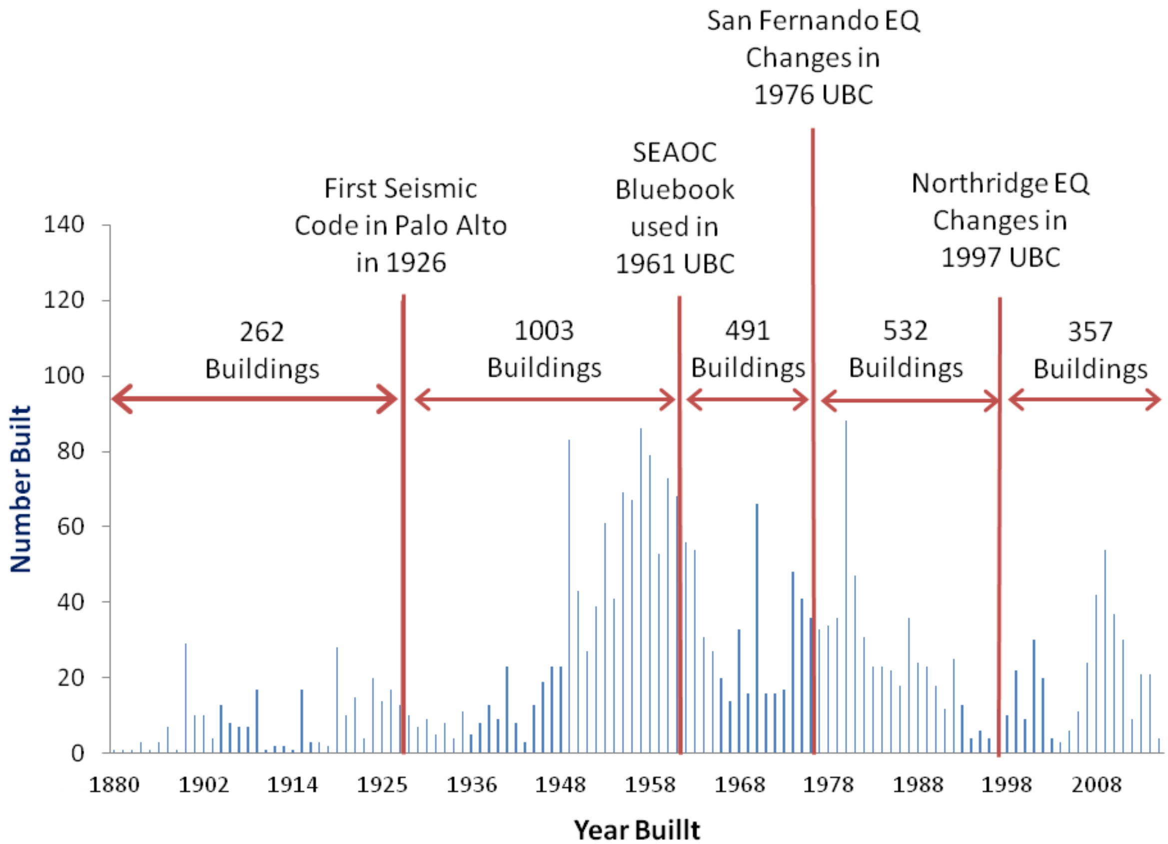

Figure 10: Distribution of year built of buildings in study group with significant changes in the building design practice.

CHAPTER V.

VULNERABLE BUILDING CATEGORIES

One of the important tasks in the risk assessment study was to identify potentially vulnerable building categories specific to Palo Alto using the building inventory that was developed early in the risk assessment study. Potentially vulnerable structural system types were identified based on experience in past earthquake events, knowledge of milestones when improvements in seismic code requirements were made in Palo Alto, rankings in prominent seismic risk assessment tools such as the 2015 edition of FEMA P-154 *Rapid Visual Screening of Buildings for Potential Seismic Hazards,* results from past seismic risk assessment studies in California communities, and engineering judgment. The building categories were then evaluated in analytical loss estimate studies described ahead which helped to confirm the selected categories as appropriate for Palo Alto. Key building vulnerability metrics include the risk of deaths and injuries, the cost of damage, and the extent of downtime or loss of use. Buildings in the identified vulnerable building categories tend to perform poorly with respect to all three of these metrics though the relative degree of vulnerability to each factor varies.

Community resilience is improved if residents have homes that remain usable after an earthquake event, and if businesses can still operate. From a program perspective, the consultant team and Advisory Group believe the greatest reduction in losses and the largest benefit to community resilience will come from seismically retrofitting building types know to be both potentially hazardous and present in significant numbers in Palo Alto.

In addition to the three categories already in Palo Alto's seismic hazard identification ordinance (Categories I, II, and III below), five additional categories of vulnerable building types were identified. All five categories meet the criteria of being potentially hazardous and having a significant presence in Palo Alto. The eight categories and the approximate number of buildings included in each category are as follows:

- Category I: Constructed of unreinforced masonry, except for those small than 1,900 square feet with six or few occupants (10 remaining buildings in Palo Alto);
- Category II: Constructed prior to January 1, 1935 containing 100 or more occupants (4 remaining buildings);

- Category III: Constructed prior to August 1, 1976 containing 300 or more occupants (9 remaining buildings);
- Category IV: Pre-1977 soft-story wood frame (294 buildings);
- Category V: Pre-1998 tilt-up concrete (99 buildings);
- Category VI: Pre-1977 concrete soft-story (37 buildings);
- Category VII: Pre-1998 steel moment frame (35 buildings);
- Category VIII: Other pre-1977 concrete construction (170 buildings).

The loss estimate discussed ahead in Chapter VIII confirmed that the potential reduction in losses from retrofitting is significant for these categories.

CHAPTER VI.

CONCEPTUAL SEISMIC RETROFITTING OF REPRESENTATIVE VULNERABLE BUILDINGS

Retrofit was considered for all buildings that have not already been retrofitted and were either constructed before 1961 or between 1962 and the “benchmark” year with a soft story. A “benchmark” year is when the code requirements for that building type became similar to those currently in place. Buildings built after a benchmark year are assumed not to have significant seismic deficiencies and are typically not seismically retrofitted. Consistent with typical practice, the performance of the retrofitted buildings in an earthquake is assumed to be less than that of newly constructed buildings.

For estimating the cost of retrofit for the improved buildings, Rutherford + Chekene developed conceptual designs for Model Building Types that represent a significant number and value of Palo Alto’s building stock, as well as a significant loss and loss reduction after retrofit. This process identified wood frame (W1, W1A, W2), steel moment frame (S1), concrete shear wall (C2), concrete tilt-up (PC1), and reinforced masonry (RM1) and unreinforced masonry (URM) as appropriate candidates. For each Model Building Type, the age, square footage and number of stories were reviewed to identify a “prototype” building. In cases where the prototype building was not representative of more than two-thirds of the total number of buildings, it was judged that multiple prototypes should be considered.

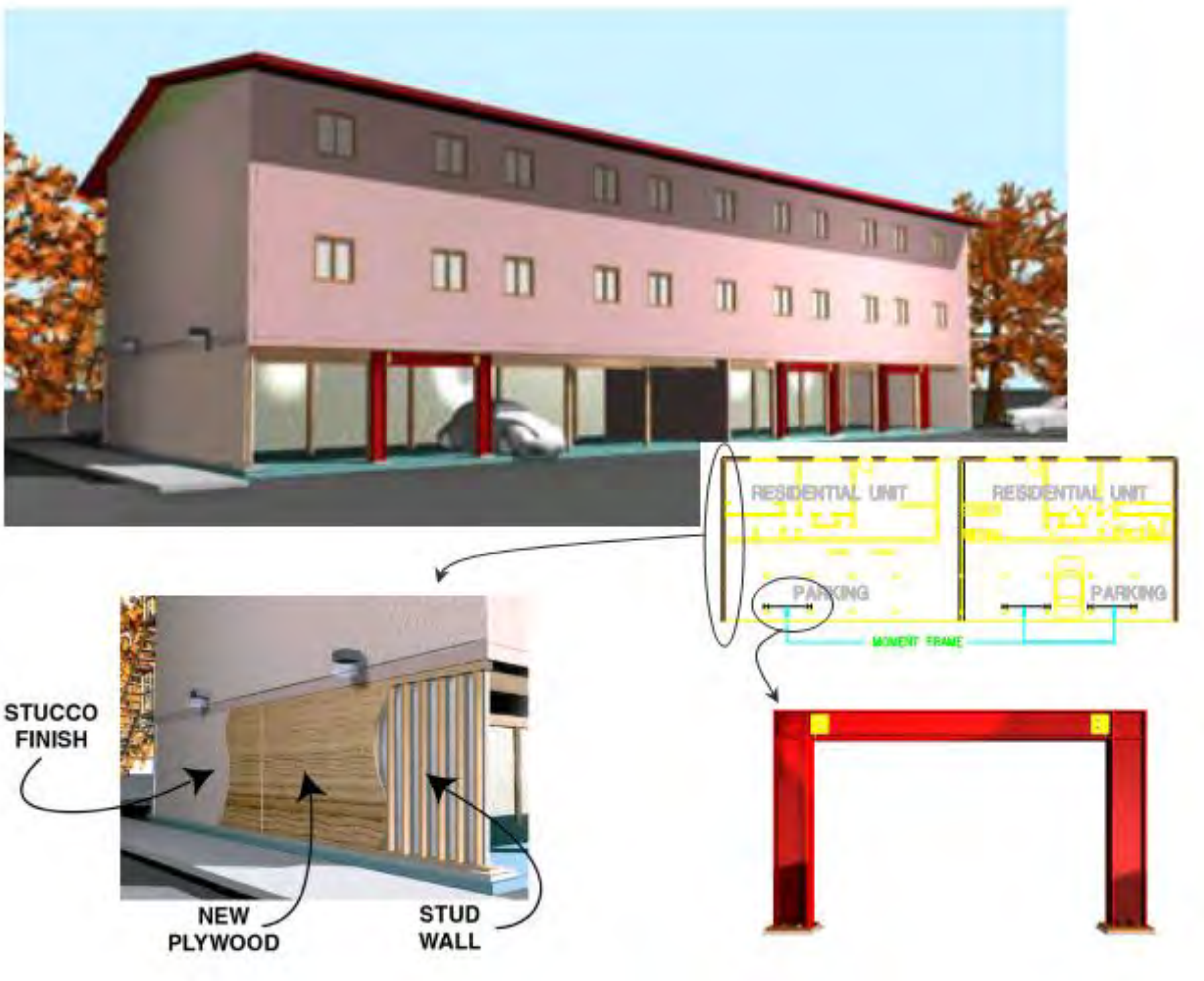

Figure 11: Retrofit scheme for Large Multi-family Soft-Story Wood Frame Building.

For example, for the W1A Model Building Type there were a significant number of two-story and three-story buildings with a significant difference in average square footage. Therefore, a two-story and a three-story prototype building were developed to represent this Model Building Type. Eventually this led to the 12 prototype buildings shown in Table 7.

Based on a review of buildings of size similar to the prototypes, representative floor plans were developed. A conceptual retrofit was then shown on the floor plans. An example of a conceptual retrofit for the W1A prototype building is shown in Figure 11 from a 2000 brochure by Rutherford + Chekene for the City of San Jose entitled "Practical Solutions for Improving the Seismic Performance of Buildings with Tuckunder Parking." The retrofit elements were keyed to representative details in 2006 FEMA 547 *Techniques for the Seismic Rehabilitation of Existing Buildings*, and a written description of collateral impacts was developed as well to provide sufficient detail to allow a rough order of magnitude cost estimate to be prepared. The conceptual retrofit designs, description of collateral impacts, and referenced details are included in Appendix E.

The cost estimators of Vanir Construction Management used the conceptual designs to estimate a range of probable cost to implement the retrofits. The retrofit costs for each prototype building are shown in Table 7. These costs include hard costs, which are the costs the owner pays the contractor, plus a design contingency as these are conceptual retrofits. The estimate further includes soft costs, representing architect and engineer design fees, testing and inspection costs, permit fees, and an owner change order contingency.

Considered costs do not include hazardous material abatement, costs associated with performing the work while occupants are using the building, triggered accessibility upgrades, cost premiums associated with retrofit of a historic building, tenant relocation or business interruption during construction, project management, renovation, financing, repair of existing conditions, and legal fees. These costs are more variable and project and site specific, and are typically not included in loss estimates for this type of study. A detailed breakdown of estimated cost is included in Appendix F

The retrofit costs were extrapolated to Model Building Types not represented by a prototype retrofit as shown in the fifth column of Table 7.

Table 7: Conceptual retrofit cost.

Retrofit Prototype	Model Building Type	Stories	Square Feet	Used for Model Building Types	Used for Square Feet	Average Retrofit Cost ($/SF)
1	Wood frame smaller residential (W1)	2	5,320	W1	All	12
2	Wood frame larger residential (W1A)	2	9,500	W1A	< 15,000	11
3	Wood frame larger residential (W1A)	3	30,000	W1A	≥ 15,000	6
4	Wood frame commercial/industrial (W2)	2	10,000	W2	All	14
5	Steel moment frame (S1)	2	43,900	S1, S2, S3	All	10
6	Concrete shear wall (C2)	1	5,000	C1, C2, S4, PC2	< 10,000	50
7	Concrete shear wall (C2)	2	17,280	C1, C2, S4, PC2	≥ 10,000	40
8	Concrete tilt-up (PC1)	1	18,435	PC1	< 25,000	29
9	Concrete tilt-up (PC1)	2	38,400	PC1	≥ 25,000	21
10	Reinforced masonry, wood floor (RM1)	1	2,750	RM1, RM2	< 5,000	74
11	Reinforced masonry, wood floor (RM1)	2	8,150	RM1, RM2	≥ 5,000	46
12	Unreinforced masonry bearing wall (URM)	1	5,000	URM, S5, C3	All	110

CHAPTER VII.

LOSS ESTIMATING FINDINGS FOR EXISTING BUILDING STOCK

Hazus is a geographic information system (GIS) based, standardized, nationally applicable multi-hazard loss estimation methodology and software tool. It is used by local, state, and federal government officials for preparedness, emergency response, and mitigation planning. FEMA has recently released the latest version of Hazus (Hazus 3.1) which includes building inventory data reflecting 2010 census data for residential structures and costs to 2014. Rather than using the embedded inventory data for Palo Alto, which are estimated from census data, a detailed earthquake risk assessment of the individual buildings in the study group was conducted using the Hazus Advanced Engineering Building Module (AEBM).

Direct loss is calculated through a complex process in Hazus. In essence, the engine consists of a large database of "fragility functions". These fragility functions describe the probability of exceeding threshold damage levels as a function of a seismic demand parameter. For example, spectral displacement is linked to slight, moderate, extensive and complete damage states to describe the performance of a structural system. The estimated level of damage for the level of ground shaking under consideration is then used to assign the costs to repair or replace the damage to the building's structural and nonstructural systems and contents (the loss). Each Hazus fragility function represents a combination of Model Building Type, number of stories, and seismic design level.

Analyses were conducted for two specific earthquake scenarios developed by the United States Geological Survey (USGS), a major M7.9 San Andreas Fault event, and a strong M6.7 San Andreas Fault event.

The USGS has developed a suite of ShakeMap earthquake scenarios for different faults around California. In the San Francisco Bay Area, they include events of different magnitude on a number of faults, such as various segments of the San Andreas Fault and the Hayward Fault. The largest scenario is a M7.9 event on the San Andreas Fault which represents a repeat of the 1906 earthquake. In this scenario, all four segments (Santa Cruz Mountains, Peninsula, North Coast, and Offshore) of the San Andreas Fault are assumed to rupture. There is a M7.2 event on the Peninsula segment with an epicenter somewhat south of Palo Alto. In addition to the scenarios, a ShakeMap of the 1989 Loma Prieta earthquake which had an epicenter southwest of Palo Alto is also available.

In reviewing the available scenarios, the repeat of the 1906 earthquake provided a desirable, easy to communicate upper bound scenario. Since the 1989 Loma Prieta event did relatively little damage to buildings in Palo Alto (though there was substantial damage to some of the older buildings at nearby Stanford University), it was judged to be too small to provide meaningful information for policy choices in Palo Alto. Most of the Hayward Fault scenarios also produce small to moderate shaking in Palo Alto. Review of the M7.2 San Andreas scenario found that it produced relatively similar peak ground acceleration and short period spectral accelerations to those of the M7.9 scenario. Tom Holzer, an engineering geologist with the USGS, is a member of the project Advisory Group. With his help and the ShakeMap team at USGS, two other scenarios were developed between the M7.2 scenario and the Loma Prieta earthquake. These are a M6.9 scenario and a M6.7 scenario on the Peninsula segment of the San Andreas with an epicenter directly adjacent to downtown Palo Alto.

In the end, the M6.7 scenario was selected in addition to the M7.9 scenario. The M6.7 scenario provided values somewhat smaller than the M7.9 scenario event, values large enough to be meaningful, and is a magnitude size commonly used in USGS communications. It also has a substantially lower equivalent return period from the M7.9 scenario.

Contour plots for the short period spectral acceleration for the two M6.7 and M7.9 scenarios are shown in Figure 12.

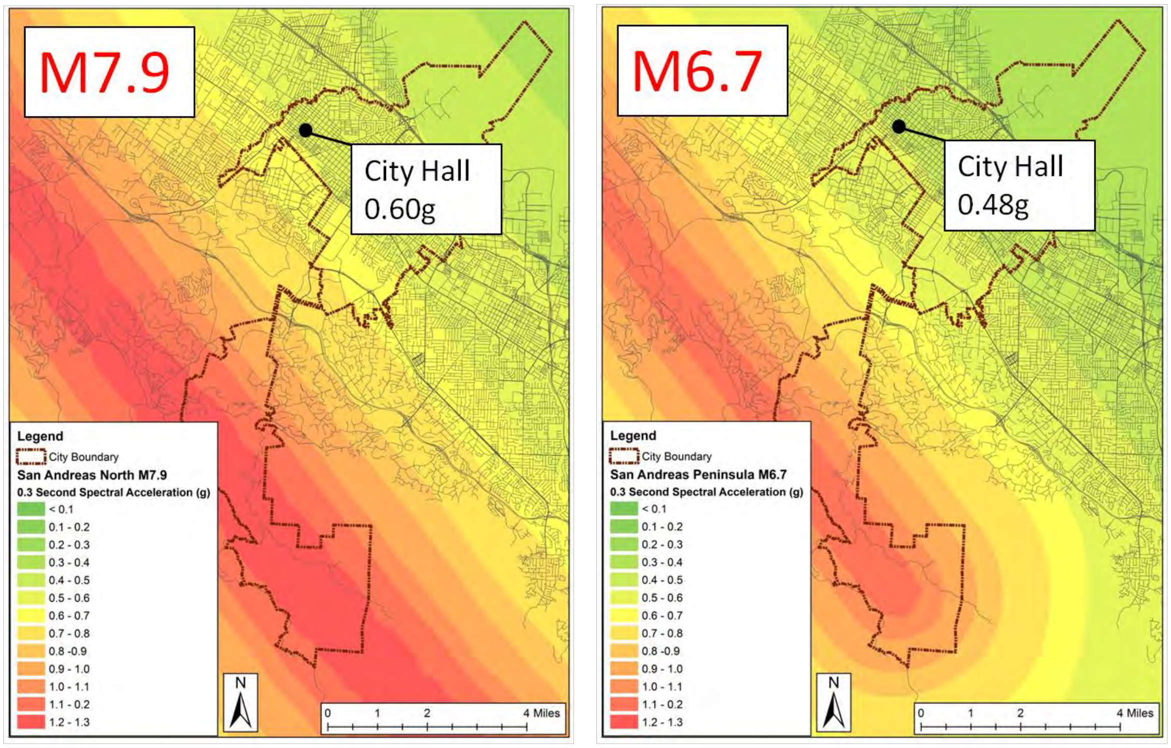

Figure 12: Predicted short period spectral acceleration in vicinity of Palo Alto (city boundary shown) for two selected San Andreas Fault scenarios.

Table 8 summarizes the total loss calculated by Hazus for the as-is condition for the two earthquake scenarios. The results show that the estimated losses to Palo Alto buildings and contents in a M6.7 scenario will be significant, on the order of $1.2 billion. Though ground shaking in the M7.9 scenario is only about 25% larger than it is in the M6.7 scenario, overall building and content losses double to $2.4 billion. Average building damage and content damage also approximately double with a M7.9 event. The difference in the number of buildings that are heavily damaged with the larger earthquake is more pronounced with a 12-fold increase from the M6.7 to the M7.9 scenarios. This is shown in the fourth column of Table 8 as the number of buildings with a damage ratio exceeding 20%.

Table 8: Total losses for study group in as-is condition.

Earthquake Scenario	Building Value[1] ($B)	Content Value[2] ($B)	Number of Bldgs with Damage Ratio ≥ 20%[3]	Estimated Building Damage[4] ($B)	Estimated Content Damage[4] ($B)	Total Building and Content Damage ($B)
M7.9	18.9	17.3	224	1.7	0.7	2.4
M6.7	18.9	17.3	19	0.8	0.4	1.2
Ratio of M7.9/M6.7				2	2	2

Notes:

1. Building value is the complete replacement cost for the building, and includes the structure, architectural, mechanical, electrical, and plumbing components (e.g., ceilings and lighting).
2. Content value includes the complete replacement cost of furniture and equipment that is not integral with the structure (e.g., computers and other supplies). They are estimated as a percent of structure replacement value, dependent on occupancy.
3. Damage ratio is defined as the cost of repairing damage divided by the replacement cost of the building.
4. Estimated building and content damage cost is the cost associated with repair and replacement of the building and its content.

To put the loss from building damage in context, the average annual valuation of Palo Alto construction permits was $400M between 2013 and 2016 (which represents a boom period). The total loss in a major M7.9 earthquake represents more than four years' worth of construction, and the total loss in a strong M6.7 earthquake represents more than two years worth of construction.

It should be noted that these losses do not include the effects of lives lost and business disruption, or the ripple effects in the local economy or real estate market, and that much of this loss will not be insured.

Table 9 breaks out the estimated loss and damage ratio for various model building types, and it can be seen that it depends on the metric used which building type is considered the poorest performer. Looking at the total loss alone, concrete bearing wall buildings and commercial wood frame buildings are responsible for the highest total loss. This tracks well with the earlier finding that these structural systems are the most prevalent ones. If we look at the highest average building damage ratio instead, buildings with unreinforced masonry bearing walls and unreinforced masonry infills are the most prone to damage. However, not very many of them exist in Palo Alto, and as a result they do not represent much of the aggregate loss. It is therefore important to look at multiple metrics when deciding which buildings are the most vulnerable and significant to the community as a whole.

Table 9: Top three vulnerable building types ranked by total loss, average damage ratio, and number of severely damaged buildings.

Building Type	Number of Buildings	Building Value ($M)	M7.9 EQ Total Building + Content Losses ($M)	M7.9 EQ Average Building Damage Ratio	M7.9 EQ Number of Bldgs with Damage Ratio ≥ 20%
Concrete shear wall (C2)	318	4,082	**477**	14%	75
Concrete tilt-up (PC1)	242	3,368	**365**	12%	32
Wood frame commercial/industrial (W2)	307	2,369	**216**	9%	9
Steel frame with masonry infill (S5)	2	3	1	**38%**	1
Unreinforced masonry bearing wall (URM)	9	15	4	**29%**	9
Concrete frame with masonry infill (C3)	8	8	2	**29%**	6
Concrete shear wall (C2)	318	4,082	477	14%	**75**
Concrete tilt-up (PC1)	242	3,368	365	12%	**32**
Steel moment frame (S1)	75	1,242	130	18%	**27**

CHAPTER VIII.

LOSS ESTIMATING FINDINGS WITH BUILDINGS RETROFITTED

A second Hazus AEBM run was done assuming a retrofitted building stock. For this run, it was assumed that a building would be retrofitted if it has not already been retrofitted and is either constructed before 1961 or between 1962 and the benchmark year with a soft story. The Hazus model was rerun with the updated fragilities simulating retrofit.

Table 10 shows the resulting total losses and damage ratios. Though total losses are still significant, comparing the results of Table 10 with Table 8 shows a reduction in total loss of 45% for the M7.9 scenario, and 33% for the M6.7 scenario. In other words, aggregate loss to the community if all considered properties were retrofit could be reduced by one third in a very plausible event and almost halved in a much larger event.

Another important improvement is the reduction of the number of buildings with more than 20% damage. The M7.9 scenario shows a reduction from 224 buildings to 6 buildings, meaning that the probability of building collapse and resulting injuries and fatalities has become very low.

Finally, the damage and loss of the M7.9 scenario remain approximately two times the amount sustained in the M6.7 scenario. This suggests that the retrofit has a similar impact for both levels of ground shaking.

Table 10: Total losses after retrofitting.

Earthquake Scenario	Building Value ($B)	Content Value ($B)	Estimated Building Damage ($B)	Number of Bldgs with Damage Ratio ≥ 20%	Estimated Content Damage ($B)	Total Building & Content Damage ($B)
M7.9	18.9	17.3	0.9	6	0.5	1.3
M6.7	18.9	17.3	0.5	0	0.3	0.8
Ratio of M7.9/M6.7			2	-	2	2

Table 11 breaks out the reduction in total loss by model building type for the M7.9 scenario, and shows the associated retrofit cost. The average reduction in loss varies by building type, with URM buildings showing the highest reduction in loss after retrofit of 80%, and steel braced frames showing an 18%

reduction at the low end. On average, the retrofit costs are on the order of the damage reduction for this scenario, though by building type the average damage reduction (loss avoided) divided by retrofit cost ranges from 0.14 for steel light frame buildings to almost eight for reinforced masonry buildings. Wood frame and concrete buildings are responsible for the largest reduction in total loss, with wood frame construction representing over 20% of the loss reduction, and concrete buildings over 50%.

It should be noted that the data in Table 11 also includes buildings that were not retrofitted. As a result, further parsing of the data is needed to better understand which buildings are responsible for the most loss, and those that can be improved more cost-effectively.

Table 11: Comparison of retrofit benefits and costs by Model Building Type.

Model Building Type	M7.9 EQ Average Damage ($/SF)	M7.9 EQ Total Damage Reduction ($1,000)	Average Damage Reduction ($/SF)	Retrofit Cost ($/SF)
Wood frame smaller residential (W1)	16	13,775	4	12
Wood frame larger residential (W1A)	25	61,317	7	6-11
Wood frame commercial/industrial (W2)	50	160,155	26	14
Steel moment frame (S1)	62	76,150	25	10
Steel braced frame (S2)	44	24,222	8	10
Steel light metal frame (S3)	108	38,163	72	10
Steel frame with concrete shear walls (S4)	101	11,118	69	40-50
Steel frame with masonry infill (S5)	247	695	121	110
Concrete moment frame (C1)	55	8,045	25	40-50
Concrete shear wall (C2)	70	336,574	35	40-50
Concrete frame with masonry infill (C3)	120	865	34	110
Concrete tilt-up (PC1)	68	218,491	27	21-29
Precast concrete frame (PC2)	21	0	0	21-29
Reinforced masonry, wood floor (RM1)	59	87,697	31	46-74
Reinforced masonry, concrete floor (RM2)	35	3,727	6	46-74
Unreinforced Masonry Bearing Wall (URM)	23	5,216	19	110
Totals	**51**	**1,046,210**	**22**	

Table 12 shows those buildings types that may be considered good candidates for a retrofit program. Although representing only about 15% of the total inventory, these buildings are responsible for over 30% of the total loss. This is reflected in the considerably higher than average loss (fourth column of Table 12). The benefit of retrofit is also considerable for this group of buildings, as they are responsible for over 50% of the reduction in loss. Additionally, the cost to retrofit them is only a fraction of the losses avoided in a major event, ranging from a third for the concrete buildings to a tenth for the steel frames. Note that these values are based on conceptual retrofits. Actual retrofit costs for individual buildings would vary substantially, and the steel moment frame benefit-to-cost ratio is higher than expected by engineering judgment. This is caused in part by a comparatively low retrofit cost for this Model Building Type.

Table 12: Comparison of benefits and costs by selected Model Building Type, date and characteristics.

Model Building Type	Number of Buildings	Total SF (1,000)	M7.9 EQ Average Loss by Building ($/SF)	M7.9 EQ Average Loss Avoided by Retrofit ($/SF)	Average Cost to Retrofit ($/SF)	(Average Loss Avoided) / (Average Retrofit Cost)
Pre-1977 wood frame soft-story (W1, W1A, W2)	294	3,690	66	46	12	4
Pre-1998 tilt-up (PC1)	99	3,078	106	71	23	3
Pre-1977 concrete soft-story (C1, C2, C3)	37	842	149	108	42	3
Pre-1998 steel moment frame (S1)	35	690	152	110	10	11

CHAPTER IX.

REVIEW OF PAST SEISMIC RETROFITS

To gain a better understanding of the quality of the retrofits and identify relevant issues to updating Palo Alto's seismic risk mitigation program, a sample of the submitted engineering studies and building retrofit drawings was reviewed.

Ten buildings were selected, so that their permit history could be reviewed and documents could be retrieved from the archives of the Building Department. They were distributed over the three existing hazardous buildings categories, and also included soft-story wood frame buildings. Records were retrieved for four Category I buildings (to reflect the higher number of these), two Category II buildings, two Category III buildings, and two soft-story wood frame buildings.

The City tracked permit numbers for the retrofit projects in their "hazardous buildings" database. Even so, it proved difficult to retrieve associated documents. After careful review of the City's records, some archived documents showing structural modifications were retrieved. The type of documents available varied from building to building. In about half of the cases, plans were available, and in the other half, the documents consisted of calculations with sketches.

For one of the Category I buildings, plans showing a comprehensive retrofit were available. The 2001 California Building Code was referenced for seismic design. In a second case, the retrieved plans show retrofit of a section of the building that appears to be intended to improve the original retrofit. It was unclear if other sections of the building were improved in a similar fashion. In the third case, structural calculations were provided. It is unclear what criteria were used, as the 1991 UCBC is used for certain elements and the regular UBC seismic load calculations for global loading. The set of plans retrieved for the last building is for a tenant improvement that appears to have been constructed a few years after the original seismic retrofit. Interestingly, the structural engineer referenced the 1977 UBC as the seismic design criteria. The building is identified on the plans as a concrete building, rather than a URM building.

For the Category II buildings, in one case only the permit application worksheet was available; in the other case there were detailed calculations and sketches (no construction documents). The permit application for the first building indicates that shear walls were added as part of a voluntary seismic upgrade. The sketches for the second building indicated that the retrofit was designed to mitigate the deficiencies identified in the evaluation report. It references both elements and loads from the earlier study.

For the Category III buildings, it appears that in both cases the projects were driven by modifications or additions to the existing building. Since no plans were archived, and the calculations could not be easily followed, it was not clear if the existing building was fully evaluated and if all deficiencies found in the original evaluation report were addressed.

In 2003, the Collaborative for Disaster Mitigation at San Jose State University completed an "Inventory of Soft-First Story Multi-Family Dwellings in Santa Clara County". According to the report the City of Palo Alto had 130 soft-first story multi-family buildings including 1,263 residential units housing 3,158. The list of addresses from the San Jose State University report was updated with information from the City of Palo Alto Fire Department, and resulted in a reduced list of 108 addresses. According to this list, which was included in a recent Staff Report to Palo Alto's Policy and Services Committee[33], six buildings were improved voluntarily. Two sets of plans were retrieved and reviewed; in one case the plans improved two buildings with the same plan as a mirror image. One of the permits was issued in 2006 and one in 2009. It appears that in both cases the buildings were of a more recent vintage, as plans show that existing plywood shear walls are present. On both sets of plans design criteria were referenced, with one building referring to the 2001 California Building Code, and one Appendix Chapter A4 of the 2006 International Existing Building Code.

Review of the submitted engineering studies and building retrofit drawings identified the following relevant needs for future seismic risk mitigation programs:

- Clear identification of retrofit design intent, scope, and limitations, also for voluntary retrofits;
- Identification of existing structural systems;
- Decision on requirements for buildings that have had partial seismic retrofits completed, and may have remaining seismic deficiencies.

[33] Policy and Services Committee Staff Report 5293, Discussion of Updating the Seismic Safety Chapter of the Municipal Code for Hazardous Buildings, December 9, 2014, available online at https://www.cityofpaloalto.org/civicax/filebank/documents/44945 (accessed 12/21/2016)

CHAPTER X.

ADDITIONAL RECOMMENDED PROGRAM FEATURES

In addition to expansion of the building categories included within the City's seismic risk mitigation program and refinement of disclosure measures and incentive options, a number of other program features are recommended. They are described in the following:

- *Use the current inventory, taking note of its limitations:* The inventory developed for the effort to date involved use of digital information and field surveys. A complete field survey of all buildings in Palo Alto was outside the scope of the project. However, the inventory that has been developed is an excellent resource. The first step in any future ordinance will involve notification of building owners that they may be subject to the requirements of the ordinance. Those buildings that were field surveyed and fall within the scope of the ordinance can be notified using the existing inventory. For the remaining buildings, additional field survey is recommended. This would be a rapid visual assessment and could be conducted by City staff or outside consultants.

- *Use an initial screening form phase:* Typically, as part of the notification process, a screening form of about one-page in length is sent, and the owner is required to have a design professional, such as a structural engineer or architect, complete the form for a relatively nominal cost to confirm whether or not the building actually is subject to the City's ordinance. Some buildings may appear from a rapid visual assessment to be one of the building categories covered, but upon closer review they are exempt. This approach has been taken in many communities in the past, and thus sample forms are available that can be easily tailored for Palo Alto.

- *Clearly specify seismic evaluation and retrofit scope:* The seismic evaluation (and retrofit) methodology for each building category will need to be defined after the building categories included in the updated ordinance are determined. Industry consensus standards exist and cover the vulnerable building categories identified for Palo Alto. These include the 2015 *International Existing Building Code (IEBC)* and 2014 ASCE 41-13 *Seismic Evaluation and Retrofit of Existing Buildings*. Both are currently being updated by groups of engineers and building officials. For soft-story wood frame buildings, there is also the 2012 FEMA P-807 *Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings with Weak First Stories.* For steel moment frame buildings, there is also the 2000 FEMA 351 *Recommended Seismic Evaluation and Upgrade Criteria for Existing Welded Moment Resisting Steel Structures*. ASCE 41 has three tiers of evaluation: Tier 1, Tier 2, and Tier 3. Tier 1 is primarily a screening tool. As a minimum standard, Tier 2 is recommended. Table 13 provides recommended evaluation and retrofit standards.

Table 13: Recommended Evaluation and Retrofit Standards

Category	Description	Evaluation and Retrofit Standards
I	Unreinforced masonry	IEBC Appendix Chapter A1
II	Built before 1/1/35 with 100 or more occupants	ASCE 41
III	Built before 8/1/76 with 300 or more occupants	ASCE 41
IV	Pre-1977 soft-story wood frame	IEBC Appendix Chapter A4, ASCE 41, or FEMA P-807
V	Pre-1998 tilt-up	IEBC Appendix Chapter A2 and ASCE 41
VI	Pre-1977 soft-story concrete	ASCE 41
VII	Pre-1998 steel moment frame	ASCE 41, or FEMA 351
VIII	Other pre-1977 concrete	ASCE 41

- *Provide detailed evaluation report submittal requirements:* Minimum submittal requirements for evaluation reports will need to be defined. The above evaluation and retrofit standards provide some guidance but a short clear set of requirements will be beneficial. This will include such items as address, construction date, size, number of stories above and below grade, owner, occupancy type, structural system type, the location and features of the primary structural system, the extent of field review, material properties, the evaluation criteria and methodology used, whether the structure meets the evaluation criteria, identified seismic deficiencies if it does not. The current ordinance requires identification of retrofit measures to address seismic deficiencies. Even in a voluntary program, it is recommended that this be continued to help owners, tenants, and the City better understand what is necessary to mitigate the issues that exist.

- *Specify how past partial retrofits will be handled:* In the past, some buildings have had partial seismic retrofits where only selected portions of the seismic force-resisting system have been upgraded, and some seismic deficiencies may still exist in these structures. If mandatory retrofit requirements are implemented that provide for comprehensive retrofitting of the full seismic load path, there may be buildings with previous partial retrofits that do not fully comply and need remaining deficiencies to be addressed. This will be identified in the seismic evaluation report.

- *Update both new and existing building permit submittal requirements:* Review of City records found that basic information such as the building structural system, date of construction, and retrofit standard used (where applicable) are not readily available. It is recommended that submittals for permit for both new buildings and existing building renovations require this information. For structural systems, both the categorization found in ASCE 41 and the ASCE 7 Table 12.2-1 is recommended. This will allow the city to have a much better understanding of its building stock and its expected performance in an earthquake.

- *Write a new ordinance or set of ordinances to update the program:* After the Council has provided direction and the above issues have been addressed, an updated ordinance will need to formally be written. This can be done by City staff, but will likely benefit from the involvement of an appropriately experienced structural engineering consultant.

- *Carefully address program management and interdepartmental coordination needs:* To successfully manage Palo Alto's updated Seismic Risk Mitigation Program, an effective management plan is needed so that progress is monitored by the City and community intent is achieved. It will include a realistic list of information that can be easily input, summarized, and tracked in digital records such as the submittal requirements recommended above and that can be used to link the seismic risk program data to other digital records such as assessor files or GIS systems; quality assurance procedures for checking information; clearly defined roles and responsibilities; timelines and requirements for reporting of information internally and externally; procedures for gathering, assessing and implementing community feedback and suggestions; and links between the seismic risk mitigation program and activities that will occur following an earthquake, such as postearthquake safety evaluation.

- *Delineate department and key staff responsibilities:* For Palo Alto's updated Seismic Risk Mitigation Program, City staff will be responsible for several categories of activities.. These will include the basic activities such as managing the notification and inventory process, reviewing evaluation reports and plan checking retrofit construction documents, and field inspections of retrofit work. Less obvious activities will include evaluating requested exceptions to the program or alternative means of compliance; managing feedback from design professionals, owners, and the public; tying pre-earthquake retrofitting to post-earthquake safety evaluations records; and managing post-earthquake safety evaluation, repair, and recovery plans. Depending on the scale of the updated program, it is possible that addition staff members or consultants will be needed to handle the work flow. The City may also benefit from an appropriately experienced structural engineer to provide advice on technical and program management issues, particularly as the program moves to final definition and then to initial implementation. Later, as is done in some communities, it may be desirable to create volunteer review boards of local structural engineers who review questions on the evaluation and retrofit criteria and provide the city with technical opinions that staff can use.

CHAPTER XI.

QUESTIONS TO GUIDE COUNCIL DELIBERATIONS AND POTENTIAL ISSUES FOR FUTURE STUDY

1. QUESTIONS TO HELP GUIDE COUNCIL DELIBERATIONS

Preferred policy directions were developed with the Advisory Group and staff as discussed in Chapter I and include expansion of the building categories currently covered by the City's ordinance, movement toward mandatory requirements for some categories, additional disclosure measures and use of incentives to increase the effectiveness and likelihood of compliance and of success. To help the Council in its deliberations, a series of questions are given here. They are similar to questions and issues discussed by the Advisory Group.

1. Does the Council wish to expand the current seismic hazard program to cover more vulnerable building categories?
2. If so, which of the building categories in Table 1 should be included? The Advisory Group proposed that the existing Categories I-III, plus the Categories IV-VII, be included as follows. The categories are:
   a. Category I: Constructed of unreinforced masonry, except for those smaller than 1,900 square feet with six or fewer occupants (in the current ordinance)
   b. Category II: Constructed prior to January 1, 1935 containing 100 or more occupants (in the current ordinance)
   c. Category III: Constructed prior to August 1, 1976 containing 300 or more occupants (in the current ordinance)
   d. Category IV: Pre-1977 soft-story wood frame
   e. Category V: Pre-1998 tilt-up concrete
   f. Category VI: Pre-1977 concrete soft-story
   g. Category VII: Pre-1998 steel moment frame

   An eighth category (Category VIII other older nonductile concrete buildings) was discussed, but because of the lack of inexpensive analytical methods for reliably identifying the worst of these buildings, inclusion of this building category in an updated ordinance is not recommended at this time. Such buildings could be included in the future when the engineering community has developed appropriate analytical methods.

3. In addition to mandatory initial evaluation requirements, should one or more of the categories of buildings be subject to mandatory retrofit requirements? The Advisory Group had a consensus on mandatory requirements for renovation for unreinforced masonry buildings and there was strong support among many members for other categories such as soft-story wood frame buildings and tilt-up buildings, particularly those with high occupancies.

4. Should the City develop a trigger mechanism based on sale or substantial renovation where seismic retrofit is required? If so, which building categories should be subject to a trigger mechanism? There was support among some Advisory Group members for a trigger mechanism for some building categories, such as tilt-up industrial buildings, particularly those that are being converted to office buildings and increasing the occupant load and thus exposure to seismic risk.

5. What public disclosure or notice measures of the need for retrofitting a building should be pursued? The Advisory Group supported website listing and tenant notification, but there was low support for placing notices on property titles or for signage or placing placards on the outside of buildings. Other possibilities include encouraging earthquake performance rating systems and disclosing them to the public or developing such a rating system for city-owned buildings.

6. What incentive measures to encourage property owners undertake a structural retrofit should be pursued?

   The Advisory Group supported incentives for fee waivers, expedited permitting, and property-assessed financing tools. There was minimal interest in deep financial assistance such as establishing a special district or passing of bond measure to assist property owners financially. . Opinions were split on the use of transfer of development rights, floor area ratio bonuses, and parking exemptions.

8. How much time do you feel is reasonable for property owners of at risk buildings in the community to: a) prepare the initial structural evaluation reports for regulated buildings; and b), to complete mandatory structural retrofits to their buildings?

2. POTENTIAL ISSUES FOR FUTURE STUDY AND CONSIDERATION

For some issues, based in part on Advisory Group discussions, additional information may be beneficial to help develop a strategy and to better understand potential impacts on key stakeholders and community concerns. Some of these issues are primarily economic and were outside the scope of the current study. The City Council may wish to direct staff and/or outside consultants to investigate some of these items in more detail as the seismic risk management program effort proceeds. These issues include the following:

- *Occupants and tenants*
  - How much would a typical retrofit add to the monthly rent of a multifamily soft-story wood frame apartment tenant?
  - Would some tenants be unable to afford a rent increase and seek housing elsewhere in Palo Alto or move outside the city (and if so, how many might be displaced)?
  - If soft-story wood frame apartments in Palo Alto are retrofitted in time before the next major earthquake, how much less displacement of residents would occur as a result of the earthquake?
  - What categories of buildings are most important to address in order to help maintain the commercial viability and vitality of the City's core business districts and tax base?
- *Property owners, developers, and business owners*
  - What are the characteristics of property owners that would be affected?
  - How might small businesses be affected compared to larger ones?
  - How many property owners are in need of lower cost capital or other substantial financial assistance to fund retrofitting?
- *Impacts of Seismic Restoration on Retention of Historic Structures in the City*
  - Insure that the review of initial seismic evaluations identify those structures that are listed in the City's Historic Inventory and flag them for attention during subsequent review.
  - Develop a clear process for reviewing proposed seismic retrofits to historic structures that is coordinated among responsible city departments and is consistent with current regulations and Community policies.
  - Seek out retrofit alternatives that are consistent with the Historic Building Code, historic characteristics of the structure, and provide the most risk reduction.
- *City departmental resources and budgets*
  - What would be the loss in revenue to the Building Department if fee waivers were offered?
  - What would be the staffing and budgetary needs over time to administer an expanded program that addresses additional building types?
  - What kinds of interdepartmental cooperation and staff resources in other departments are necessary to ensure effective implementation and coordination with other city planning and public safety efforts?

- *Overall community economic health*
  - What kind of benefits could accrue to Palo Alto in terms of maintaining community function and ability to recover if various building categories are retrofitted in time before the next major earthquake?
- *Other related issues*
  - It was brought up in the Advisory Group that the Building Department needs flexibility and authority to take steps to get tough seismic mitigation projects done. One idea was to grant the Building Official the ability to classify certain projects (with well-specified criteria) as warranting a kind of "seismic safety" or "earthquake resilience" fast tracking, with city departments agreeing to coordinate on a specified accelerated project review timeframe.
  - Although outside the formal scope of this planning effort, several Advisory Group members commented that it would be desirable for the City to do some kind of assessment of any earthquake mitigation needs in public buildings and facilities serving the City.
  - Advisory group members recommended the community be informed of Palo Alto's overall potential seismic risk by providing a summary of potential impacts on the City's website, including the expected performance of vulnerable buildings.
  - The group also had a high degree of support for recommending that the City initiate and nest future earthquake mitigation programs within a broader disaster or community resilience initiative, as cities such as Los Angeles, Berkeley, and San Francisco have done. This could be incorporated into the update of the City's Comprehensive Plan Safety Element. There was insufficient time in the project's six advisory group meetings to consider potential initiatives to assess risks for cell phone towers, water supply, facades, private schools, post-earthquake shelter facilities, and/or other assets important to community recovery.

APPENDIX A

Table of Historic California Earthquake Risk Reduction Legislation

Appendix A -- Table of Historic California Earthquake Risk Reduction Legislation

				Type of Legislative Approach		
Short Title	***Year***	***Description***	***Relevance to Palo Alto Program Update***	***Targeted Use or Structure Type***	***Special Programs***	***Status and Reference Statute or Code***
Field Act	**1933**	Established regulations for the design and construction of K - 12 and community college buildings. The Division of the State Architect enforces the Field Act.	*Palo Alto has school facilities subject to this policy.*	Public Schools		Education Code-§17281
Riley Act	**1933**	Required local governments to have building departments that issue permits for new construction and alterations to existing structures and conduct inspections. The Act also set minimum seismic safety requirements that have since been incorporated into all building codes.	*Palo Alto has school facilities subject to this policy.*	Public Schools		
Garrison Act	**1939**	Required school boards to assess building safety of pre - Field Act schools, ordered modernization of non-Field act compliant structures.	*As of 2011, Palo Alto had six schools on the "AB300 list" of affected buildings. Current status of these properties is not known.*	Public Schools		
California Planning and Zoning Law Requirements	**1971**	Required city and county plans to include seismic safety elements.	*Palo Alto addresses earthquake hazards in the Safety element of its 2008 General Plan.*		General Plan	Government Code § 65302

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Short Title	Year	Description	Relevance to Palo Alto Program Update	Type of Legislative Approach: Targeted Use or Structure Type	Type of Legislative Approach: Special Programs	Status and Reference Statute or Code
Alquist-Priolo Earthquake Fault Zoning Act	**1972**	Required cities and counties to require a geologic investigation, before issuing building permits, to ensure that proposed buildings will not be constructed across active faults. Proposed building sites must be evaluated by a licensed geologist. If an active fault is found, a structure for human occupancy cannot be placed over the trace of the fault.	*Palo Alto contains areas located in Earthquake Fault Zones where construction is subject to these rules about heighted review or prohibitions exist on new development.*		Zoning	Public Resources Code § 2621-2630
Strong Motion Instrument Act	**1972**	Established a statewide network of strong motion instruments to gather vital earthquake data for the engineering and scientific communities.	*Palo Alto may have relevant facilities within its jurisdiction, and the resulting information is a planning resource. Data obtained from the strong motion instruments can be used to recommend changes to building codes, assist local governments in the development of their general plans, and help emergency response personnel in events.*		Research	Public Resources Code§§2700 - 2709.1

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Short Title	***Year***	***Description***	***Relevance to Palo Alto Program Update***	***Targeted Use or Structure Type***	***Special Programs***	***Status and Reference Statute or Code***
Alfred E. Alquist Hospital Facilities Seismic Safety Act	**1973**	Regulated the design, construction and alteration of hospitals; set seismic safety standards for new hospitals; created an advisory Hospital Building Safety Board. Office of Statewide Health Planning & Development enforces this Act.	*Palo Alto has at least two major hospitals in its jurisdiction that are subject to this Act. Current status of their facilities is not known.*	Hospitals		Health and Safety Code§129675
Seismic Safety Commission Act	**1975**	Created the independent California Seismic Safety Commission (CSSC) to provide a consistent earthquake policy framework for the state. The mission of CSSC is “to provide decision makers and the general public with cost - effective recommendations to reduce earthquake losses and expedite recovery from damaging earthquakes.	*Palo Alto can take advantage of the technical assistance offered by the CSSC and its publications, in particular the statewide Earthquake Hazard Loss Mitigation Plan of 2013, provides extensive advice about high priority earthquake issues and initiatives.*		Strategy	Business and Professions Code §1014
AB 2438 (Wray)	**1980**	Authorized local governments to adopt ordinances requiring earthquake gas shut-off valves in buildings open to the public.	*Palo Alto does not currently require gas shut off valves but could choose to do so.*		Utilities	Chapter 971, Statutes of 1980

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				Type of Legislative Approach		
Short Title	***Year***	***Description***	***Relevance to Palo Alto Program Update***	***Targeted Use or Structure Type***	***Special Programs***	***Status and Reference Statute or Code***
SB 360 (Alquist)	**1981**	Required mobile home bracing devices. It also required the Department of Housing and Community Development to administer the program, test devices, and issue certifications.	*Palo Alto has one mobile home park in its jurisdiction, Buena Vista Mobile Home Park. Status of these homes with regard to bracing is not known.*	Mobile Homes		Chapter 533, Statutes of 1981
Mello Roos Act	**1982**	Permits cities to establish Capital Improvement Districts that can issue special bonds to fund facilities improvements without coming under the caps on property tax increases that were imposed under Proposition 13.	*Although there is no precedent to date, Palo Alto may be able to use this tool to secure additional funds for retrofit projects for either public or private buildings.*		Financing	Government Code §53311-53317.5
SB 961 (Alquist)	**1982**	Required the Office of Statewide Health Planning and Development to institute plan review and field inspection of hospital buildings being constructed to ensure building safety. Requires the State Fire Marshal to ensure fire safety of these buildings.	*Palo Alto has at least two major hospitals in its jurisdiction that are subject to this Act.*	Hospitals		Chapter 303, Statutes of 1982

Short Title	Year	Description	Relevance to Palo Alto Program Update	Type of Legislative Approach: Targeted Use or Structure Type	Type of Legislative Approach: Special Programs	Status and Reference Statute or Code
Alquist Hospital Facilities Seismic Safety Act	**1983**	Required design and construction standards for hospitals; requires that after Jan. 1, 2008 any general acute care hospital building determined to be at potential risk of collapse or poses a risk of significant loss of life be used only for non-acute care.	*Palo Alto has at least two major hospitals in its jurisdiction that are subject to this Act.*	Hospitals		Health and Safety Code §§130000 - 130070
Economic Disaster Act	**1984**	Institutionalized the planning and response of state agencies to disasters in order to reduce economic hardship stemming from these disasters to business. Upon the completion of the emergency phase and the immediate recovery phase of a disaster, appropriate state agencies shall take actions to provide continuity of effort conducive to long -range economic recovery.	*This law establishes the authorities and guidance for coordination among local and state entities in the management and recovery from a major event.*		Recovery	Government Code §8695

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				Type of Legislative Approach		
Short Title	***Year***	***Description***	***Relevance to Palo Alto Program Update***	***Targeted Use or Structure Type***	***Special Programs***	***Status and Reference Statute or Code***
SB 239 (L. Greene)	**1985**	Created the Essential Services Building Act and declared the intent of the Legislature that essential services buildings be designed and constructed to a higher standard to resist damage from earthquakes. Established design and construction requirements.	*Palo Alto Building Department is required to implement heightened review for its fire stations, police stations, emergency communications, and other qualifying buildings.*	Essential Buildings		Chapter 1521, Statutes of 1985
Essential Services Building Seismic Safety Act	**1986**	Required enhanced regulatory oversight by local governments during the design and construction of new essential service facilities, such as fire and police stations and emergency communications and operations facilities. The Division of the State Architect within DGS enforces this Act.	*Palo Alto Building Department is required to implement heightened review for its fire stations, police stations, emergency communications, and other qualifying buildings.*	Essential Buildings		Health and Safety Code §16000
Unreinforced Masonry Building Law	**1986**	Required local governments in high seismic regions of California to inventory un - reinforced masonry buildings, establish mitigation programs, and report progress to the CSSC. Signage requirements were added in 2004.	*Palo Alto mandated to comply. Current program in place has resolved nearly all cases but a few remain.*	URM		Government Code §§ 8875-8875.10

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				Type of Legislative Approach		
Short Title	***Year***	***Description***	***Relevance to Palo Alto Program Update***	***Targeted Use or Structure Type***	***Special Programs***	***Status and Reference Statute or Code***
California Earthquake Hazards Reduction Act	**1986**	Called for a coordinated state program to implement new and expanded activities to significantly reduce the earthquake threat.	*Established the legal basis for several key programs.*		Strategy	Government Code §8870
SB 548 (Alquist)	**1986**	Created the California Earthquake Hazard Reduction Act which called for the Commission to administer a program to "significantly reduce hazards by January 1, 2000."	*Established the legal basis for several key programs.*		Strategy	Chapter 1491, Statutes of 1985
SB 2453 (Maddy)	**1989**	Required surgical clinics to hire architects and structural engineers to assure that medical equipment are properly anchored.	*Palo Alto may have relevant health facilities within its jurisdiction.*	Hospitals		Chapter 1579, Statutes of 1990
Seismic Hazards Mapping Act	**1990**	Directed the Department of Conservation to identify and map areas prone to liquefaction, earthquake -induced landslides, and amplified ground shaking. Requires geotechnical investigations and mitigation measures before permitting developments in mapped Zones of Required Investigation.	*Palo Alto contains areas located where construction is subject to these additional rules for heighted review or prohibitions exist on new development.*		Zoning	Public Resources Code §§ 2690 - 2699.6

				Type of Legislative Approach		
Short Title	***Year***	***Description***	***Relevance to Palo Alto Program Update***	***Targeted Use or Structure Type***	***Special Programs***	***Status and Reference Statute or Code***
Natural Hazards Disclosure Act	**1990**	Required transferor of real property, consisting of not less than one nor more than four dwelling units, to disclose to transferee if the real property lies within any of the following hazardous areas: a Special Flood Hazard Area (any type Zone A or V) designated by FEMA; an area of potential flooding shown on a dam failure inundation map; a very high fire hazard severity zone; wildland area that may contain substantial forest fire risks and hazards; an earthquake fault zone; and/or a seismic hazard zone.	*All relevant real estate transactions in Palo Alto are subject to this requirement, but compliance is not monitored or enforced. Evidence suggests it is common practice to check "do not know" as a blanket policy for seismic vulnerability questions.*		Disclosure	Civil Code §1102
AB 3313 (Woodruff)	**1990**	Required the State Architect and the Building Standards Commission to develop and adopt seismic retrofit guidelines for state buildings, including public universities.	*Palo Alto may have relevant facilities within its jurisdiction or be able to take advantage of the guidelines produced for this program in considering rehabilitation of its own facilities.*	Public Buildings and Universities		Chapter 1511, Statutes of 1990

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Short Title	Year	Description	Relevance to Palo Alto Program Update	Type of Legislative Approach: Targeted Use or Structure Type	Type of Legislative Approach: Special Programs	Status and Reference Statute or Code
Earthquake Safety and Public Buildings Rehabilitation Bond Act	**1990**	Authorized the state to issue $300 million in general obligation bonds for the seismic retrofit of state and local government buildings ($250 million for state -owned buildings and $50 million for partial financing of local government essential services facilities).	*Funding is exhausted but this legislation provides a model of one pathway to financial support to local entities to do seismic mitigation work.*	Public Buildings and Universities		Prop 122 & Government Code §§8878.50-8878.52
Executive Order D-86-90	**1990**	Required CalTrans to prepare plan to retrofit transportation structures; requests UC and requires CSU to give priority consideration to seismic safety in allocation of funds for construction projects.	*Palo Alto may have related facilities within its jurisdiction or that affect its citizens or local businesses.*	Infrastructure		
AB 204 (Cortese)	**1991**	Created a model, minimum building code for the retrofit of buildings with brick-bearing walls.	*Palo Alto can reference the codes that resulted from this law as input regarding methods for URM retrofit.*	URM		
AB 908 (Farr)	**1991**	Specified that liquefaction and other seismic hazards are geologic hazards to be addressed in the safety element of a general plan.	*Palo Alto complies with this requirement through its 2008 General Plan.*		General Plan	Chapter 823, Statutes of 1992

				Type of Legislative Approach		
Short Title	***Year***	***Description***	***Relevance to Palo Alto Program Update***	***Targeted Use or Structure Type***	***Special Programs***	***Status and Reference Statute or Code***
AB 43 (Floyd)	**1991**	Excluded seismic retrofit improvements to hazardous buildings from property-tax reassessments.	*Palo Alto building owners who invest in retrofits can file paperwork to obtain relief from any property tax assessment increases that might result. This law provides a modest incentive to invest in retrofits (by removing any new tax obligations that might arise) but the downside is these investments do not increase the local tax base.*		Tax Policy	Chapter 8, Statutes of 1991
Emergency Room Mandates	**1991**	Established seismic safety standards for ambulatory surgical centers; requires fixed medical equipment (floor roof or wall mounted) to be installed using services of licensed architect or structural engineer; and requires inspection every five years.	*Palo Alto may have health facilities subject to this policy.*	Hospitals		Health & Safety Code § 1226.5

				Type of Legislative Approach		
Short Title	***Year***	***Description***	***Relevance to Palo Alto Program Update***	***Targeted Use or Structure Type***	***Special Programs***	***Status and Reference Statute or Code***
SB 597 (Alquist)	**1992**	Required the state architect to develop seismic retrofit guidelines and standards for certain buildings enclosing more than 20,000 square feet of floor area with concrete or reinforced masonry column construction.	*Although outdated, this law provides background guidance on the importance and potential pathways to retrofitting this particular high risk category of large commercial structures. Palo Alto may have qualifying structures in its jurisdiction.*	Concrete		Chapter 1079, Statutes of 1992
SB 119 (Hart)	**1992**	Enacted the Higher Education Facilities Bond Act of June 1992 and required five-year capital outlay plans at colleges and universities to include a schedule that prioritized the seismic retrofitting needed to significantly reduce seismic hazards.	*Palo Alto may have relevant facilities within its jurisdiction.*	Public Buildings and Universities		Chapter 13, Statutes of 1992
Seismic Retrofit Bond Act (California Proposition 192)	**1996**	Authorized $2 billion for seismic retrofitting, including $650 million for seismic retrofitting of toll bridges.	*Palo Alto may have relevant facilities within its jurisdiction.*	Bridges		

				Type of Legislative Approach		
Short Title	***Year***	***Description***	***Relevance to Palo Alto Program Update***	***Targeted Use or Structure Type***	***Special Programs***	***Status and Reference Statute or Code***
Highway Safety, Traffic Reduction, Air Quality, and Port Security Bond Act	**2006**	Essential Facility Seismic Safety Program. Provided $125 million funding for seismic retrofit work on local bridges, ramps, and overpasses; established Local Bridge Seismic Retrofit Account.	*Palo Alto may have been affected by some of the projects resulting from this law, though the budget is now exhausted.*	Bridges and Roads		Proposition 1B, Government Code §8879.23(i)
General Obligation Bonds		A city or a city and county may incur indebtedness pursuant for seismic strengthening of unreinforced buildings and other buildings. Proceeds of bonds authorized pursuant to this section may be used to make loans to public entities or owners of private buildings.	*Palo Alto may issue bonds to create funds for use in loan programs to cover seismic retrofit costs for publically- or privately-owned buildings as long as it can justify the public purpose of the work.*		Financing	Government Code Section 43600-43638
AB 964 (Aroner)		Required the California Earthquake Authority to establish, in the operational rules of the Earthquake Loss Mitigation Fund, a plan for the expedited expansion of the residential retrofit program statewide.	*CEA has broad authority to spend ELMF funds on physical mitigation improvements related to 1-4 unit dwellings. Currently Palo Alto is not in the program but it could apply to be part of a future pilot phase.*	Small Residential		Chapter 715, Statutes of 1999

				Type of Legislative Approach		
Short Title	***Year***	***Description***	***Relevance to Palo Alto Program Update***	***Targeted Use or Structure Type***	***Special Programs***	***Status and Reference Statute or Code***
Automatic Gas Shut Off Valves		Authorized local governments to adopt ordinances requiring installation of earthquake sensitive gas shutoff devices in buildings; allowed Division of the State Architect to establish a certification procedure for installation.	*Palo Alto does not require gas shut off valves but could do so.*		Utilities	Health and Safety Code §§19180-83 & §§19200-05
AB 3249 (Katz)		Required private schools constructed after July 1, 1987 to have plans that meet applicable code standards. Required their plans to be reviewed by a structural engineer, and that the project's design professionals periodically review the construction.	*Palo Alto may have relevant schools in its jurisdiction, and their status is unknown. The City of San Francisco identified earthquake vulnerability of private schools as a major public concern and recently passed a mandatory evaluation ordinance.*	Private Schools		Chapter 439, Statutes of 1986

				Type of Legislative Approach		
Short Title	***Year***	***Description***	***Relevance to Palo Alto Program Update***	***Targeted Use or Structure Type***	***Special Programs***	***Status and Reference Statute or Code***
AB 2959 (Klehs)		Required the Seismic Safety Commission to develop, adopt, and publish a Homeowner's Guide to Earthquake Preparedness by January 1, 1992 (SSC 97-01)	*This pamphlet is regularly exchanged from seller to buyer in smaller residential real estate transactions, as and by state law, doing so meets disclosure requirements. Palo Alto currently provides a link to this document on the Building Inspection website. There is high potential to improve this process so that homeowners pay attention the information in the pamphlet.*		Education	Chapter 1499, Statutes of 1990
AB 1968 (Areias)		Required the Seismic Safety Commission to develop, adopt, and publish a Commercial Property Owner's Guide to Earthquake Safety for distribution to real estate licensees.	*Palo Alto property owners are required to provide this pamphlet to a buyer at sale. Palo Alto currently provides a link to this document on the Building Inspection website.*		Education	Chapter 859, Statutes of 1991
Natural Disaster Assistance Act		Provided state financial assistance for recovery efforts to counties, cities and/or special districts after a state disaster has been proclaimed.	*Palo Alto would be eligible for applying for these funds following a local event.*		Recovery	Government Code §8680

Appendix A -- Table of Historic California Earthquake Risk Reduction Legislation

				Type of Legislative Approach		
Short Title	***Year***	***Description***	***Relevance to Palo Alto Program Update***	***Targeted Use or Structure Type***	***Special Programs***	***Status and Reference Statute or Code***
AB 1890 (Cortese)		Required new and replacement water heaters to be braced and anchored.	*Properties in Palo Alto are required to have two seismic straps on their water heater per CPC 508.2. Status of non-inspected older water heaters unknown.*		Utilities	Chapter 951, Statutes of 1989
SB 1742 (L. Greene)		Required local agencies to review the structural design and construction of certain bridges, and required the Caltrans director to establish a statewide priority list for retrofit projects based on these reviews.	*Palo Alto may have infrastructure subject to this policy.*	Bridges and Roads		Chapter 1082, Statutes of 1990
ACR 96 (Perino)		Requested the Seismic Safety Commission to study the problem of mobile-home bracing and make recommendations to the Department of Housing and Community Development for implementation.	*Resulting reports provide information relevant to planning effective mobile homes policies.*	Mobile Homes		Resolution Chapter 99, Statutes of 1980

				Type of Legislative Approach		
Short Title	***Year***	***Description***	***Relevance to Palo Alto Program Update***	***Targeted Use or Structure Type***	***Special Programs***	***Status and Reference Statute or Code***
AB 631 (Bradley)		Required the Department of Housing and Community Development to adopt regulations governing the installation of earthquake-resistant bracing systems on manufactured homes or mobile homes.	*Palo Alto may have health facilities subject to this policy.*	Mobile Homes		Chapter 304, Statutes of 1989
AB 958 (Areias)		Directed the Seismic Safety Commission to administer a privately funded task force, with specified membership, to consider the development of seismic safety building guidelines for the use of state and local governmental agencies in evaluating applications for the construction of new cellular facilities.	*Palo Alto may have relevant facilities within its jurisdiction.*	Telecommuni-cations		Chapter 813, Statutes of 1991

				Type of Legislative Approach		
Short Title	***Year***	***Description***	***Relevance to Palo Alto Program Update***	***Targeted Use or Structure Type***	***Special Programs***	***Status and Reference Statute or Code***
California Earthquake Authority		Created the California Earthquake Authority and authorized CEA to issues policies of basic earthquake insurance.	*Residential renters and owners of Palo Alto 1-4 unit properties are eligible to purchase policies through CEA. Rates of insurance uptake average about 10% statewide. The level of uptake in Palo Alto is not known but could be researched and potentially improved through educational programs or partnerships with CEA.*		Insurance	Insurance Code §§ 10089.5 - 10089.54
Disaster Recovery Reconstruction Act		Authorized and otherwise enabled cities, counties, and other entities to prepare in advance of a disaster for the expeditious and orderly recovery and reconstruction of the community or region; Includes plans and ordinances facilitating recovery and reconstruction and contingency plan of action and organization for short -term and long-term recovery and reconstruction to be instituted after a disaster.	*This legislation sets out relevant authorities and guidance for effective pre-disaster emergency management and recovery planning.*		Recovery	Government Code §8877.1

				Type of Legislative Approach		
Short Title	***Year***	***Description***	***Relevance to Palo Alto Program Update***	***Targeted Use or Structure Type***	***Special Programs***	***Status and Reference Statute or Code***
Public School Tilt-Up Concrete Inventory		Required the Department of General Services to conduct an inventory of public school buildings that are concrete tilt -up or have non-wood frame walls that do not meet requirements of the 1976 UBC, by Dec. 31, 2001.	*Palo Alto may have relevant facilities within its jurisdiction.*	Concrete		Education Code §17317
SB 1122 (Alarcón)		Required the Office of Emergency Services, in cooperation with the State Department of Education, the Department of General Services, and the Seismic Safety Commission, to develop an educational pamphlet for use by grades K-14 personnel to identify and mitigate the risks posed by nonstructural earthquake hazards.	*Palo Alto could use this pamphlet or more recent versions in a public education campaign in coordination with local schools.*		Education	Chapter 294, Statutes of 1999

				Type of Legislative Approach		
Short Title	***Year***	***Description***	***Relevance to Palo Alto Program Update***	***Targeted Use or Structure Type***	***Special Programs***	***Status and Reference Statute or Code***
SB 577 (Rosenthal)		Replaced references to earthquake sensitive or seismic gas shutoff valves with the term earthquake sensitive or seismic gas shutoff devices. Also revised the bracing requirements for water heaters to apply to all new and replacement water heaters, and all existing residential water heaters; required any water heater to be secured in accordance with the California Plumbing Code.	*Provisions for seismic strapping of water heaters are contained in CPC 508.2.*		Utilities	Chapter 152, Statutes of 1996

APPENDIX B

Table of Contemporary California Earthquake Risk Reduction Legislation

*Sources: CSSC, 2009; *LegInfo*, 2016.

			Type of Legislative Approach		
Short Title	***Description***	***Relevance to Palo Alto Program Update***	***Targeted Use or Structure Type***	***Special Programs***	***Status and Reference Statute or Code***
AB 428 -- Income Taxes Credit: for Seismic Retrofits (Nazarian)	This bill allows a tax credit in an amount equal to a specified percent of costs incurred by a qualified taxpayer for any seismic retrofit construction on a qualified building. Requires certification from the appropriate jurisdiction with authority for building code enforcement that the building is an at-risk property.	*If a future version is passed and funded, Palo Alto building owners -- on a first come first serve basis statewide -- could receive up to 30 percent tax credit on pre-approved eligible seismic mitigation investments.*	Any		**Vetoed** by Governor for financial reasons.

*Sources: CSSC, 2009; *LegInfo*, 2016.

			Type of Legislative Approach		
Short Title	***Description***	***Relevance to Palo Alto Program Update***	***Targeted Use or Structure Type***	***Special Programs***	***Status and Reference Statute or Code***
SB 494 -- Seismic Safety and Earthquake-Related Programs (Hill)	This bill creates the California Earthquake Safety Fund. Upon appropriation by the Legislature, the moneys in the fund shall be used for seismic safety and earthquake-related programs, including the earthquake early warning system. The bill authorizes the fund to accept federal funds, funds from revenue bonds, local funds, and funds from private sources for purposes of carrying out its provisions. This bill also requires the identification of funding of the earthquake early warning system to occur by July 1, 2016, and makes conforming changes.	*Sponsored by Palo Alto's District Assembly Member. If this program is funded, Palo Alto could advocate for local public and private sector involvement in the state's Earthquake Early Warning System.*		Early Warning System	**Signed by Governor October 2015** – Chapter 799, Statutes of 2015

*Sources: CSSC, 2009; *LegInfo*, 2016.

			Type of Legislative Approach		
Short Title	***Description***	***Relevance to Palo Alto Program Update***	***Targeted Use or Structure Type***	***Special Programs***	***Status and Reference Statute or Code***
SB 1205 -- Commercial Earthquake Risk Management Courses (Monning)	Requires an existing California Department of Insurance (CDI) board to develop or recommend educational courses for agents and brokers on commercial earthquake risk management.	*Recommendations and resources materials will likely be created within a few years that could assist Palo Alto in promoting greater awareness and action among commercial property agents and owners.*		Education	**Signed by Governor August 2014** – Chapter 252
SB 602 -- California Earthquake Authority: Property Secured Mitigation Program (Monning)	This bill would authorize the CEA to establish a state-wide program to provide property assessment financing for seismic retrofits.	*This bill would create the authority for another PACE-type funding mechanism that cities could use to offer loans to owners for seismic mitigation work, to be paid off through higher property tax assessment over the course of 20 years.*	Small Residential		**Pending**

*Sources: CSSC, 2009; *LegInfo*, 2016.

			Type of Legislative Approach		
Short Title	***Description***	***Relevance to Palo Alto Program Update***	***Targeted Use or Structure Type***	***Special Programs***	***Status and Reference Statute or Code***
AB 1429 -- Earthquake Mitigation Retrofit Program: 5 to 10 Dwelling Units (Chui)	This bill requires the CRMP to implement a grant program that would give a grant to a qualifying applicant who owns a residential structure that contains between five and ten dwelling units to defray the owner's cost of seismic retrofit work to the structure, as specified, if the Legislature appropriates funds for that purpose.	*If passed and funded, grant funds might be made available to Palo Alto small multi-family residential buildings.*	Small Multifamily		**Pending**
AB 1440 -- Earthquake Mitigation Retrofit Program: Single-Family Residential Structures (Nazarian)	This bill requires the CRMP to implement a grant program and give a grant to a qualifying owner of a single-family residential structure to defray the owner's cost of seismic retrofit work to the structure, as specified, if the Legislature appropriates funds for that purpose.	*If passed and funded, grant funds might be made available to Palo Alto small residential owners.*	Small Residential		**Pending**

*Sources: CSSC, 2009; *LegInfo*, 2016.

			Type of Legislative Approach		
Short Title	***Description***	***Relevance to Palo Alto Program Update***	***Targeted Use or Structure Type***	***Special Programs***	***Status and Reference Statute or Code***
SB 336 -- California Earthquake Authority: Mitigation Discount (Roth)	This bill provides that CEA policyholders who have retrofitted their homes shall enjoy a premium discount or credit of "at least" five percent.	*If passed, Palo Alto homeowners that purchase earthquake insurance would have greater assurance that premium discounts for mitigation investments would not be reducible below five percent.*	Small Residential		Pending
AB 2181 -- Soft-Story Local Program Authorization	Authorizes each city, city and county, or county to require that owners assess the earthquake hazard of soft story residential buildings and older concrete residential buildings. Includes concrete residential buildings that were constructed prior to the adoption of local building codes that ensure ductility as potentially hazardous if an earthquake occurs and to initiate programs to inform owners, residents and the public about such dangers.	*There is no state law that forbids such programs, but this law would have removed any ambiguity that such programs are permitted.*	Soft-Story		Dead in 2014, never heard in committee.

APPENDIX C

Table Describing Incentives Used in Local Earthquake Risk Reduction Programs

Appendix C. Table Describing Incentives Used in Local Earthquake Risk Reduction Programs.

Type of Incentive	Description	Examples of Use	Advantages	Costs, Issues or Concerns
FINANCIAL TOOLS & INCENTIVES				
General Obligation or Special District Bonds	Direct provision of funds for qualifying retrofit work based on voter approval of issuance of new municipal or state debt to be repaid by taxation.	This mechanism is commonly used for seismic improvements to infrastructure, but also has been used in URM building programs and for retrofit of historic properties. One URM example is the city of Long Beach, which offered 11.3% interest financing to participating members of a Special District created for URM building owners.	Once passed, this type of funding can be distributed over time as provided for in the approved wording.	Must be approved by two thirds of voters, which sets a high bar even if there is significant public support. Jurisdictions must administer the allocation of funds and have at times not been able to use all of it. Owner education about the provisions of the program is critical. Owners of highly leveraged buildings and buildings in depressed areas may be unable to meet prerequisite loan-to-value ratio criteria. Retrofits are generally not revenue-generating improvements upon which financing can be leveraged.
Grants	Direct provision of funds for qualifying retrofit work.	CEA's Earthquake Brace & Bolt program for single family homes.	Some sources exist for city-scale projects or privately-owned buildings, such as FEMA Pre-Disaster Mitigation Grants.	Limited sources exist. Programs can be difficult to manage administratively. Fairness concerns exist over which owners can benefit.

Type of Incentive	Description	Examples of Use	Advantages	Costs, Issues or Concerns
Property-Assessed Financing Loans	Also known as a Property Assessed Clean Energy (PACE) program, this works as a loan to an individual property owner, transferrable to future owners, where the upfront costs of qualifying work are repaid over a period of approximately 20 years through the owner's property tax assessment.	San Francisco's PACE program.	Provides an upfront way for owners to access private capital to afford retrofit projects. The loan can be paid off over time through higher rents or at future sale, as well as being transferrable to future owners.	Administratively complex for both jurisdictions and owners. Challenges include setting up this complex financing instrument which has heavy involvement of third parties, barriers to owners that want to refinance, and barriers to the transfer of a PACE-financed properties to a new owner. Owners may not need it if affordable regular market capital is available. Lenders may resist allowing an additional lien.
Tax Credits	Waiver of a portion of a business, parcel, or income tax for a number of years to encourage owners to retrofit.	Although vetoed by the Governor, the legislature of California passed AB 428 in 2015, which would have offered up to 30% credit for qualifying retrofit costs.	The funding source can be outside the local jurisdiction, and depending on the clarity of program requirements, owners can count on the funds as part of planning their project.	Owners would need to be aware of the credit and verify qualifying work and complete all follow up documentation. Mostly benefits owners already intending to retrofit and those with more financial and business sophistication.

Type of Incentive	Description	Examples of Use	Advantages	Costs, Issues or Concerns
Real Estate Transfer Tax Rebates	Building owners can apply for a rebate of a fraction (usually 1/3, up to a cap) of the amount of the transfer tax owed to the city for a property at sale for any qualifying seismic improvement expenditures made within a certain period before or after transfer of title.	This policy has existed in Berkeley since 1991 for residential dwellings up to four units and in San Francisco since 2008 for properties worth $5 million or more.	In Berkeley, the program was immediately popular and eventually highly influential in increasing support for other earthquake policies because it touched so many community members and firmly established a tone that the city takes seismic risk seriously and will put its “money where its mouth is.” About half the single-family homes and one third of the smaller rental buildings in Berkeley have claimed the credit, leading to widespread community awareness of seismic safety issues.	The jurisdiction forgoes tax revenue. Anecdotally in Berkeley, city officials had no easy way to assess the quality of work done. Some experts suspect that some of the funds went to incomplete or improperly done retrofits.
Waivers or Reductions of Building Department Fees	Full waivers, fixed, or percentage-based reductions of building permit fee reductions.	The Jurisdictions of San Francisco, Berkeley, and Alameda have offered flat or waived plan check fees as an incentive for owners to retrofit their buildings. Oakland currently offers a flat permit fee of $250 for owners of qualified single-family residences to perform seismic retrofits.	Modestly reduces the cost of a retrofit project. Easy for city to implement. Perceived by owners as a significant gesture of good will by owners, who may feel it is "the least the city could do."	This measure has direct loss of revenue implications for the jurisdiction.

Type of Incentive	Description	Examples of Use	Advantages	Costs, Issues or Concerns
Pass Through of Retrofit Costs to Tenants	For residential properties in jurisdictions with rent control laws in place, owners who seismically retrofit their buildings could be allowed to pass through all or a fraction the costs of these retrofits to renters in rent-controlled units, amortized over a particular time period such as 10 years.	Berkeley is 100% pass-through, San Francisco is 50%, and Oakland is %75.	Perceived as fair by owners because tenants that benefit most from the retrofit work pay a share of it. Owners can use this anticipated source of revenue as a basis for securing a loan.	Tenants with fixed or low incomes might suffer hardship with the added costs, although hardship provisions can lessen those effects.
Special District or Historic Designation Tax Reductions	Creation of Mello-Roos, Mills Act, historic or other special districts that are then eligible for special loans, grants, or tax credits.	For URM buildings, the jurisdictions of St. Helena and West Hollywood used Mello-Roos funding.	Provides a clear way for a local jurisdiction to provide direct funding or special financing rates for privately-owned vulnerable properties.	Can be difficult for jurisdictions to initiate and carry out. Owners must join the special district at the outset or will be left out of future funding availability.
POLICY INCENTIVES				
Density or Intensity Bonuses	Specific increases in the maximum allowable building density or intensity to help offset the added costs of seismic upgrades.	Palo Alto's Floor Area Ratio bonus program.	Owners that invest in a retrofit can expand their projects in order to increase future revenue.	Typically, feasible only in areas of high growth. Sometimes controversial because of potential community impacts such as increased traffic, parking needs, and rental rates.

Type of Incentive	Description	Examples of Use	Advantages	Costs, Issues or Concerns
Exemptions for Non-Conformities	Relief from timelines or waivers of required work such as fire resistance upgrades and sprinklers, Title 24 energy analysis and upgrades, parking, setback or other current code measures that would otherwise be triggered by the size of the project being undertaken for projects involving qualifying retrofit work.	None identified.	Offering relief from what may be expensive rehabilitation of nonconforming uses can make seismic retrofits easier to design and more affordable.	May be viewed as an excessive concession to owners among some members of the public.
Zoning Incentives	Specific concessions regarding encroachment into setbacks, increased allowable floor/area ratios (FAR), height limits, or onsite parking requirements to help offset the added costs of seismic upgrades.	Since 1986, Palo Alto allowed owners of included buildings in the downtown area to expand the floor area if the owner performed seismic upgrades. Buildings were also exempted from onsite parking requirements and fees for offsite parking.	Useful when bond financing options are prohibitively costly or not much more attractive than private credit terms. Most likely to work when zoning plans in the community generally call for limited to no growth. Costs to the city are mainly in the form of technical and design cost review of proposed projects.	Similarly-situated properties must be treated alike so as to avoid claims of "spot zoning." Citizens may object to special treatment for work that could be seen as essential anyhow. Not likely to work in locations with little development pressure or where the community favors growth.

Appendix C. Incentives, continued.

Type of Incentive	Description	Examples of Use	Advantages	Costs, Issues or Concerns
Condominium Conversion Assistance	Process expediting for condo conversion for properties that seismically retrofit.	None identified.	In jurisdictions where condo conversation rates are capped or allocated by lottery, offering priority to buildings that retrofit could be an effective tool to promote seismic upgrading of multifamily buildings.	May negatively impact other housing affordability goals. Only available to owners that can afford it, unless accompanied by other assistance programs.
Exemption from Future Retrofit Requirements	Relief from imposition of future retrofit requirements for a certain period following completion of qualifying seismic work.	The City of Berkeley offered a 15-year exemption from future retrofit requirements for soft-story wood frame properties that did a retrofit concurrent with its mandatory evaluation program.	This can motivate owners to complete retrofit work sooner rather than later in order to reduce uncertainty about future city policies, and allows owners to better anticipate business expenses over a longer term.	The jurisdiction could not easily impose new regulation on exempted properties, even if such policies became warranted by new technologies or knowledge.
Transfer of Development Rights (TDR)	TDR allow owners to transfer unused development rights that are comparable to the value of the retrofit to another site.	Very commonly used for historic preservation, including in Palo Alto.	Useful when the use of the building in question is not likely to generate added value to justify the costs of the retrofit work. This is most useful when retrofit costs can be particularly high and there are natural or regulatory use restrictions.	Careful analysis of construction costs is necessary to avoid situations of under- or over-compensation.

Type of Incentive	Description	Examples of Use	Advantages	Costs, Issues or Concerns
Expedited Permits, Inspections, and Reviews	Prioritization, expediting, or bypassing of certain internal protocols for over the counter permits and inspection processes for projects involving seismic retrofit work.	Several Bay Area cities have anecdotally stated that this is their internal policy, but no official records of such were identified.	This can relieve the burden of time and hassle for owners in getting permits and inspections, which are a significant source of cost and uncertainty for owners during retrofit projects.	Requires flexibility on the part of city staff and plan check consultants.
Technical Assistance	Case-management style assistance for owners and/or engineers during the process of obtaining financing, complying, permitting, and carrying out retrofit projects. This is different than engineering advice about how to resolve specific technical issues of design.	Cities such as Berkeley have found it necessary to maintain additional staff to operate their mitigation programs. A significant portion of their staff time is devoted to owner and engineer consultation.	Knowledgeable staff can help owners navigate complex issues such as investigating and applying for incentives (if offered), following guidelines, or addressing the necessary standards.	Labor costs to the city for additional staff. Difficulty sustaining project funding and staff continuity over time.

APPENDIX D

Options for Moving to a Comprehensive, Resilience Approach

Appendix D. Options for Moving Towards a Comprehensive Resilience Approach

Palo Alto's current earthquake policy development effort is led by the Building Division and focused on physical upgrade or retrofitting of privately-owned existing structures. In other words, it deals with pre-disaster physical aspects of earthquake vulnerabilities in the current building stock and the kinds of ordinances, code adjustments, and initiatives that could be undertaken to reduce the risks posed by those buildings. Other City of Palo Alto efforts to address earthquake risks and impacts more broadly are the responsibility for instance of the Office of Emergency Services, Fire, Public Works, and Planning departments. These activities are relevant to the present effort because its recommendations are intended to be well-informed by and linked to other related ongoing jurisdictional activities.

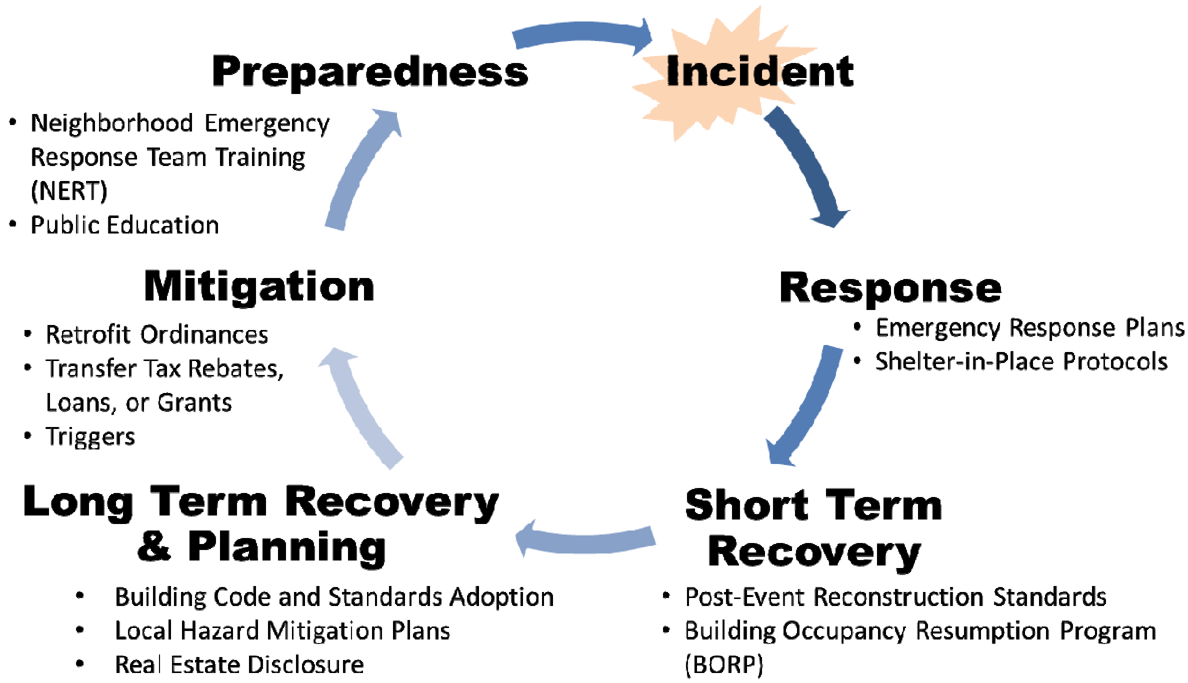
In the future, Palo Alto has options for broadening the scope of its mitigation efforts. For instance, the City could consider developing a formal ***Building Occupancy and Resumption Program (BORP)*** as did San Francisco. It could also investigate creating special programs or requirements for key infrastructure such as cell phone towers, vulnerable building features such as ***facades***, or important building uses such as ***publicly-owned buildings***, ***private schools***, ***places of worship and large assembly***, or ***post-earthquake shelter facilities***. These types of programs aim to create a more comprehensive, integrated approach that places earthquake mitigation within the overall context of community resilience.

Jurisdictions can promote comprehensiveness in different ways. Four potential pathways that Palo Alto could pursue, as well as examples of jurisdictional models, are briefly introduced below.

Address More Phases of the Disaster Cycle

One useful way to think about public policy related to earthquakes is to consider the "Disaster Cycle" (see Figure 1). Some activities primarily take place *before* an event (e.g., hazard assessment, building code adoption and enforcement, public education campaigns) while others focus on things that happen *during* a crisis (e.g., emergency response, building re-occupancy inspections). *After* an event, jurisdictions may operate both short and long term programs as part of managing the overall recovery process (e.g., temporary housing and business resumption efforts). The cycle begins again as cities attempt to learn from the past to better inform plans and programs for the future.

Figure 1. Diagram of the Disaster Cycle and examples of local level programs that address different phases.



Actions in all of these of phases contribute to the overall community goal of *resilience*. Many different definitions exist for this term, but for the purposes of this report it can be summarized as the local capacity to be effectively protected from, respond quickly to, and recover as completely as possible in long-term from chronic stresses as well as acute shocks, one of which are earthquakes. In some sense, all communities want to avoid, survive, and thrive as best they can in the midst of many current and potential challenges and threats.

Integrate Earthquake Efforts into Multi-Hazard Planning and Programs

Another way to address disaster resilience more broadly is to create plans and programs that simultaneously address a large suite of physical threats. Many preparedness, mitigation, response and recovery activities are similar for different types of disasters, from floods to blast to bioterrorism to earthquakes. FEMA and many jurisdictions have embraced the concept of multi-hazard planning in order to achieve potential synergies and savings through coordination, cross-functionality, eliminating redundancies, and improved communication. The two main federal programs for local jurisdictions that relate to this –the Local Hazard Mitigation Plan process and FEMA Pre-Disaster Mitigation Grants –were described in the Task 2 report. Palo Alto could launch an effort to evaluate opportunities for leveraging and increasing alignment of its earthquake programming with other multi-hazard mitigation efforts.

Create Linkages with Sustainability, Energy and Climate Adaptation Issues

Not all environmental threats to resilience are quick to arrive. Yet another dimension Palo Alto could ***build connections between its disaster mitigation efforts and issues of sustainability, environmental health, green tech, and climate change adaptation***. The interrelationships among these issues are clear. Modification of both physical and social practices related to environmental trends could potentially enhance or work against disaster preparedness, depending on how wisely such changes ae managed. Debris and demolition following earthquakes can be a major environmental concern, with significant greenhouse gas and carbon footprint implications. Research engineers are actively working on ways to estimate the carbon implications of debris from demolished structures after an earthquake, such as through the FEMA P-58 methodology.

Expand Scope to Address Overall Community Resilience

Social, cultural, and economic vulnerabilities and social justice and equity concerns are clearly outside the scope of the present effort. However, it would be remiss to provide Palo Alto guidance about development of new programs for earthquake mitigation without mentioning that many leading cities have moved towards nesting their earthquake resilience activities within very broad, longer term ***overall community resilience*** assessment, planning, and programming initiatives. The connection between overall community resilience and earthquake program effectiveness is now firmly established, as exampled by a proliferation of initiatives briefly described below.

The ideological and programmatic shift to the concept of community resilience broadly defined was accelerated by a large infusion of money, technical assistance, and outreach from the Rockefeller Foundation's 100 Resilient Cities initiative (100RC[1]) in 2012. This ground breaking effort involved three rounds of applications from which 66 cities so far worldwide have been selected. San Francisco, Berkeley, Oakland, and Los Angeles were selected in the first round. Rockefeller Resilient Cities were chosen because they already were comprehensive leading cities in terms of their resilience efforts. Palo Alto applied to the program but was not selected.

A core feature of the 100RC membership is funding to pay the salary of a ***Chief Resilience Officer*** for two years. Patrick Otellini of San Francisco had the honor of being the first Chief Resilience Officer (CRO) in the world. The two other main benefits of the

[1] http://www.100resilientcities.org/ (Accessed January 11, 2016).

program are access to an online resilience platform and information repository and increased connectedness with a network of other 100RC cities and their CROs.

Other significant federal and regional resources are being devoted to helping local jurisdictions promote overall community resilience. Many useful technical guides and potential partners for Palo Alto exist. Important national groups include the National Institutes of Building Sciences Community Resilience Initiative, which has produced a comprehensive resilience planning guide for cities (NIST, 2015), and the Community Regional Resilience Institute (CARRI).[2]

On the local level, the San Francisco Planning and Urban Research organization through its Resilient City initiative has conducted a series of collaborative planning efforts and resulting reports that address building performance goals, recovery strategy, and tactical recommendations for San Francisco in pursuing a specific set of resilience goals (SPUR, 2008). An example recovery objective SPUR endorsed is to have 95% of San Francisco residents able to shelter-in-place following a major event (SPUR, 2011). Additionally, ABAG has recently created a resilience policy tracking database, searchable and available online,[3] and the Los Angeles Community Disaster Resilience project[4] offers a well-documented model of multi-issue regional coordinated effort.

[2] Information available at: http://www.resilientus.org/ (Accessed February 25, 2016).
[3] Available at: http://abag.ca.gov/resilience/policies.html (Accessed February 25, 2016).
[4] Information available at: http://www.laresilience.org/ (Accessed February 25, 2016).

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APPENDIX E

Retrofit Concept Designs for 12 Prototype Buildings

Building 1 – Wood Light Frame (W1)

2-story, 5,320 sq.ft, 1960, 4 unit multi-family (RES3B-3D), one unit on ground floor, three on second floor, partial parking on ground floor

Conventional framing, no plywood shearwalls, post and beam framing and open front in garage

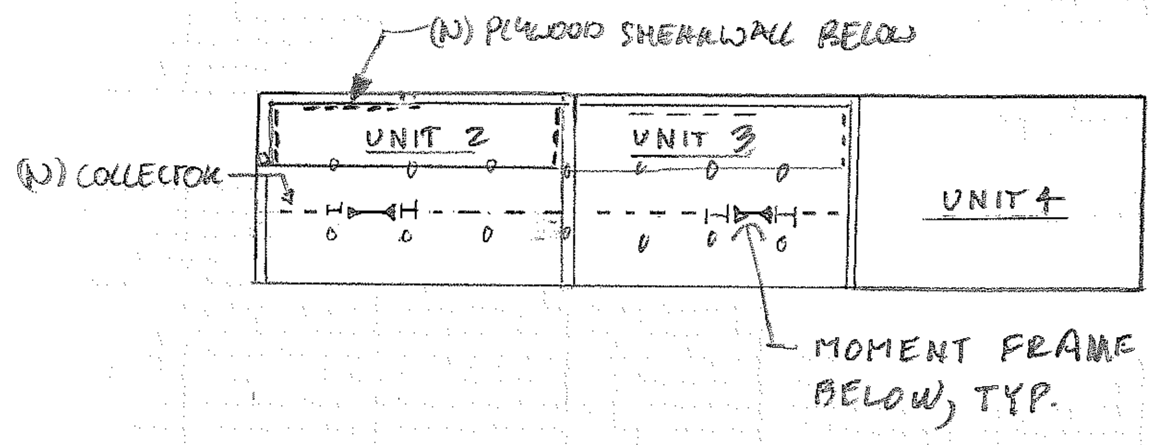
Retrofit Basis of Design: IEBC A4

Structural Retrofit Elements

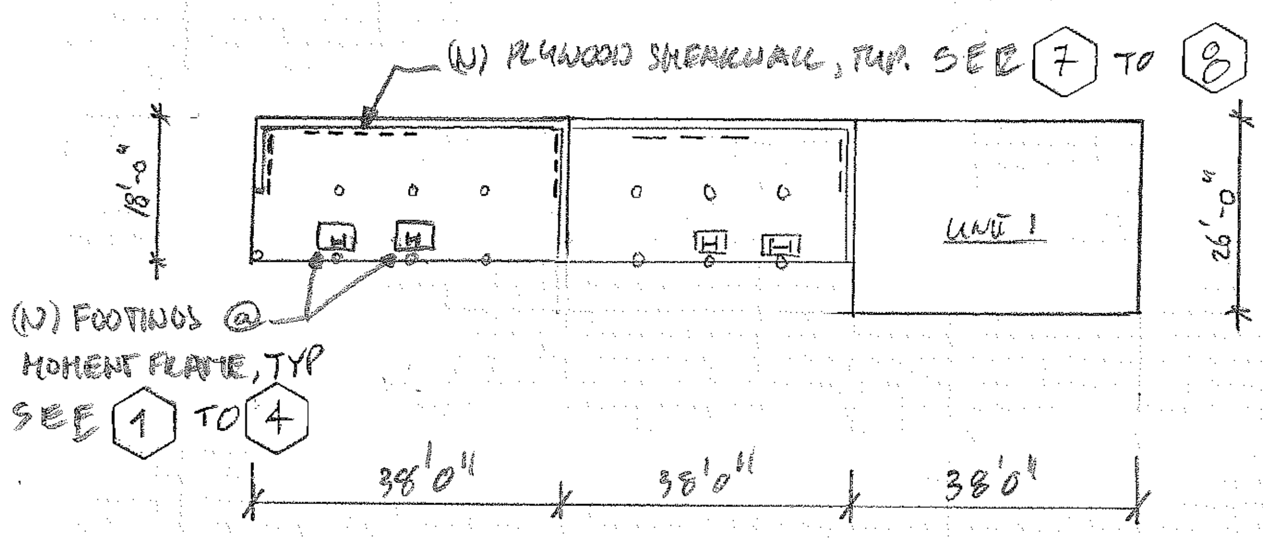
1. Install plywood sheathing, hold downs and anchor bolts on existing walls in garage area
2. Install new moment frames (2) to balance open front (w/ new footing). Use W12x50 beam and W14x68 columns.
3. Install new collector along moment frame line

Collateral Impacts

1. Remove and replace drywall at shear walls
2. Remove and replace slab on grade at moment frame
3. Remove and replace drywall along moment frame collector
4. Re-route SS drain locally
5. Re-route water line locally
6. Re-route electrical locally



SECOND FLOOR PLAN



FIRST FLOOR PLAN

BUILDING 1 - W1

RUTHERFORD & CHEKENE
55 Second Street, Suite 600
San Francisco, CA 94105
T 415 568 4400
F 415 618 0684

Building 2 – Multi-Story, Multi-Unit Wood-Frame Residential (W1A)

2-story, 9,500 sq.ft, 1960, 10 unit multi-family (COM 3C-3F), 2 units on ground floor 8 on second floor, partial parking on ground floor

Conventional framing, no plywood shearwalls, post and beam framing and open front in garage

Retrofit Basis of Design: IEBC A4

Structural Retrofit Elements

1. Install plywood sheathing, hold downs and anchor bolts on existing walls in garage area
2. Install new moment frames (2) to balance open front (w/ new footing). Use W12x50 beam and W14x68 columns.
3. Install new collector along moment frame line

Collateral Impacts

1. Remove and replace drywall at shear walls
2. Remove and replace slab on grade at moment frame
3. Remove and replace drywall along moment frame collector
4. Re-route SS drain locally
5. Re-route water line locally
6. Re-route electrical locally

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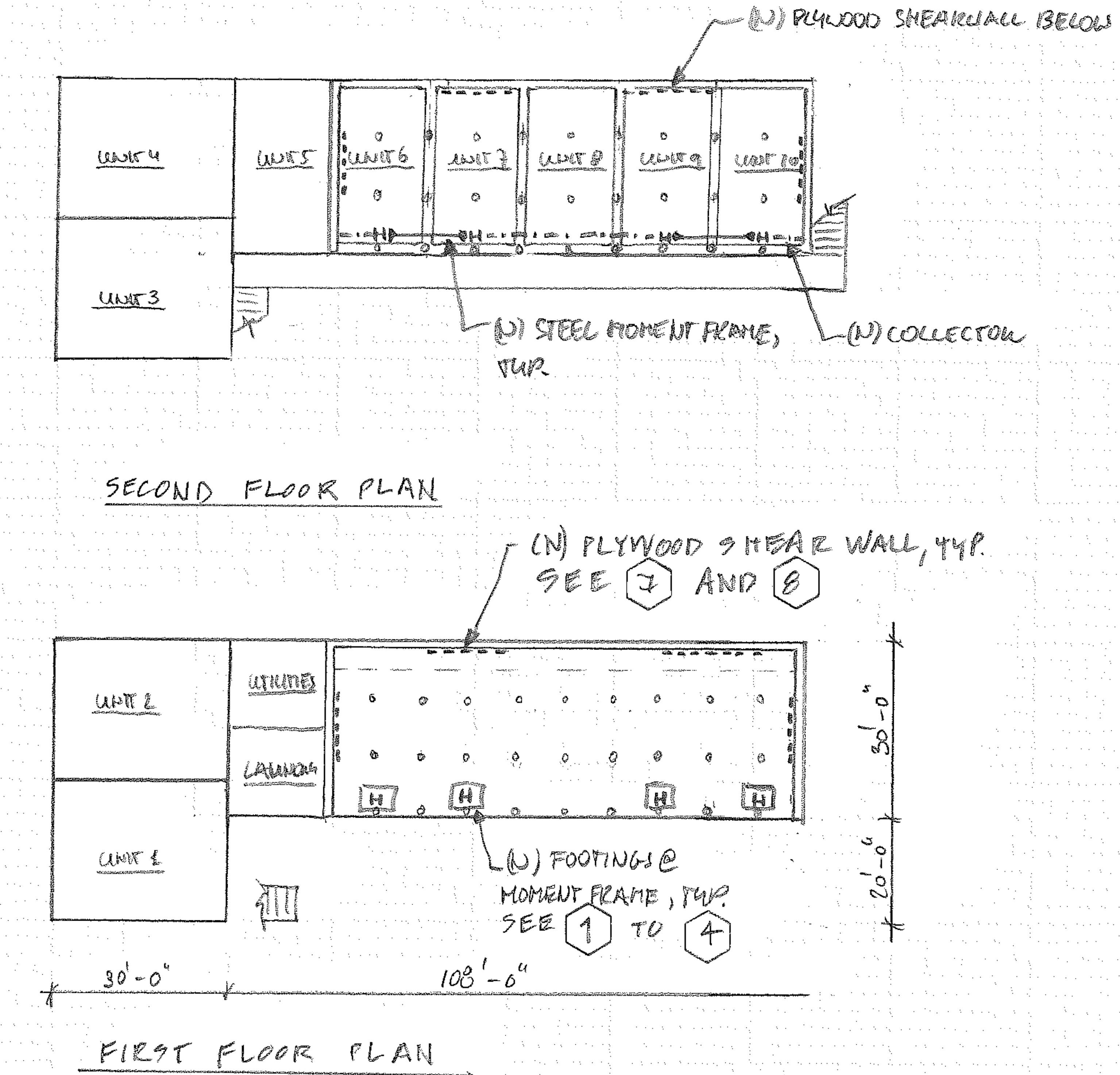
55 Second Street, Suite 600
San Francisco, CA 94105
T 415 568 4400
F 415 618 0684



BUILDING 2 - W1a

Building 3 – Multi-Story, Multi-Unit Wood-Frame Residential (W1A)

3-story, 30,000 sq.ft, 1960, 34 unit multi-family (COM 3C-3F), 4 units on ground floor, partial parking on ground floor

Conventional framing, no plywood shearwalls, post and beam framing and open front in garage

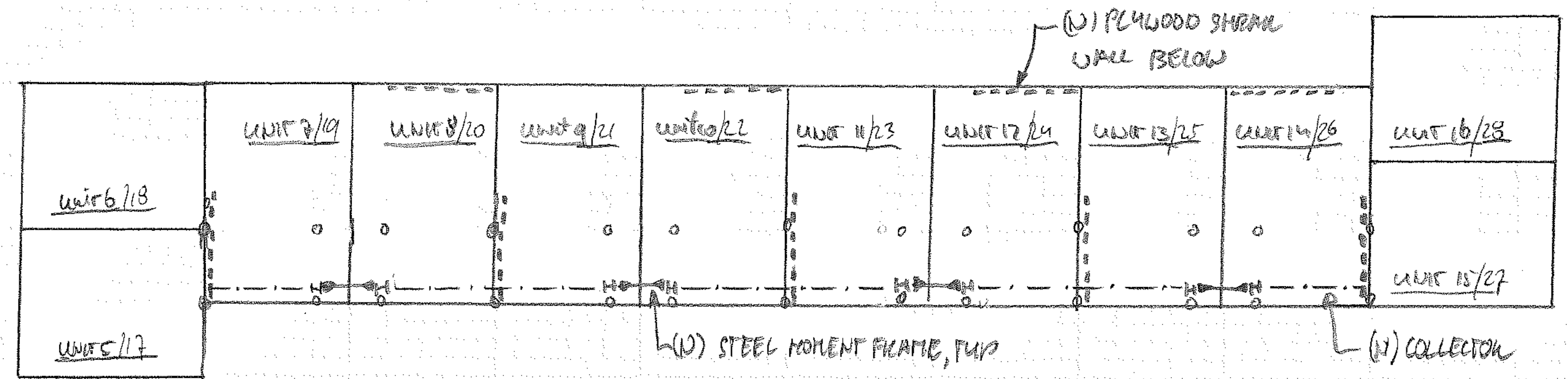
Retrofit Basis of Design: IEBC A4

Structural Retrofit Elements

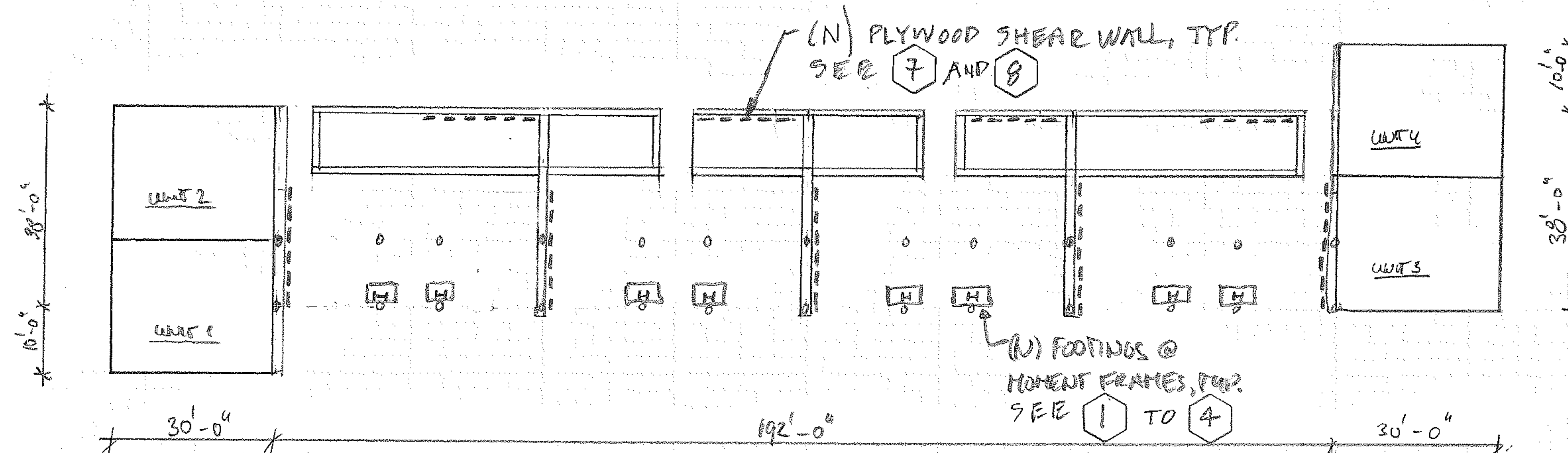
1. Install plywood sheathing, hold downs and anchor bolts on existing walls in garage area
2. Install new moment frames (4) to balance open front (w/ new footing). Use W12x50 beam and W14x68 columns.
3. Install new collector along moment frame line

Collateral Impacts

1. Remove and replace drywall at shear walls
2. Remove and replace slab on grade at moment frame
3. Remove and replace drywall along moment frame collector
4. Re-route SS drain locally
5. Re-route water line locally
6. Re-route electrical locally



SECOND FLOOR PLAN (THIRD + ROOF SIM.)



FIRST FLOOR PLAN

BUILDING 3 - W1a

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Building 4 – Commercial and Industrial Wood Frame (W2)

2-story, 12,000 sq.ft, 1960, commercial ground floor retail, second floor office (COM1, COM2, COM3, COM4, COM7, COM8)

Conventional framing, no plywood shearwalls, post and beam interior framing, open front at ground floor

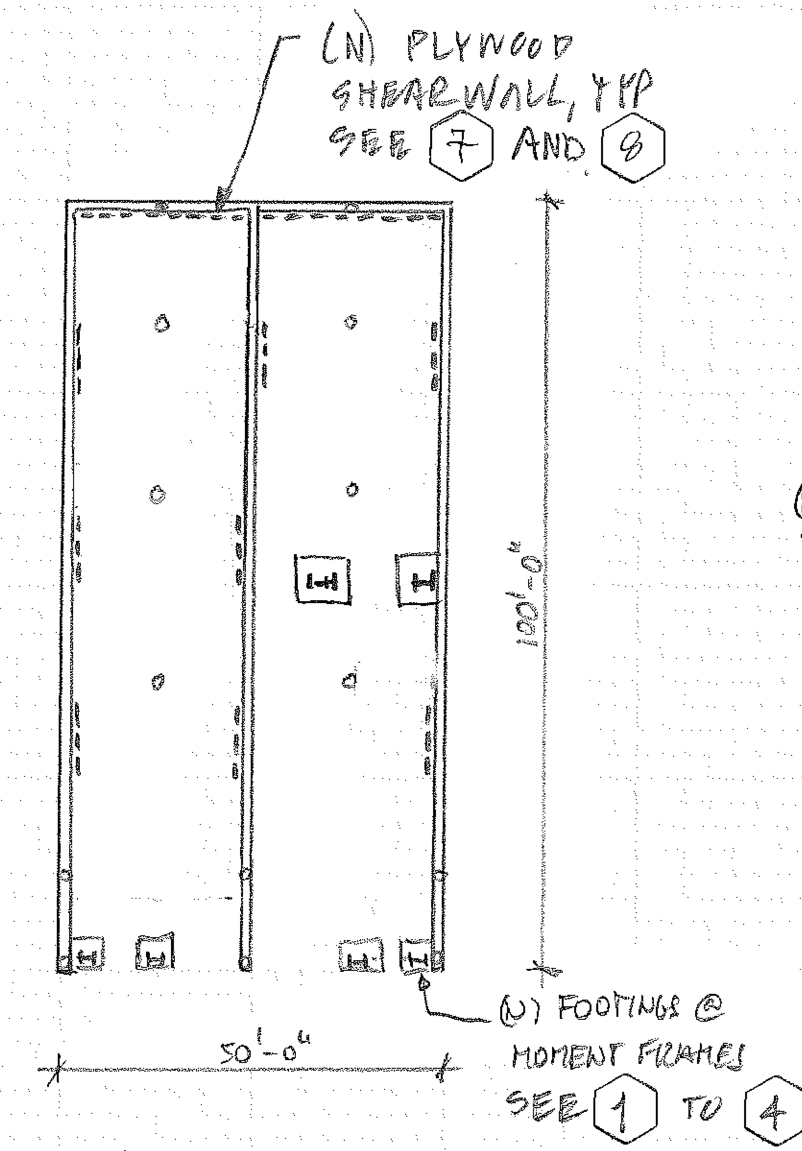
Retrofit Basis of Design: IEBC A4

Structural Retrofit Elements

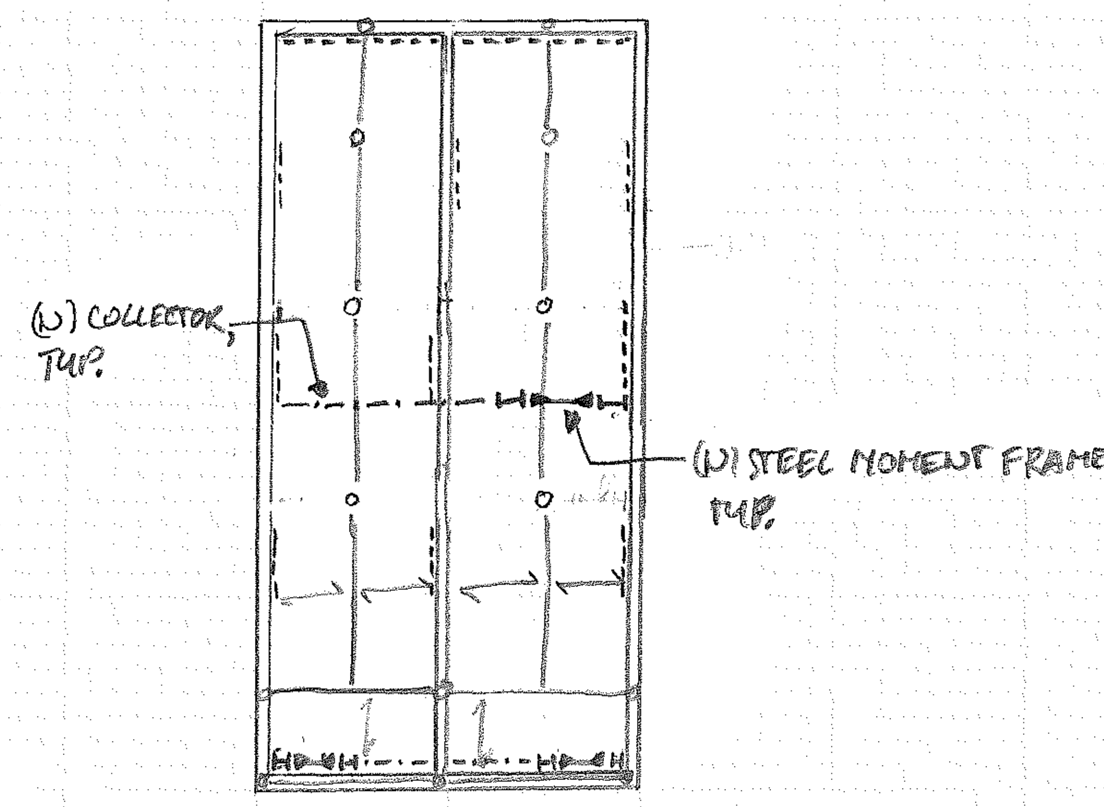
1. Install plywood sheathing, hold downs and anchor bolts on existing walls in retail area
2. Install new moment frames (3) in weak direction (w/ new footing). Use W12x50 beam and W14x68 columns.
3. Install new collector along moment frame line

Collateral Impacts

1. Remove and replace drywall at shear walls
2. Remove and replace slab on grade and flooring at moment frame
3. Remove and replace drywall along moment frame collector
4. Remove and replace casework in retail space
5. Re-route SS drain locally
6. Re-route water line locally
7. Re-route electrical locally



FIRST FLOOR PLAN



SECOND FLOOR PLAN

BUILDING 4 - W2

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Building 5 – Steel Moment Frame (S1)

2-story, 43,900 sq.ft, commercial office suites (COM1-COM10, IND1-IND6)

Two-bay perimeter moment frames, steel gravity framing, concrete fill over metal deck floor and roof,

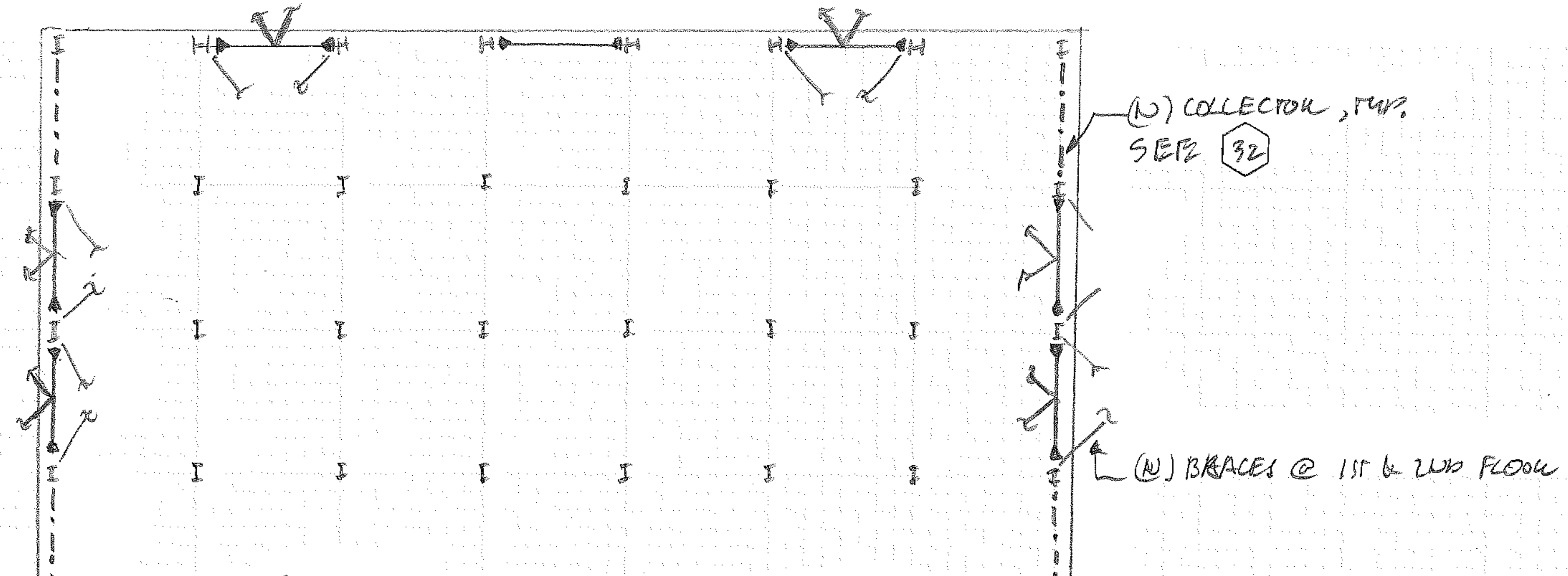
Retrofit Basis of Design: ASCE 41, BPOE

Structural Retrofit Elements

1. Install braces in existing moment frame bays. Use HSS6x6x1/2 braces at top story and HSS8x8x1/2 braces at first story
2. Enlarge pile caps and install new micropiles at braced frames (8 at each story)
3. Improve collectors at some braced frame lines

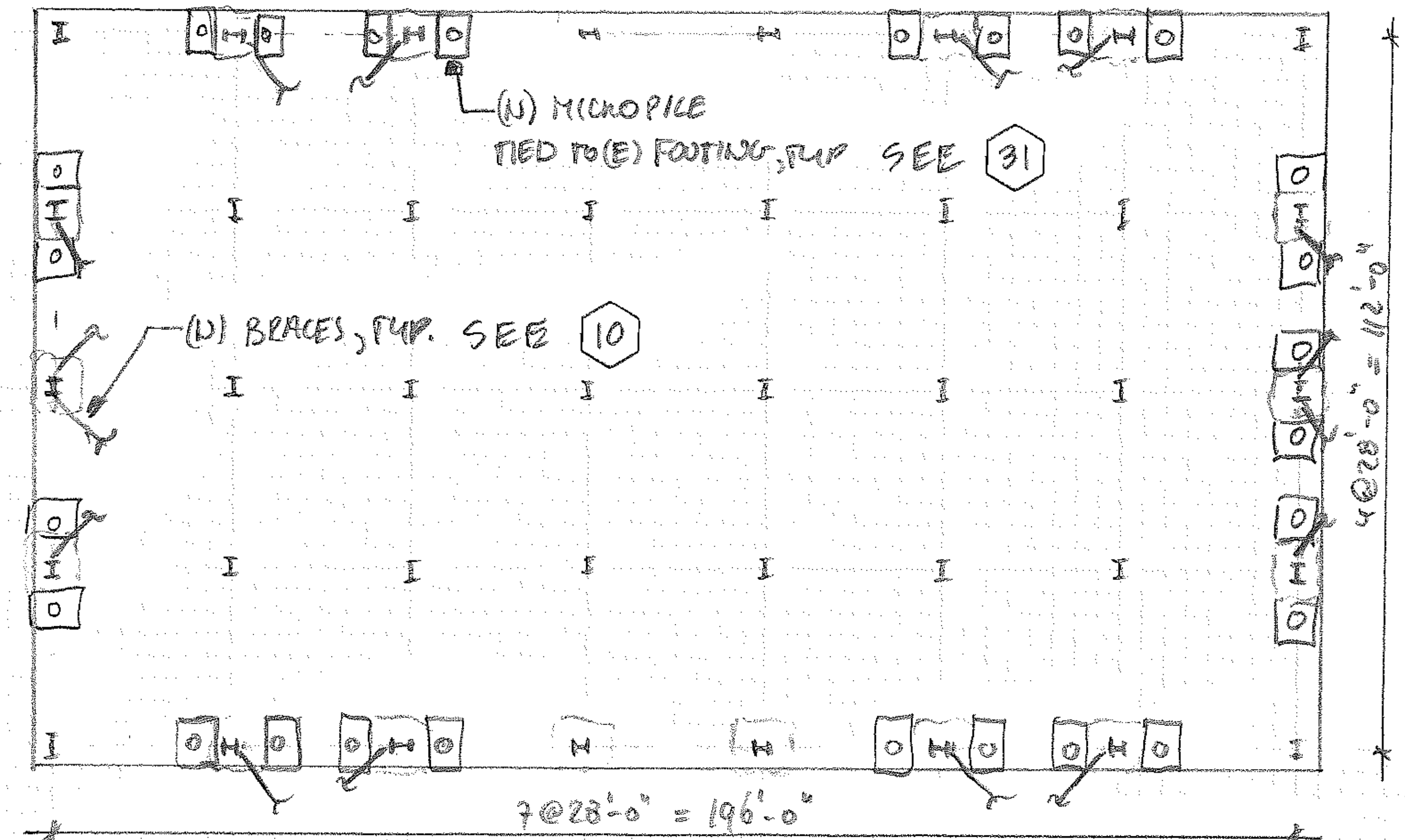
Collateral Impacts

1. Remove and replace suspended ceiling at braced frame bays
2. Remove furring wall at braced frame bays
3. Chip down concrete fill locally in brace frame bays
4. Remove and replace slab on grade and flooring at new foundations
5. Remove and replace suspended ceiling along new frame collector
6. Re-route SS drain locally
7. Re-route water line locally
8. Re-route electrical locally



2ND FLOOR & ROOF PLAN

NOTE:
GRAVITY BEAMS NOT
SHOWN FOR CLARITY



FIRST FLOOR PLAN

BUILDING 5 - S1

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Building 6 – Concrete Shear Wall (C2)

1-story, 5,000 sq.ft, 1920, commercial retail (COM1-COM10, IND1-IND6)

Concrete perimeter walls, post and beam interior framing, wood roof diaphragm sheathing, open front

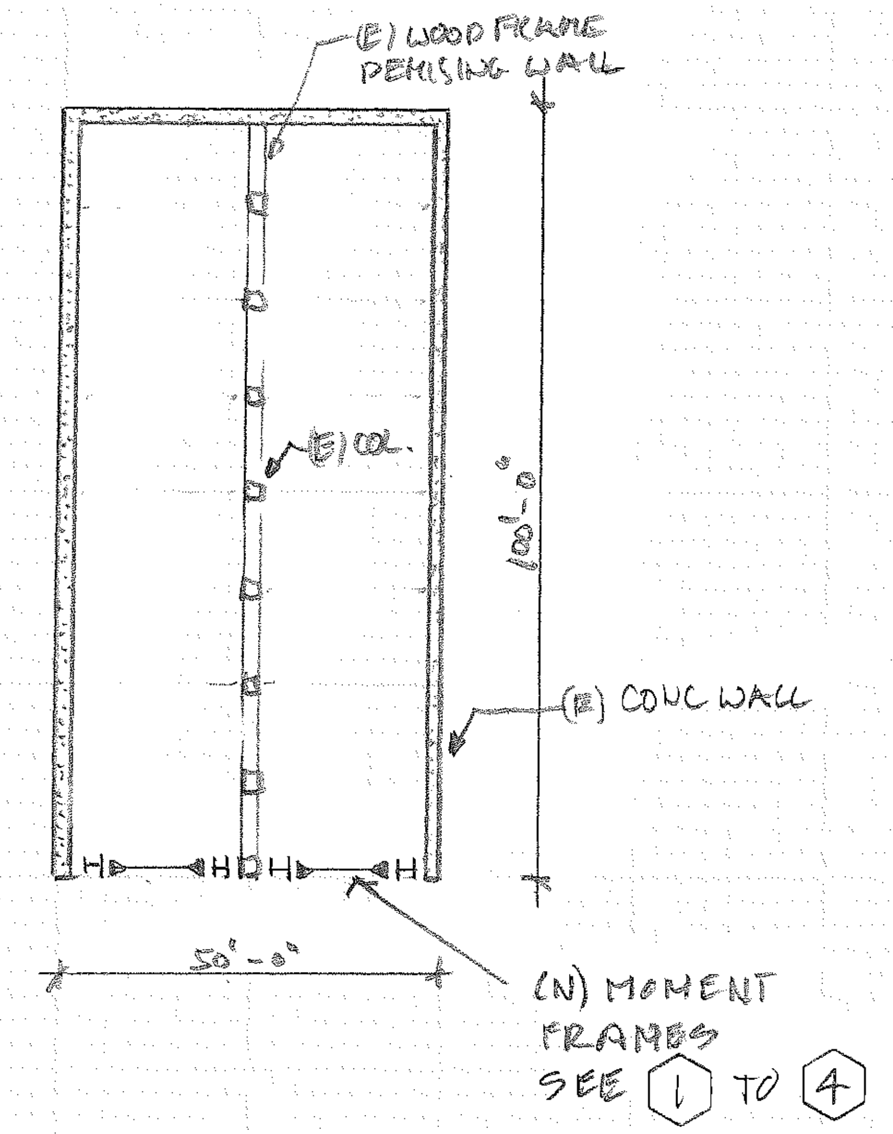
Retrofit Basis of Design: ASCE 41, BPOE

Structural Retrofit Elements

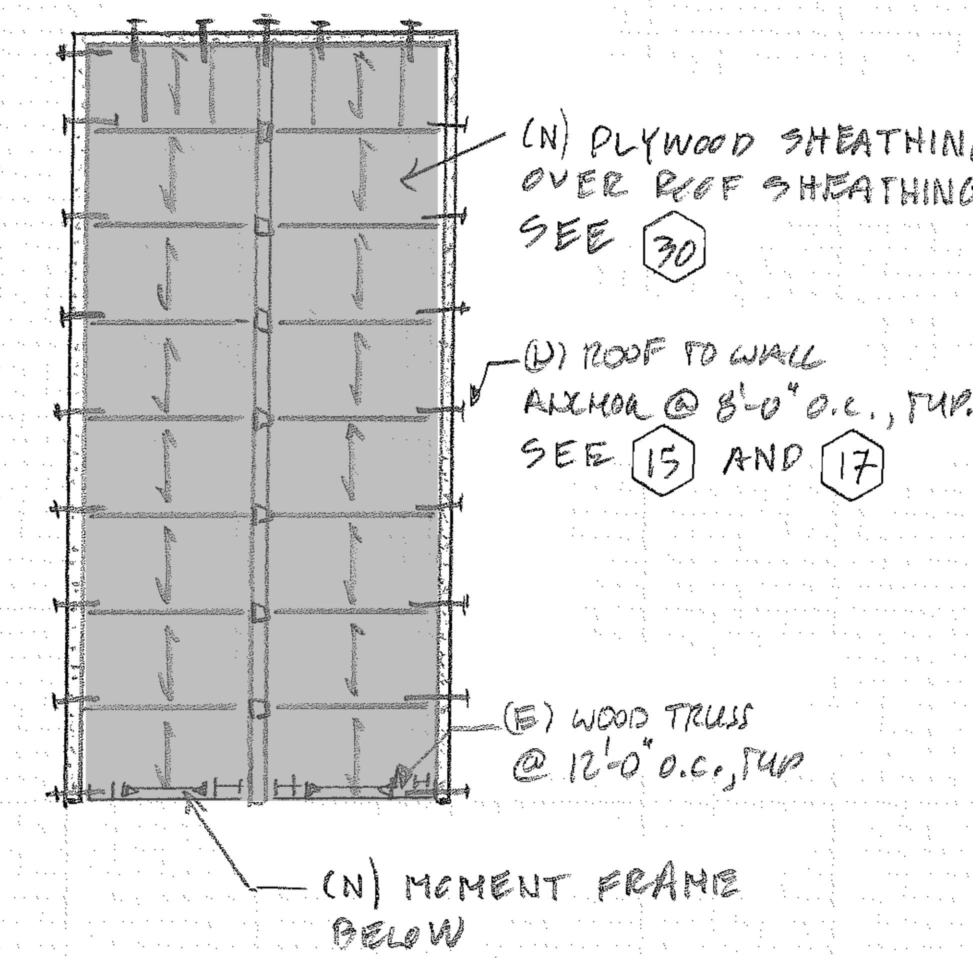
1. Install roof-to-wall anchors
2. Install new plywood sheathing over existing roof sheathing
3. Install new moment frames (2) in weak direction (w/ new footings). Use W12x50 beam and W14x68 columns.
4. Install new collector along moment frame lines

Collateral Impacts

1. Remove and replace ceiling along concrete walls
2. Remove and replace slab on grade and flooring at moment frame
3. Remove and replace ceiling along moment frame collector
4. Re-route SS drain locally
5. Re-route water line locally
6. Re-route electrical locally
7. Remove and replace roofing



FIRST FLOOR PLAN



ROOF PLAN

BUILDING 6 - C2

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Building 7 – Concrete Shear Wall (C2)

2-story, 17,280 sq.ft, 1960, commercial ground floor retail, second floor office (COM1-COM10, IND1-IND6)

Concrete perimeter walls, flat plate floor and roof framing, tall first story

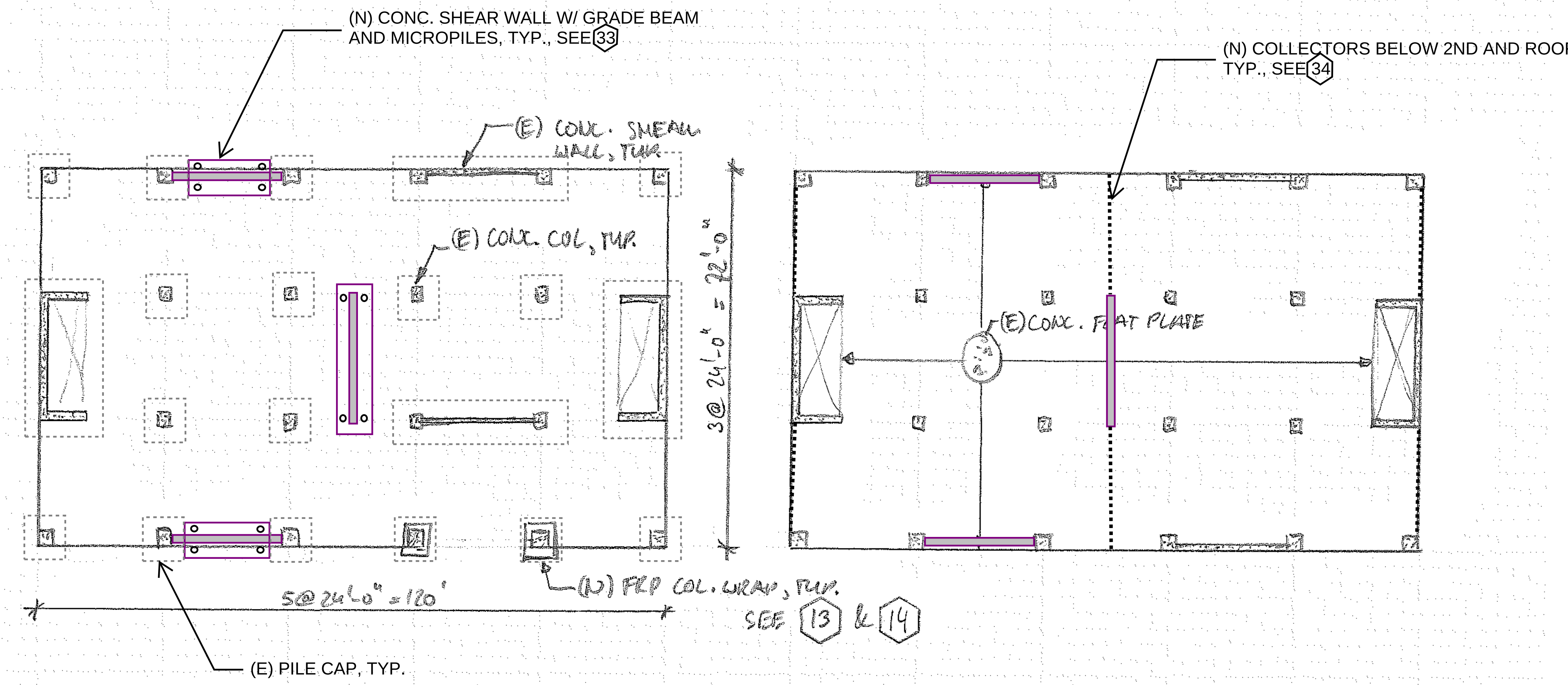
Retrofit Basis of Design: ASCE 41, BPOE

Structural Retrofit Elements

1. Install FRP column wrap at discontinuous wall
2. Install new collectors below 2nd floor and roof slab
3. Install additional shear walls (w/ new foundation), 3 bays at each story
4. Shore slab adjacent to walls

Collateral Impacts

1. Remove and replace drywall at columns to be wrapped
2. Remove and replace storefront locally at columns to be wrapped
3. Remove and replace slab on grade and flooring at new shear walls
4. Remove and replace ceiling along new collectors
5. Remove and replace furring walls at new shear walls
6. Re-route SS drain multiple locations
7. Re-route water line multiple locations
8. Re-route electrical multiple locations



Foundation/FIRST FLOOR PLAN

Roof/SECOND FLOOR PLAN

BUILDING 7 - C2

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Building 8 – Tilt-up Concrete Shear Walls (PC1)

1-story, 20,000 sq.ft, 1960, commercial office/warehouse

Precast concrete perimeter wall panels, post and beam interior framing, wood roof diaphragm sheathing, building has reentrant corner

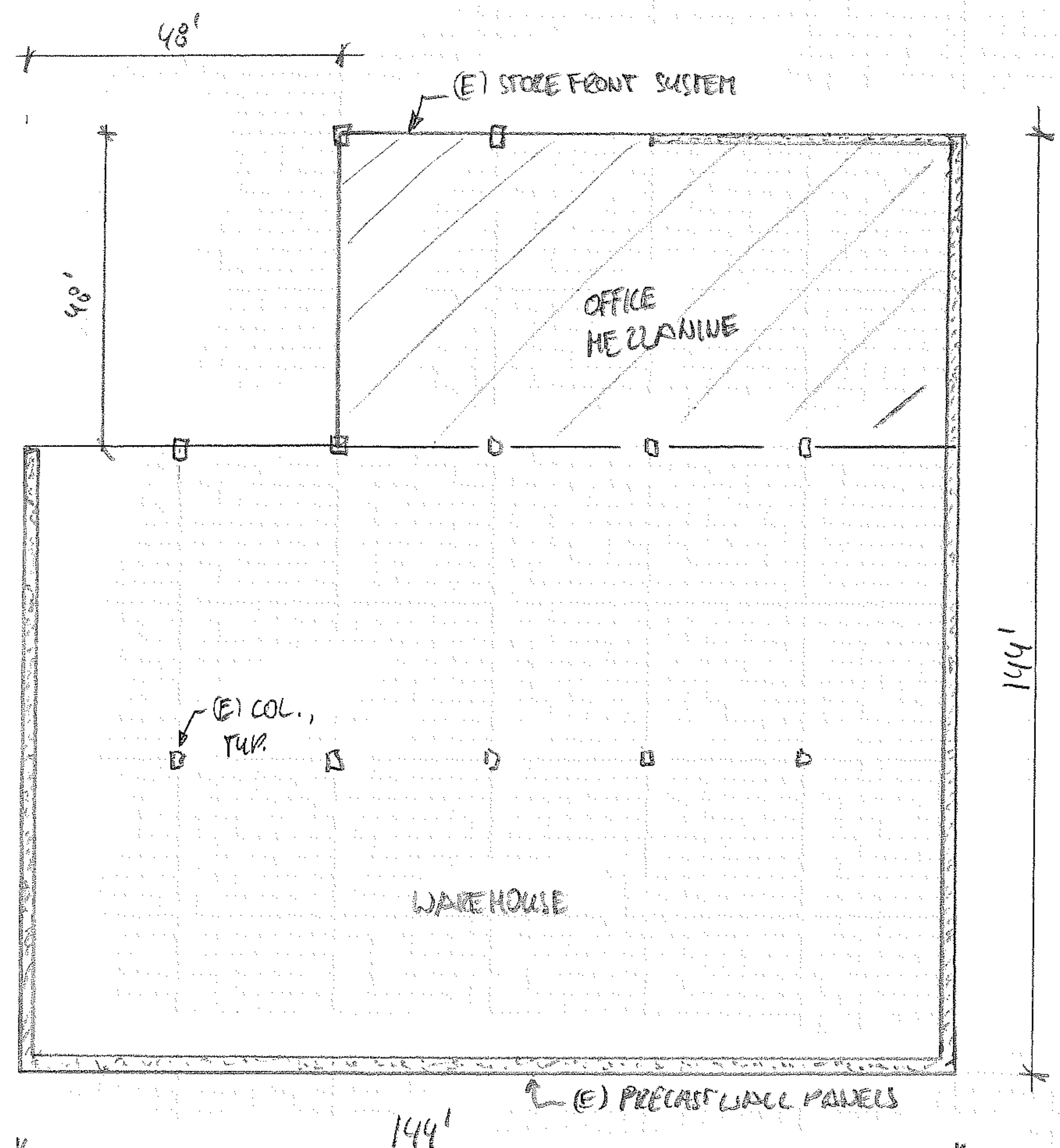
Retrofit standard: IEBC A2

Structural Retrofit Elements

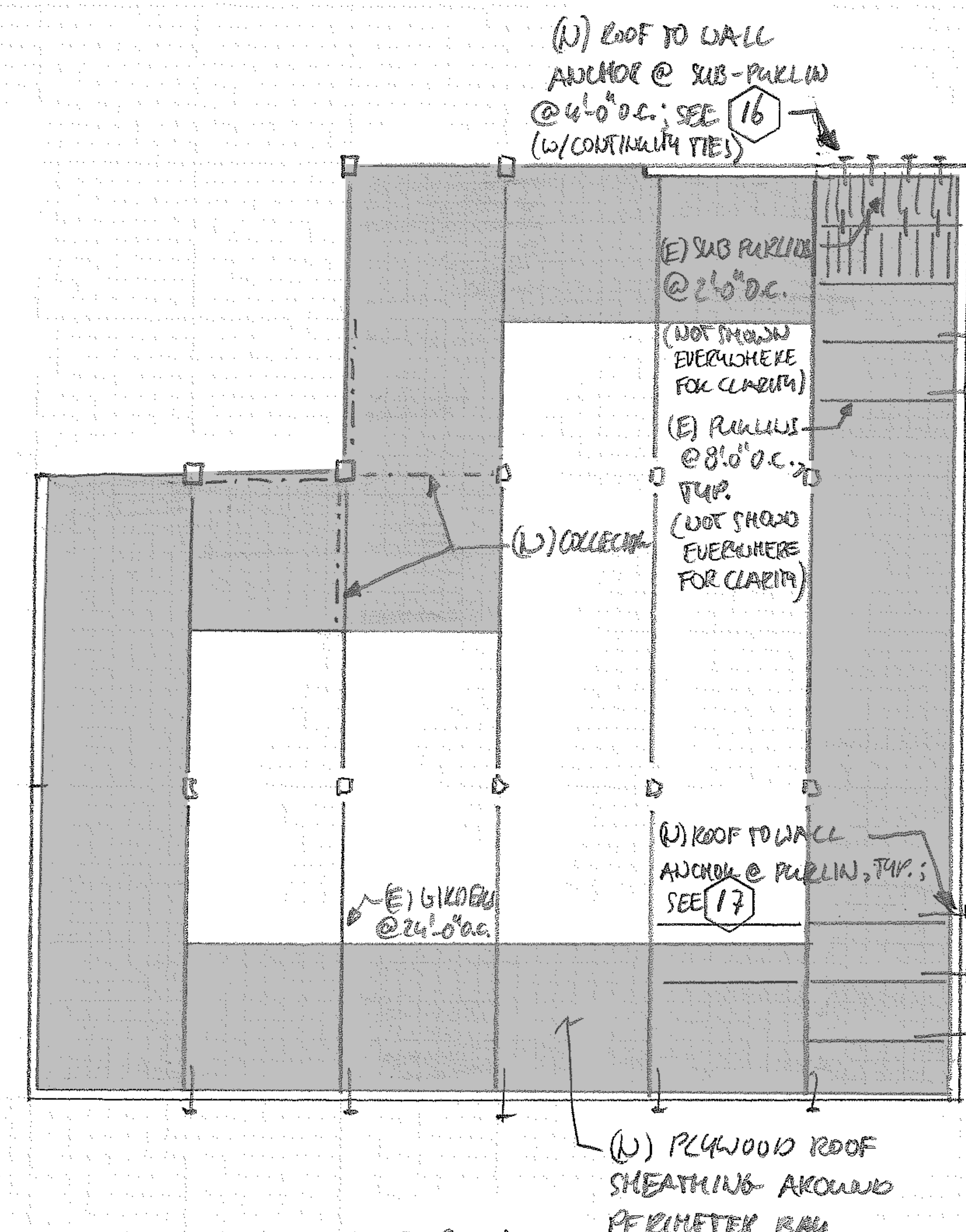
1. Install roof-to-wall anchors
2. Install new plywood roof sheathing around perimeter bay
3. Install new subpurlin continuity ties
4. Install new collectors at reentrant corner

Collateral Impacts

1. Remove and replace ceiling along perimeter
2. Remove and replace roofing
3. Re-route SS drain locally
4. Re-route water line locally
5. Re-route electrical locally



FIRST FLOOR PLAN



ROOF PLAN

BUILDING 8 - PC1

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Building 9 – Tilt-up Concrete Shear Walls (PC1)

2-story, 46,400 sq.ft, 1960, commercial office/warehouse

Precast concrete perimeter wall panels, concrete fill on metal deck at second floor with steel framing and steel columns below, wood roof sheathing with wood beam and girder framing and steel columns below.

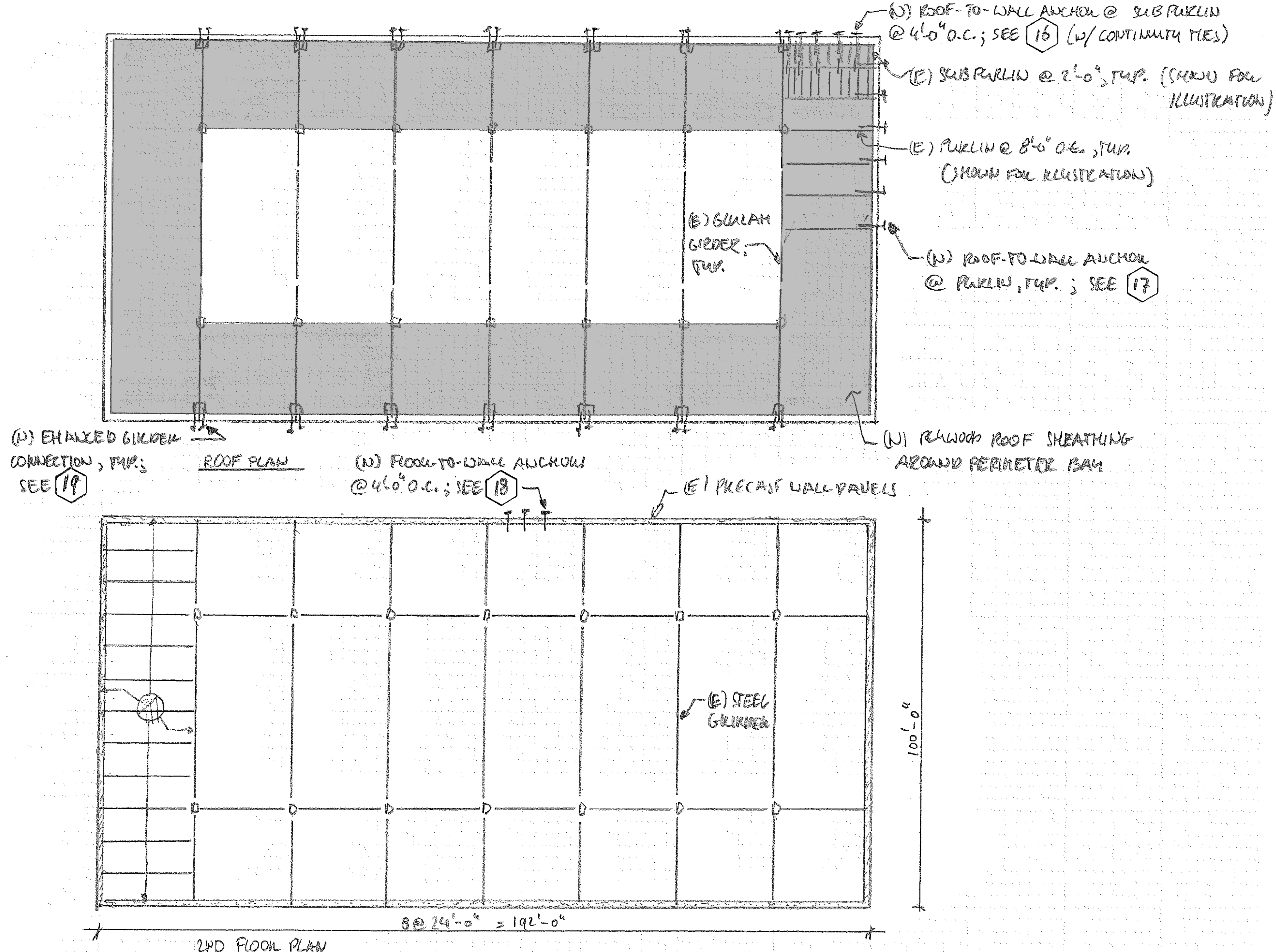
Retrofit standard: IEBC A2

Structural Retrofit Elements

1. Install floor-to-wall anchors
2. Install roof-to-wall anchors
3. Install new plywood roof sheathing around perimeter bay
4. Install new subpurlin continuity ties at roof
5. Improve girder connection capacity at roof

Collateral Impacts

1. Remove and replace ceiling along perimeter on both floors
2. Remove and replace roofing
3. Re-route SS drain locally
4. Re-route water line locally
5. Re-route electrical locally



BUILDING 9 - PC1

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Building 10 – Reinforced Masonry Bearing Wall (RM1)

1-story, 2,750 sq.ft, 1950, commercial retail (COM1-COM5, COM8, IND1-IND6)

CMU perimeter walls (3 sides), post and beam interior framing, wood roof sheathing, tall story, open front.

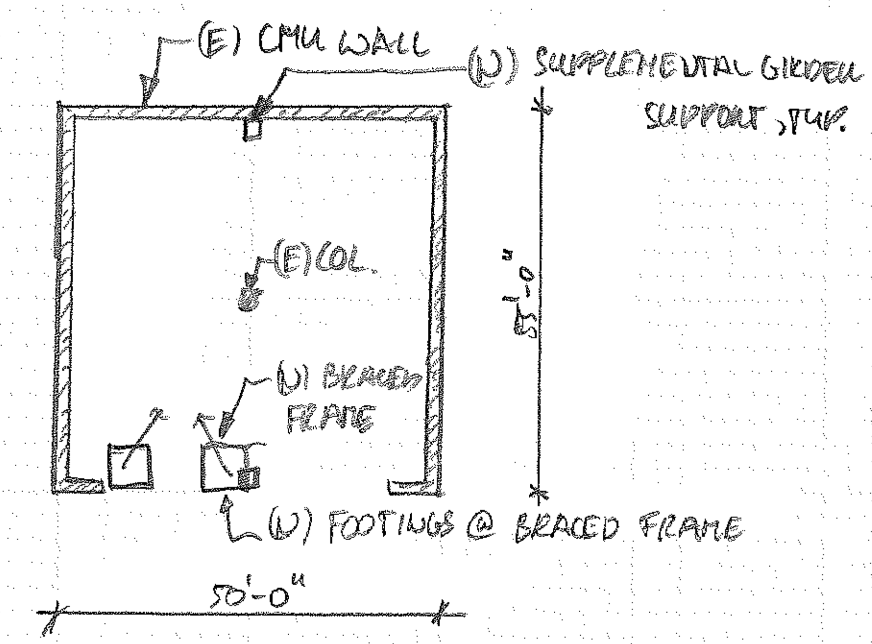
Retrofit Basis of Design: ASCE 41, BPOE

Structural Retrofit Elements

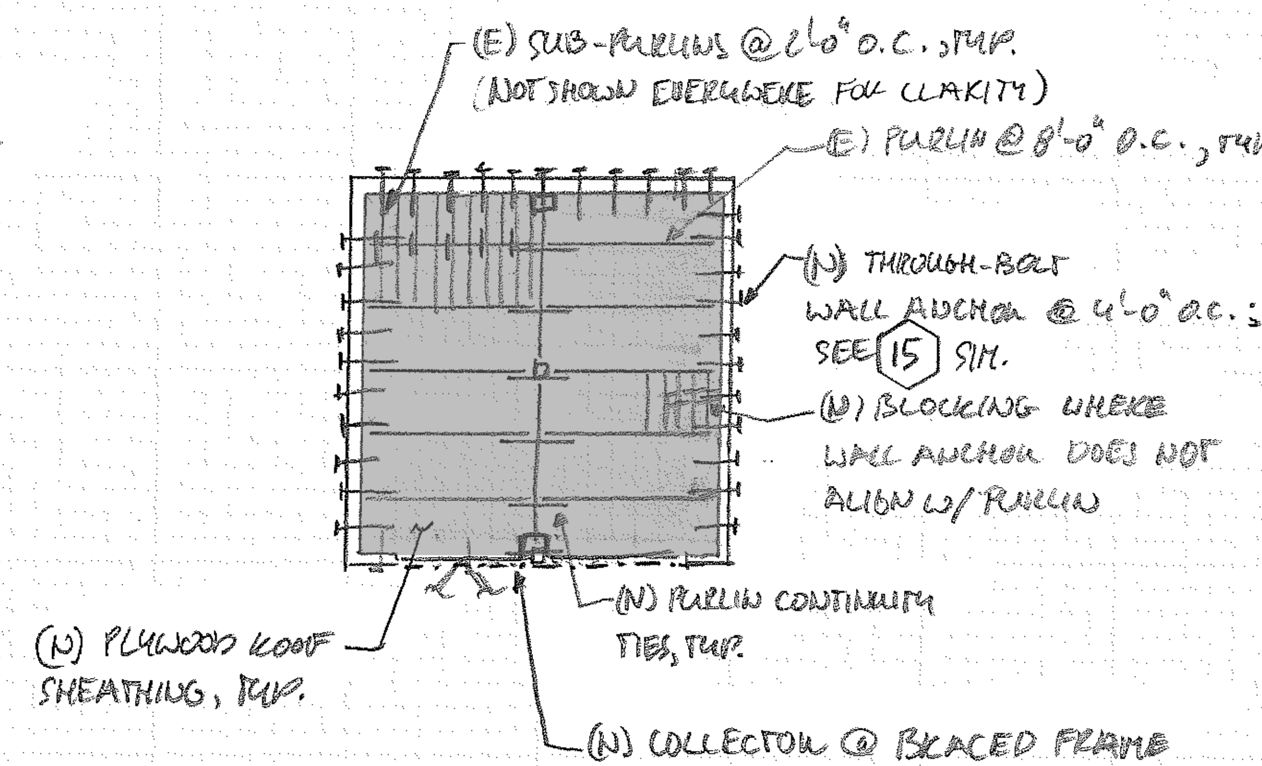
1. Install roof-to-wall anchors
2. Install new purlin and joist continuity ties
3. Install new plywood roof sheathing
4. Install new steel braced frame to balance open front (w/ new footings). Use W24x76 beam, W12x96 columns, and HSS6x6x1/2 braces.
5. Install new collector at braced frame
6. Install new supplemental girder supports (on new footings)

Collateral Impacts

1. Remove and replace ceiling along perimeter
2. Remove and replace slab on grade and flooring at braced frame
3. Remove and replace roofing
4. Re-route SS drain locally
5. Re-route water line locally
6. Re-route electrical locally



FIRST FLOOR PLAN



ROOF PLAN

BUILDING 10 - RM1

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Building 11 – Reinforced Masonry Bearing Wall (RM1)

2-story, 12,000 sq.ft, commercial office suites (RES 3D-3F, RES4, RES5, RES6, COM1-COM9, IND1-IND6)

CMU perimeter walls (3 sides), post and beam interior framing, wood floor and roof sheathing, window wall on street side

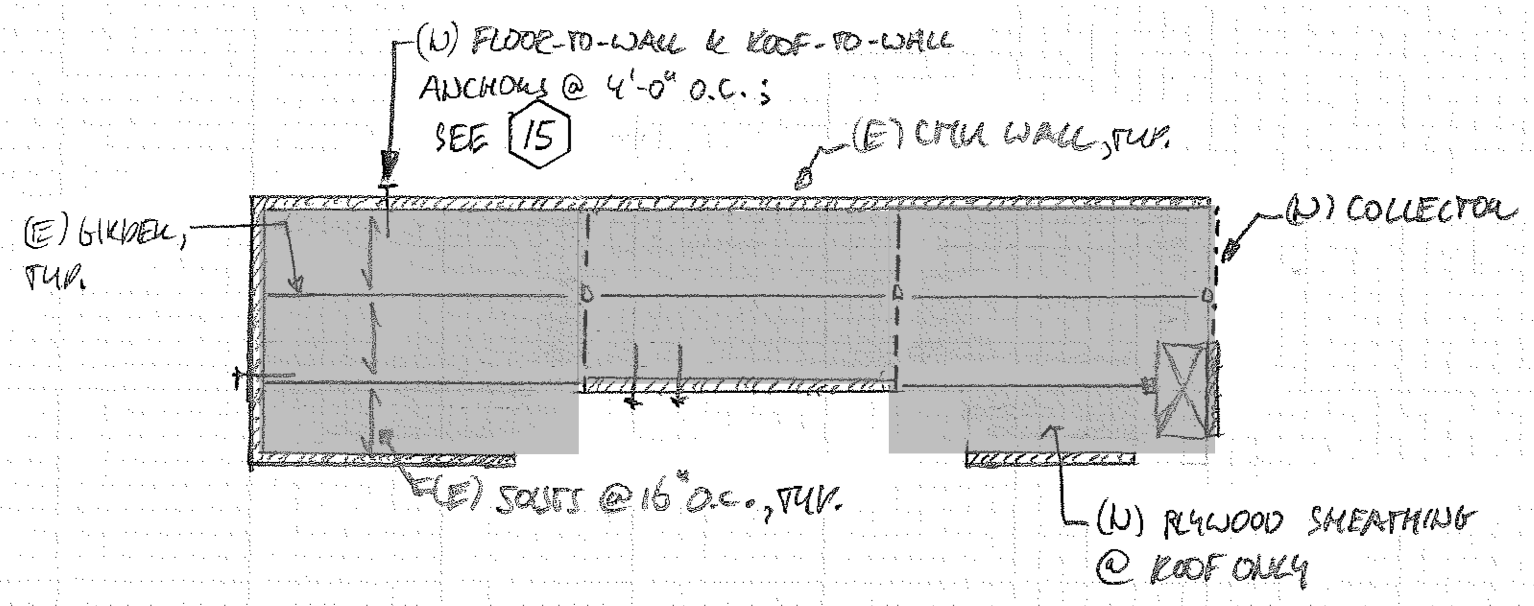
Retrofit Basis of Design: ASCE 41, BPOE

Structural Retrofit Elements

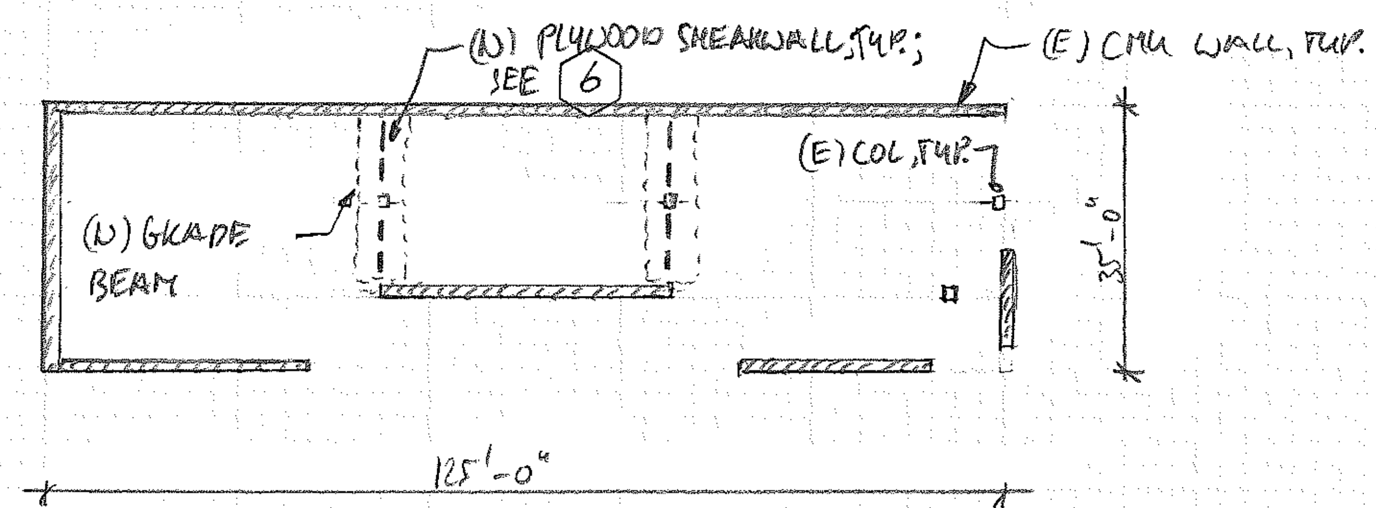
1. Install floor-to-wall anchors
2. Install roof-to-wall anchors
3. Install new purlin continuity ties
4. Install collector to existing masonry wall at roof and second floor
5. Install new plywood roof sheathing
6. Install plywood shear walls perpendicular to open front to break up diaphragm (w/ new grade beams)

Collateral Impacts

1. Remove and replace ceiling along perimeter at both floors
2. Remove and replace slab on grade and flooring at shear walls
3. Remove and replace roofing
4. Re-route SS drain locally
5. Re-route water line locally
6. Re-route electrical locally



2ND FLOOR AND ROOF PLAN



FIRST FLOOR PLAN

BUILDING 11 - RM1

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Building 12 – Unreinforced Masonry Bearing Wall (URM)

1-story, 5,000 sq.ft, retail/assembly (COM1, COM2, COM3, COM4, COM5, COM8)

URM perimeter walls (3 sides), wood post and beam interior framing with joists (flat roof) or trusses (pitched roof), wood roof sheathing, window wall on street side

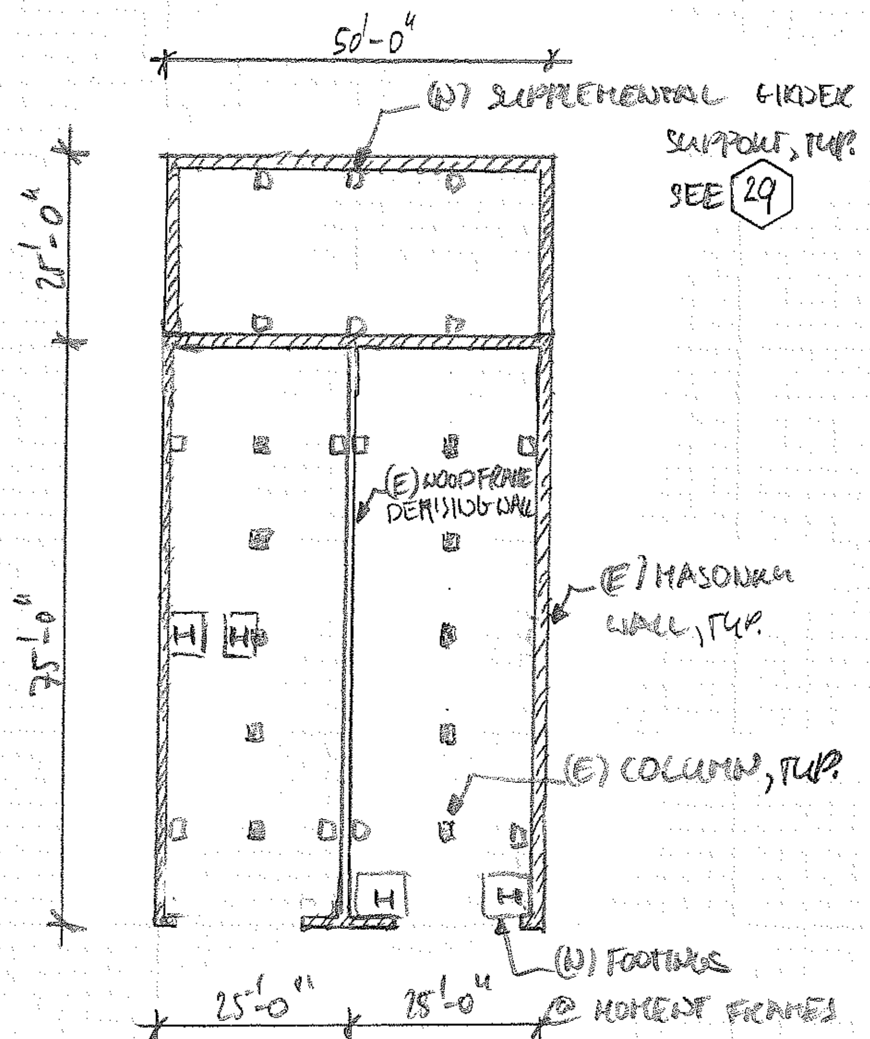
Retrofit Basis of Design: IEBC A1

Structural Retrofit Elements

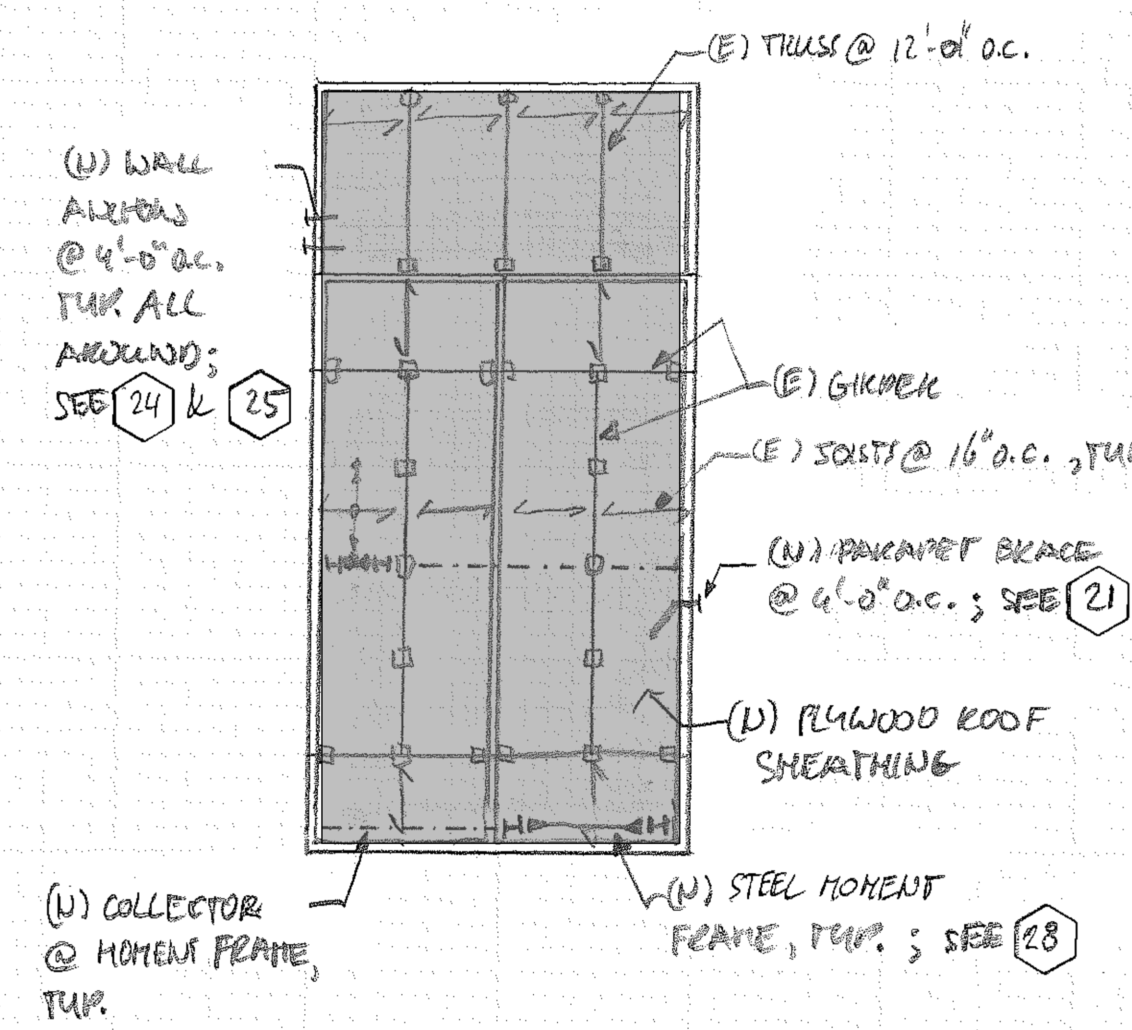
1. Roof-to-wall ties
2. Supplemental girder support
3. Install new moment frame at open front and additional frame at interior (2 total w/ footings). Use W12x50 beam and W14x68 columns.
4. Install new collector along moment frame line
5. Parapet bracing
6. Install new plywood roof sheathing

Collateral Impacts

1. Remove and replace ceiling along masonry walls
2. Remove and replace furring wall locally at supplemental supports
3. Remove and replace flooring and slab on grade at moment frame
4. Remove and replace ceiling
5. Remove and replace roofing
6. Re-route electrical locally



FIRST FLOOR PLAN



ROOF PLAN

BUILDING 12 - URM

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Typical Retrofit Details

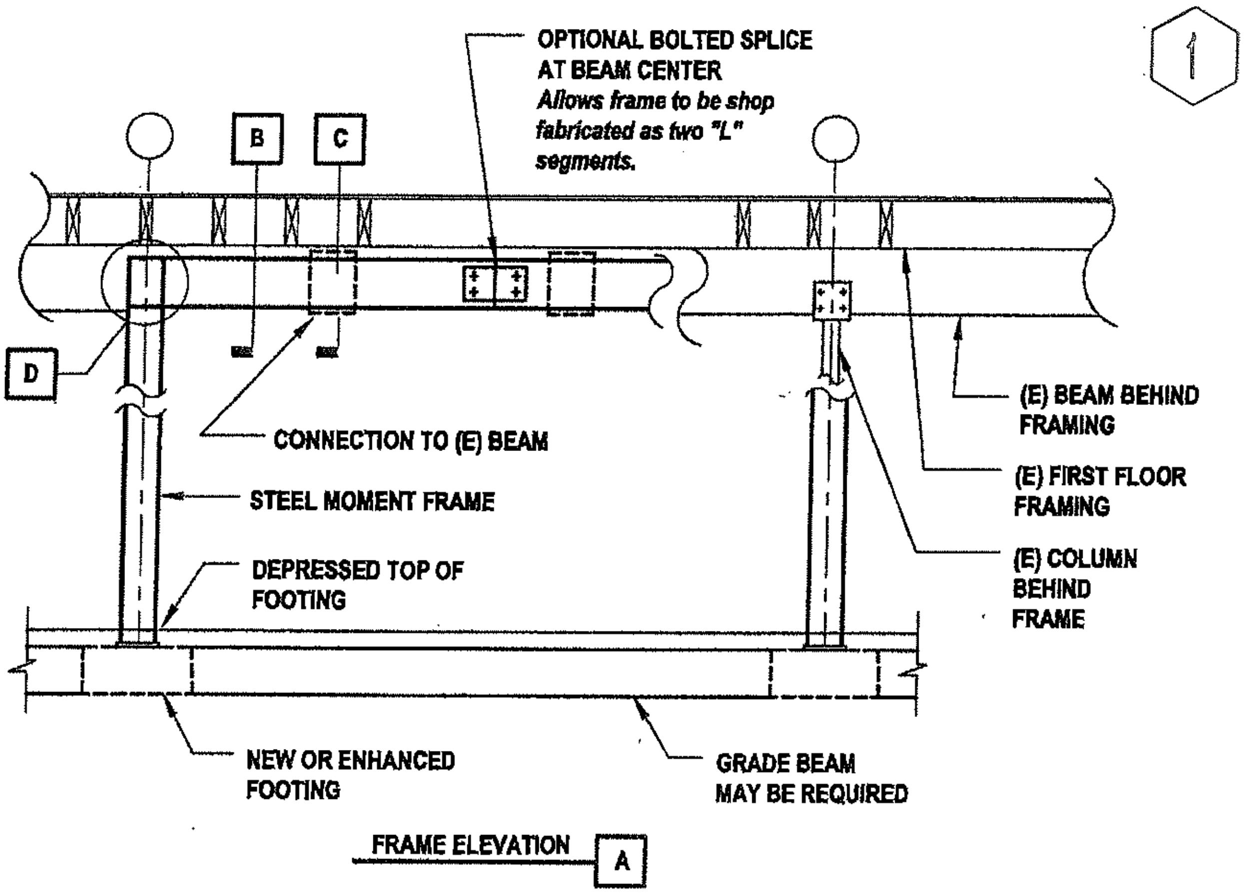


Figure 6.4.1-1A: Elevation of Steel Moment Frame in W1A Building

Footing placement will generally require the shoring of the upper stories and full or partial removal of existing footings. Transfer of earthquake load from the diaphragm above to the steel moment frame will commonly involve a collector that runs the full length of the open front and a series of connections from the collector to the steel moment frame.

Figures 6.4.1-1B, 6.4.1-1C and 6.4.1-1D illustrate possible connections. See discussion of collectors and shear transfer in the *Design Considerations* section. A number of detailing considerations discussed in Section 5.4.1 are applicable to frame connection to the existing wood building. In particular, detailing must accommodate shrinkage and possible swelling of wood, and alternate fasteners to existing sheathing may be needed.

This rehabilitation measure is not intended to address systems of steel columns cantilevered from the foundation without moment connections to a beam at the top. This cantilevered column system should be used with caution due to the difficulty of quantifying and limiting the many potential sources of rotation and deflection and to inadequate knowledge of post-elastic system behavior.

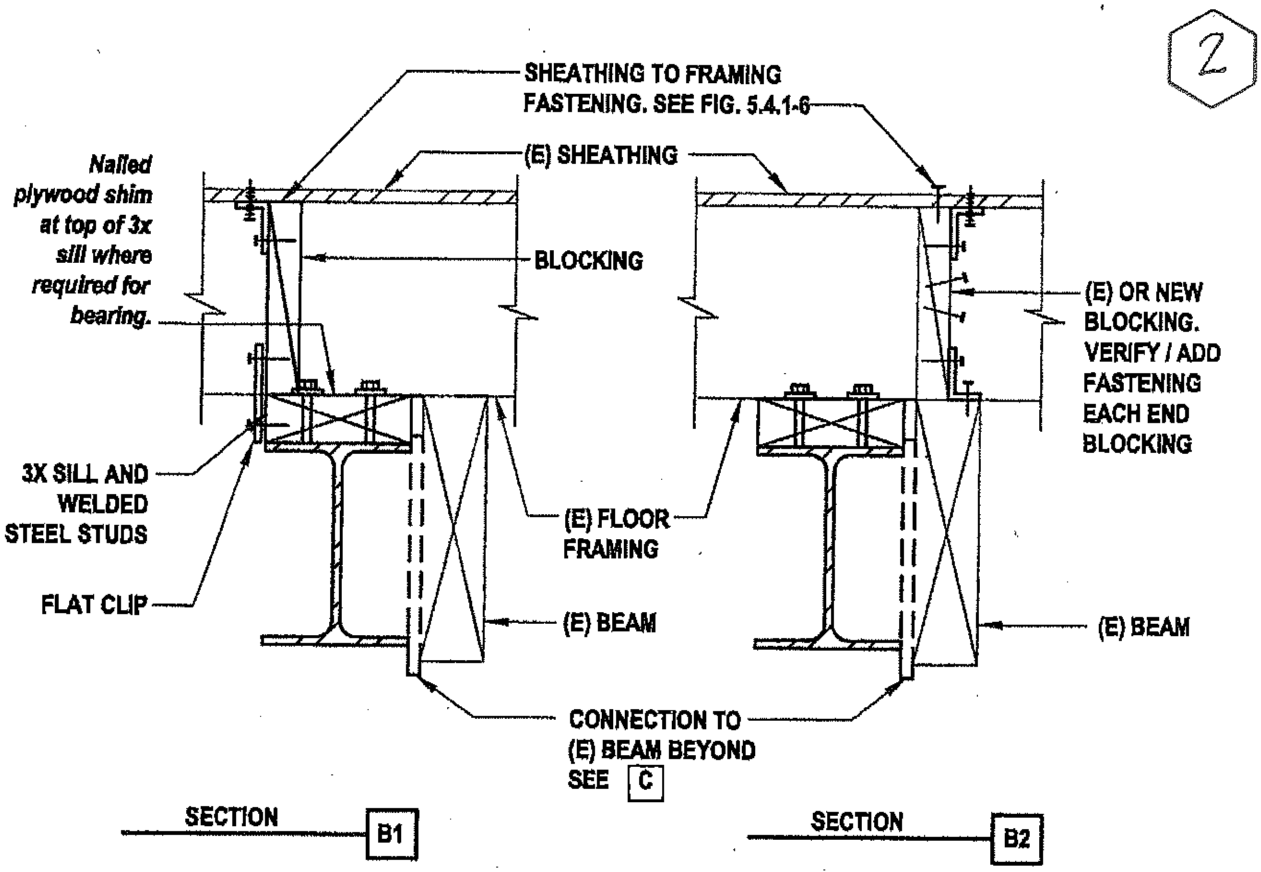


Figure 6.4.1-1B: Shear Transfer Between Moment Frame Beam and Diaphragm

Design Considerations

Research basis: Research specifically addressing steel moment frames in woodframe buildings includes: *Seismic Evaluation of an Asymmetric Three-Story Woodframe Building* (Mosalam et al., 2002) and *Improving Loss Estimation for Woodframe Buildings* (Porter et al., 2002). Results from these studies are also discussed in Cobeen, Russell, and Dolan (2004).

Moment frame design criteria: Chapter 8 of this document addresses steel moment frame rehabilitation in buildings where steel moment frames are the primary lateral force-resisting system. In contrast, when used for rehabilitation of **W1A** buildings, steel moment frames will generally only be used in one story and along one building line. The response modification factor of the woodframe building above makes use of either an ordinary or intermediate moment frame a logical choice for the first story of a multistory **W1A** building. Limitations addressing use in light-frame buildings have been in a state of flux. The most current seismic design provisions, ASCE 7-05 (ASCE, 2005) and AISC Seismic (2005), permit:

- Single story ordinary moment frames (OMF) for new buildings in Seismic Design Category (SDC) D and E, to a height of 65 feet, provided dead load tributary to the roof does not exceed 20 psf and tributary wall dead load does not exceed 20 psf

3

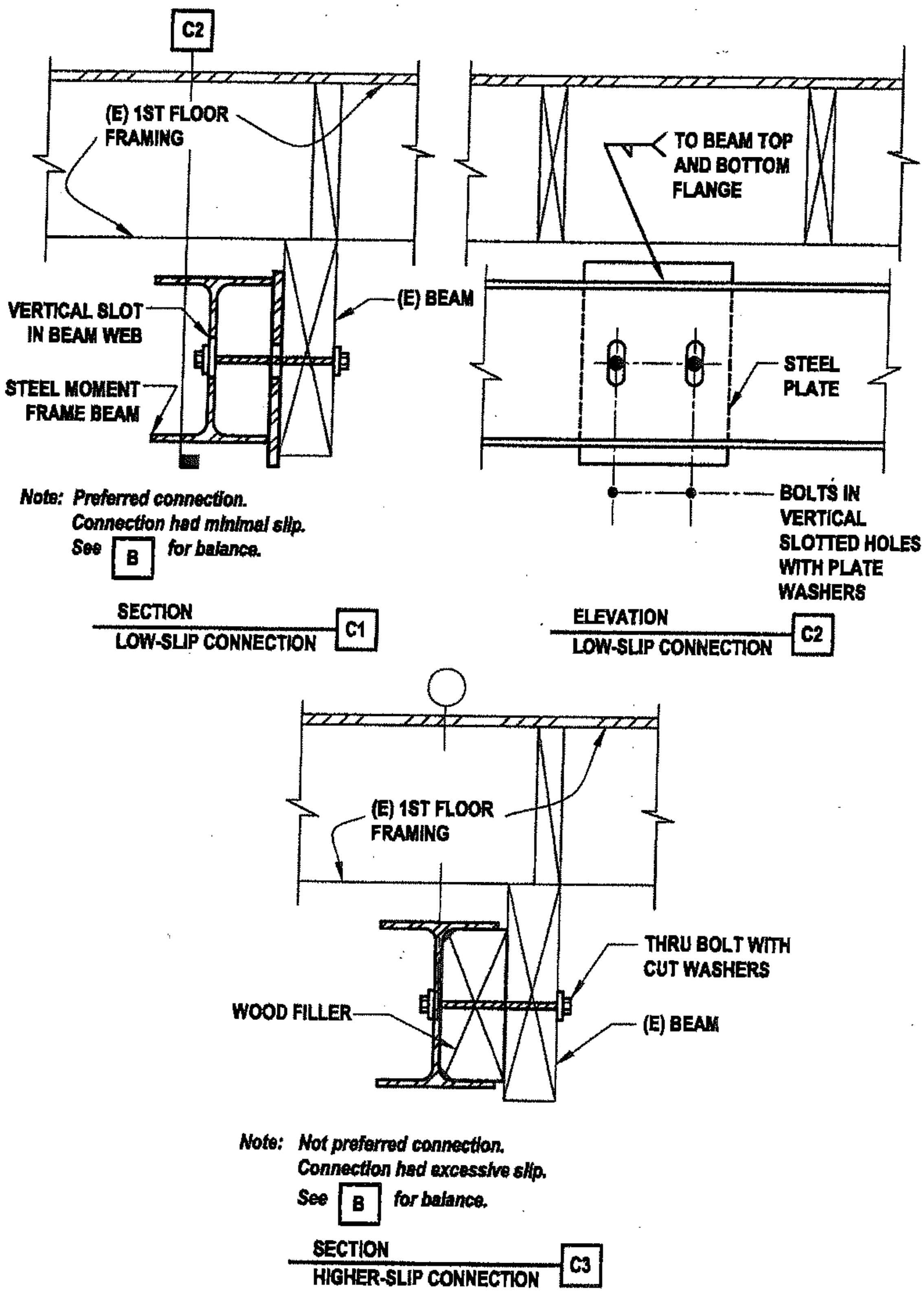
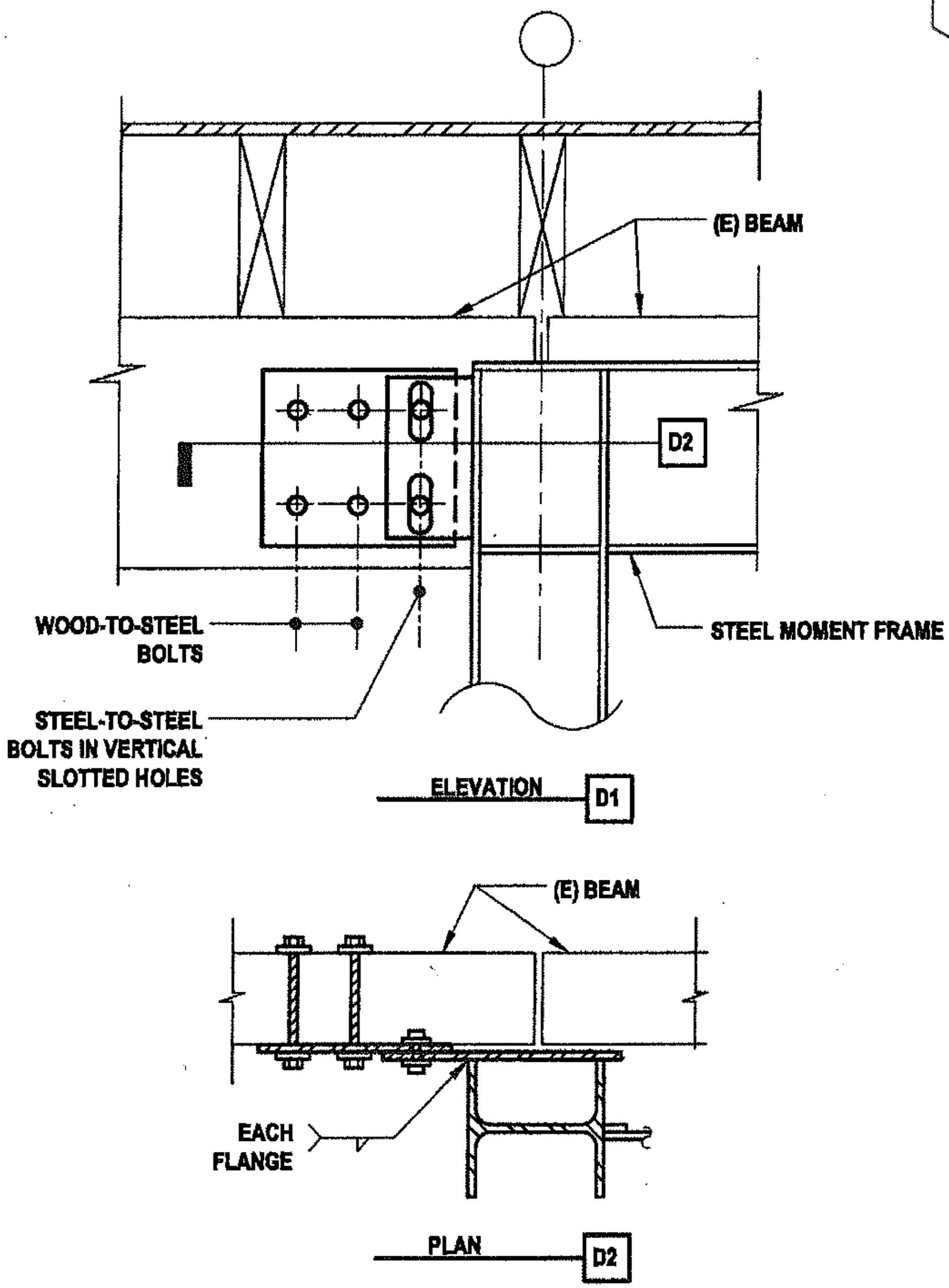


Figure 6.4.1-1C: Shear Transfer from Moment Frame Beam to Collector

4



Note: Out-of-plane bracing of steel frame is required at column tops and may be required at reduced beam sections.

Figure 6.4.1-1D: Shear Transfer from Moment Frame Beam to Collector

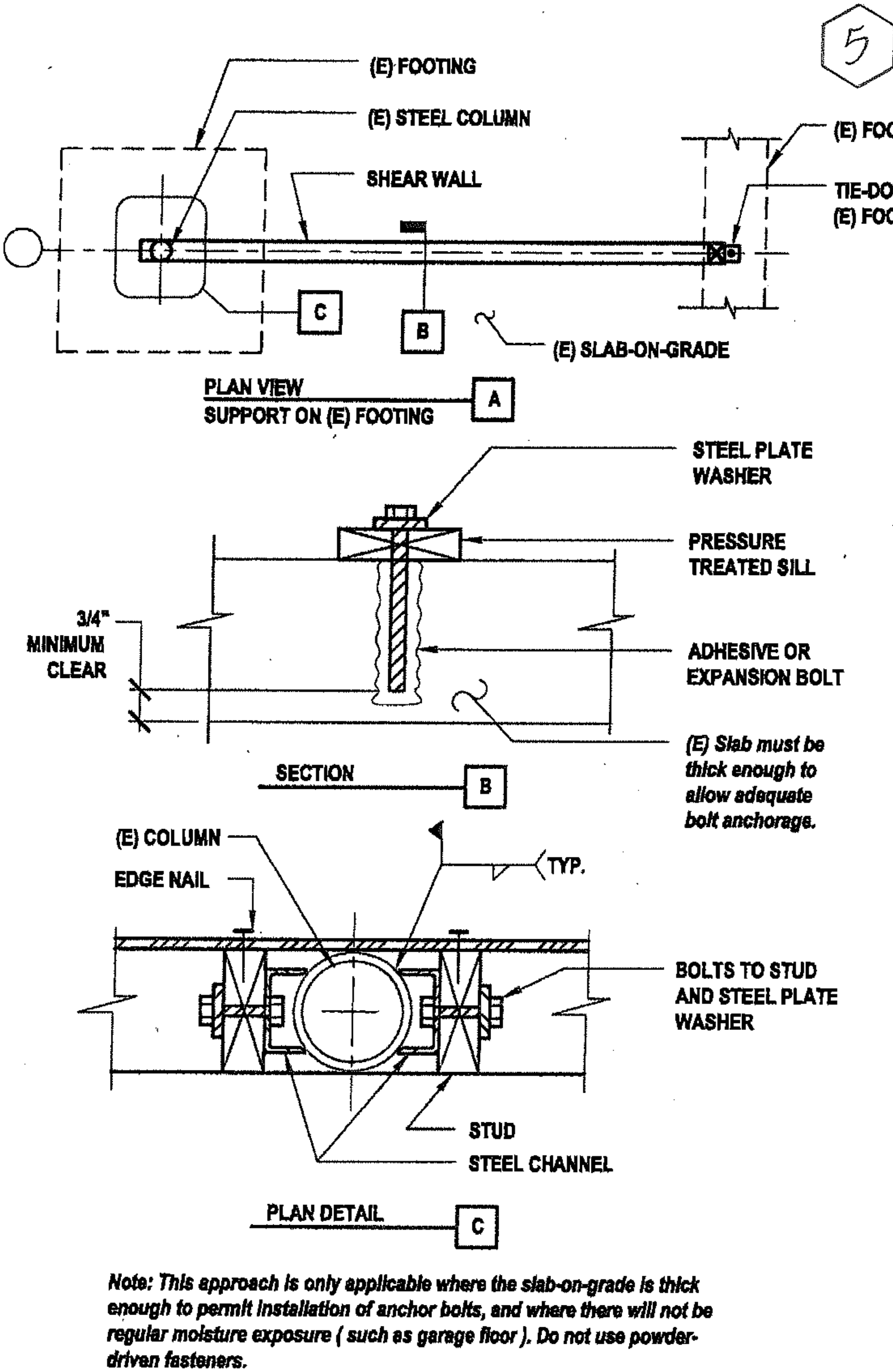


Figure 6.4.2-1: Added Shear Wall Supported on Existing Foundation and Slab

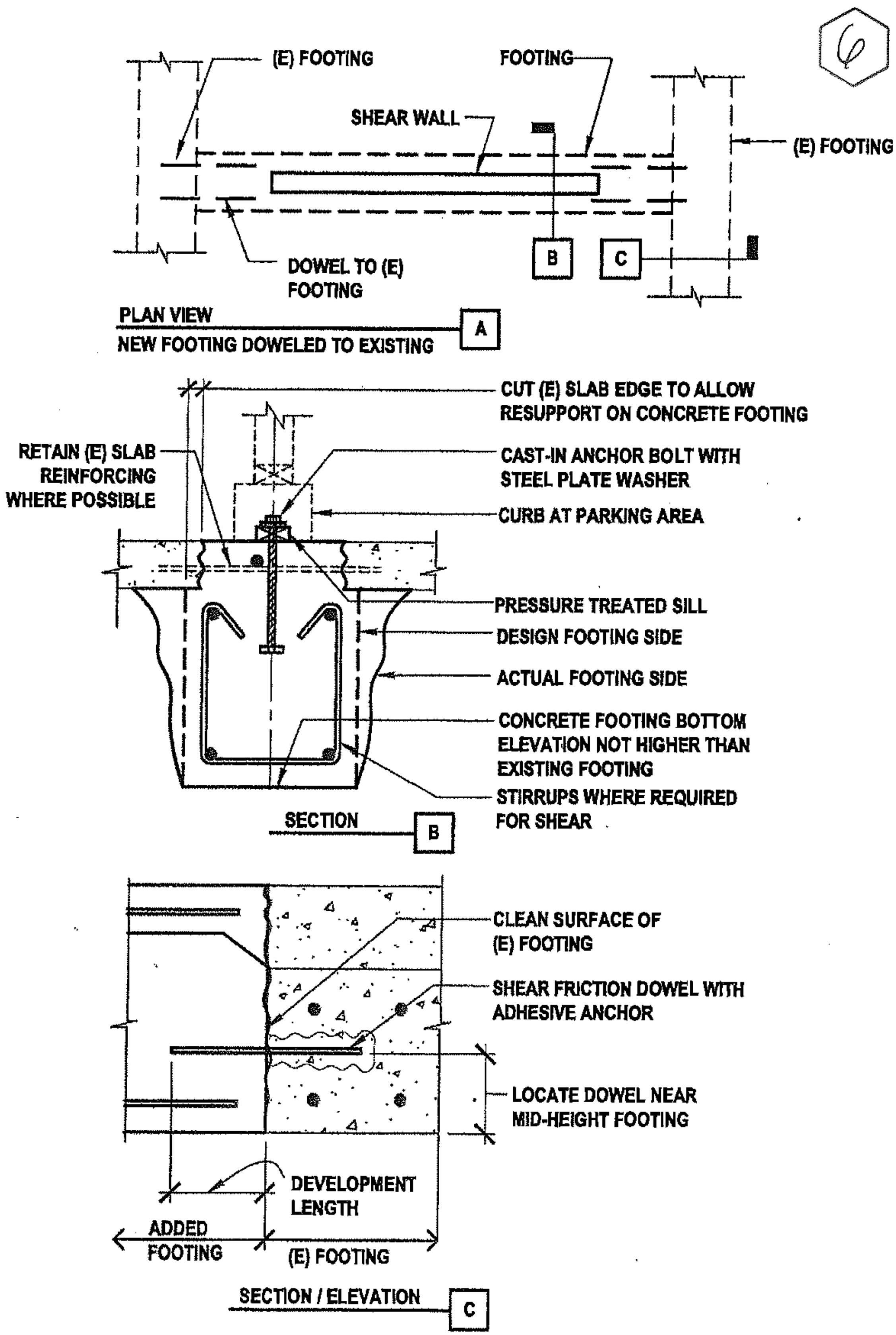
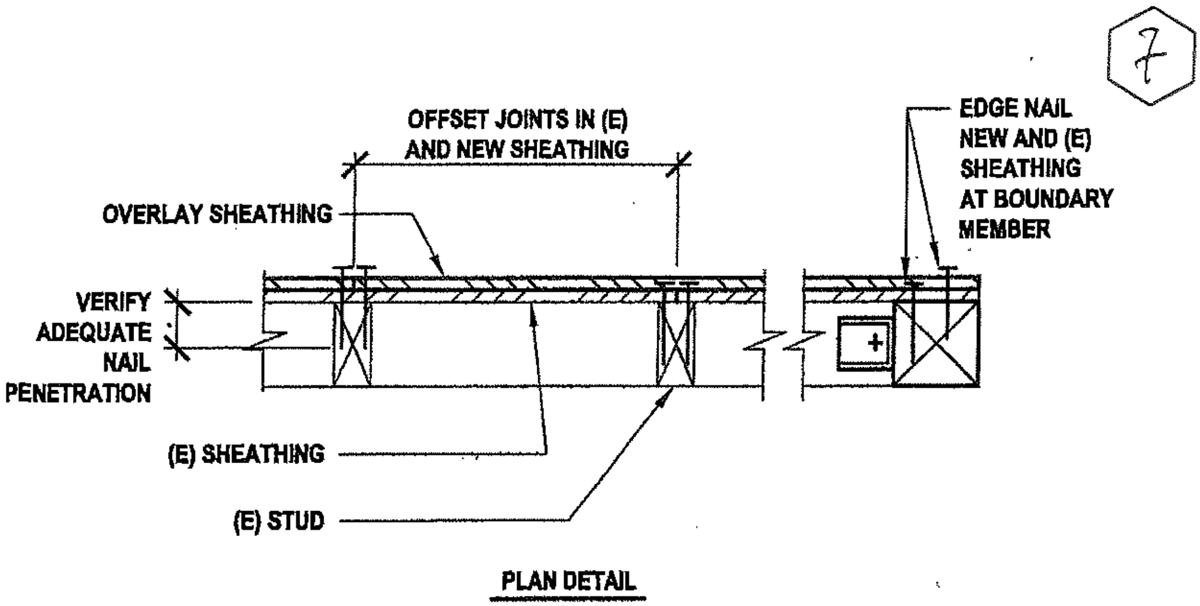


Figure 6.4.2-2: Added Shear Wall Supported by New and Existing Footings



Note: See design considerations for cautions in use of overlays.

Figure 6.4.2-5: Enhanced Shear Wall With Sheathing Overlay

strengths. At the left hand side, the existing column connection to the foundation needs to be capable of picking up the footing and surrounding slab. In Figure 6.4.2-2, the new footing needs to be specifically designed for the loading; use of a typical footing section and reinforcing may not be adequate. The existing footings need to be checked for capacity to mobilize overturning resistance and to distribute downward reactions to the supporting soils. At the interface between the new and existing footings, vertical uplift and downward reactions are generally transferred through rebar doweling. Generally this is designed as a shear-friction connection, with the face of the existing footing cleaned; roughening the concrete surface to reduce the μ factor below 1.0 is seldom practical, so a μ of 1 is generally used in design. In order to develop shear friction, the yield strength of the reinforcing needs to be developed on either side of the interface. Embedment depths to develop the reinforcing are generally available from the adhesive anchor manufacturer. If dowels are installed too close to the top or bottom of the footing, spalling can occur. Locating dowels near the center of the footing height reduces avoids spalling issues.

Stapled shear walls: Use of stapled fastening of shear wall sheathing has been studied as a desirable approach to enhancement of existing shear walls for rehabilitation. Testing by Zacher and Gray (1985) found that use of staples avoided splitting of the framing members, making it possible to achieve higher capacities without adding in 3x studs at abutting panel edges. Stapled shear walls tested Pardoen, et al. (2003) show behavior indistinguishable from equivalent nailed shear walls. Testing of stapled connections by Fonseca et al., (2002) shows adequate load and deflection behavior, suggesting them to be equally acceptable. All of the staples tested eventually experienced fatigue failure, but this was after significantly more cycles than required by the loading protocol. When staples are being used to increase the capacity of existing shear walls, enough staples should be provided to carry the entire design shear. This is because the load-deflection behavior of the staples can be expected to be different than existing nails due to the

8

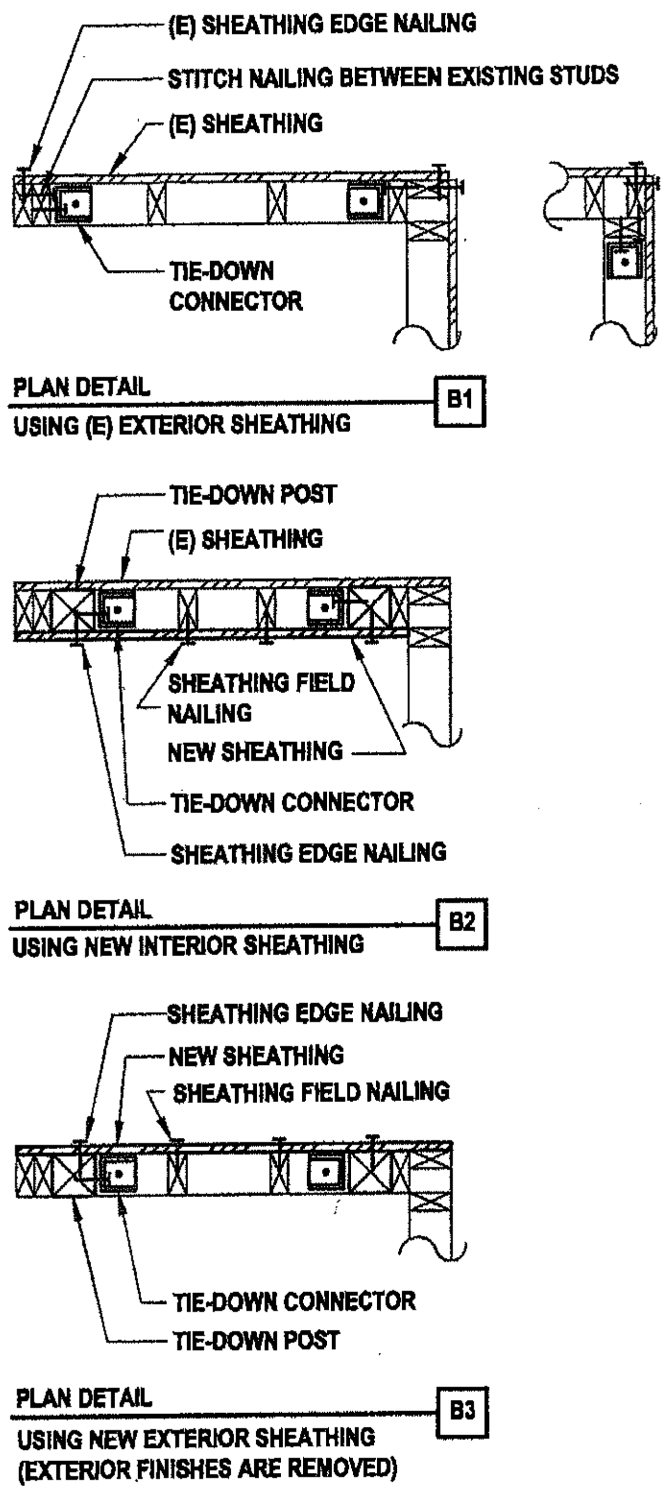
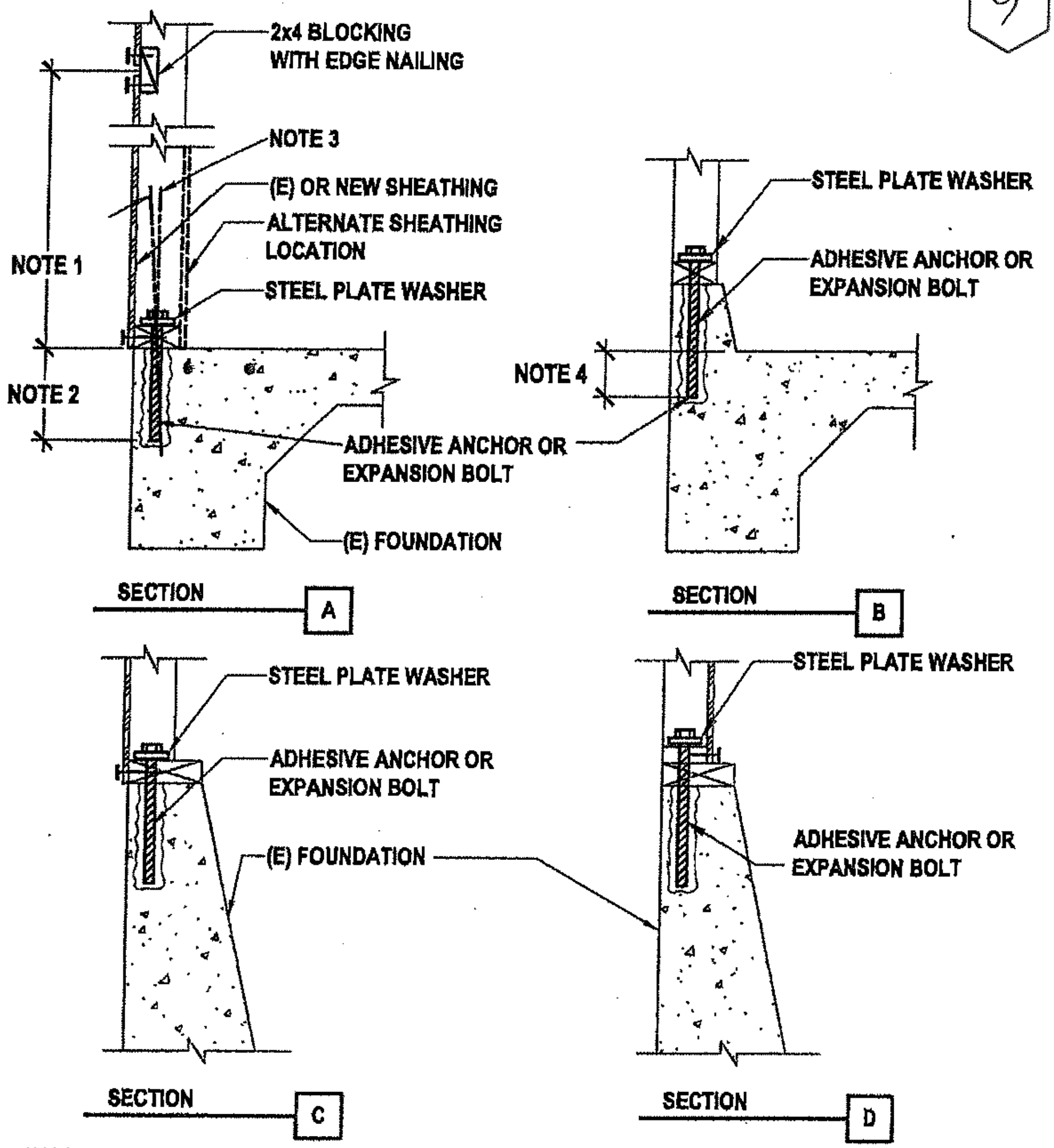


Figure 6.4.4-1B: Framing Fastening for Overturning Load Path

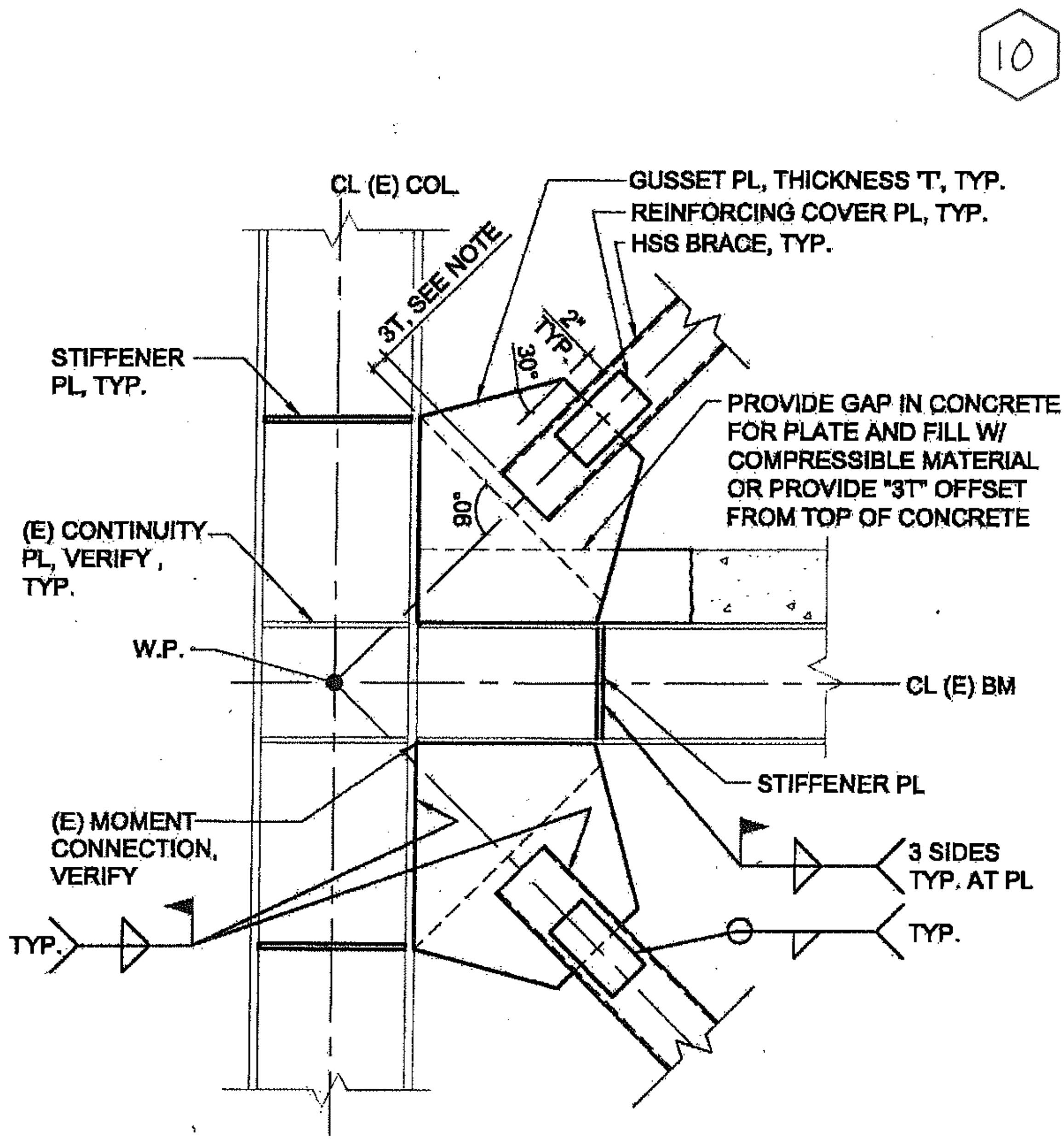
9



NOTES:

1. A height of 2 or 3 feet is required for rotohammer access to drill anchor bolt holes. Existing sheathing may need to be opened up to provide this access. Block and edge nail all panel edges when replacing sheathing.
2. Specify depth for adhesive anchor embedment into existing concrete.
3. It is acceptable to install anchor bolts at a small angle to vertical provided that concrete cover over the bolt is maintained and that full bearing between the steel plate washers and foundation sill plate is maintained.
4. Where concrete curb length is short, extend anchor bolt below top of slab.

Figure 5.4.3-1: Added Anchor Bolt at Existing Concrete Foundation



Note:
AISC recommends 2T to allow for restraint-free plastic rotations.
3T is shown here to accomodate overcutting of HSS slots.

Figure 8.4.1-1: HSS Brace at Existing Beam-Column Connection in SCBF

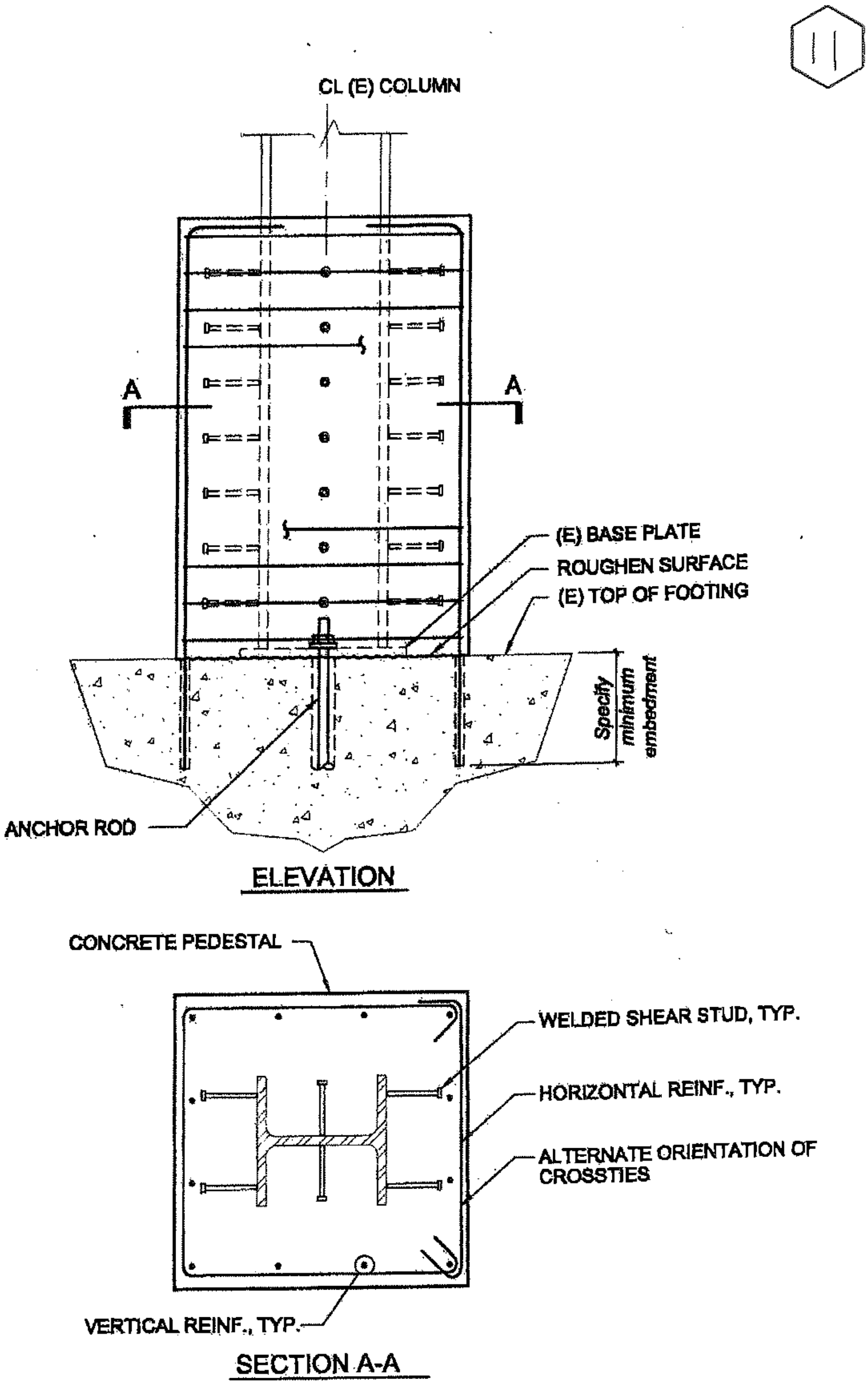


Figure 8.4.5-2: Concrete Pedestal at Existing Column

12

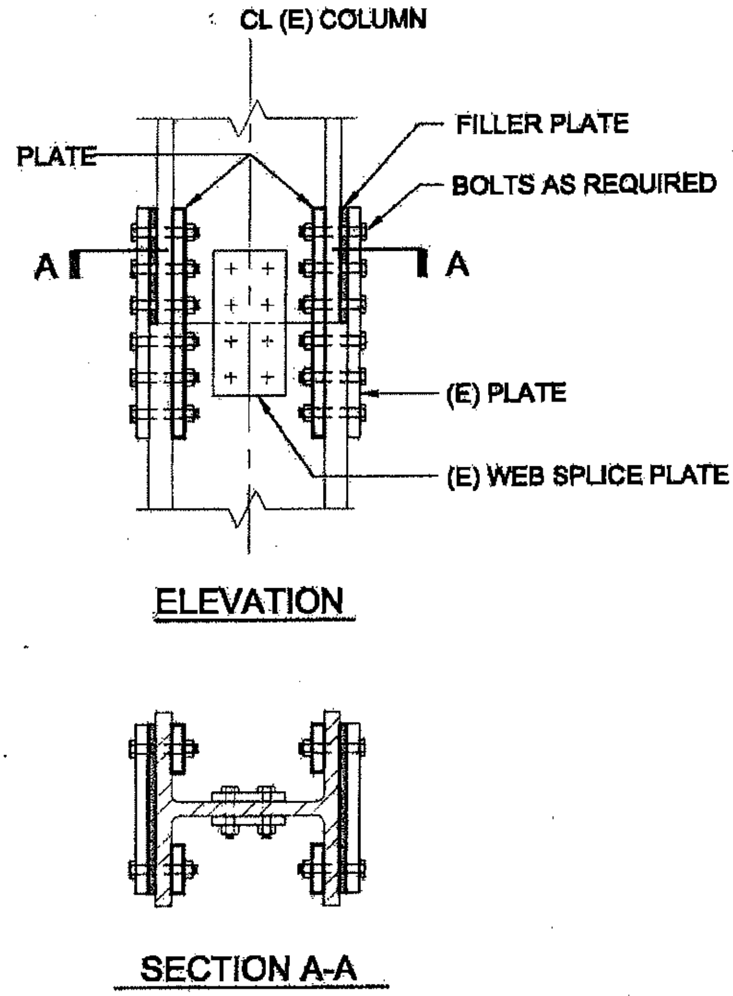


Figure 8.4.7-2: Bolted Splice Upgrade at Existing Column

Removal of existing structural elements: Due to the critical nature of columns, the removal of existing welds or bolts at a column should be minimized. Column alignment and stability should be maintained at all times.

Construction loads: See general discussion in Section 8.4.1. Typically, welding on a loaded column should not create a safety issue, although stability during construction should always be considered. At a minimum, see section in *AISC Steel Construction Manual* (2005c) on column splices and the *AISC Code of Standard Practice for Steel Buildings and Bridges* (AISC, 2005a) for other construction considerations.

Proprietary Concerns

There are no known proprietary concerns with this technique.

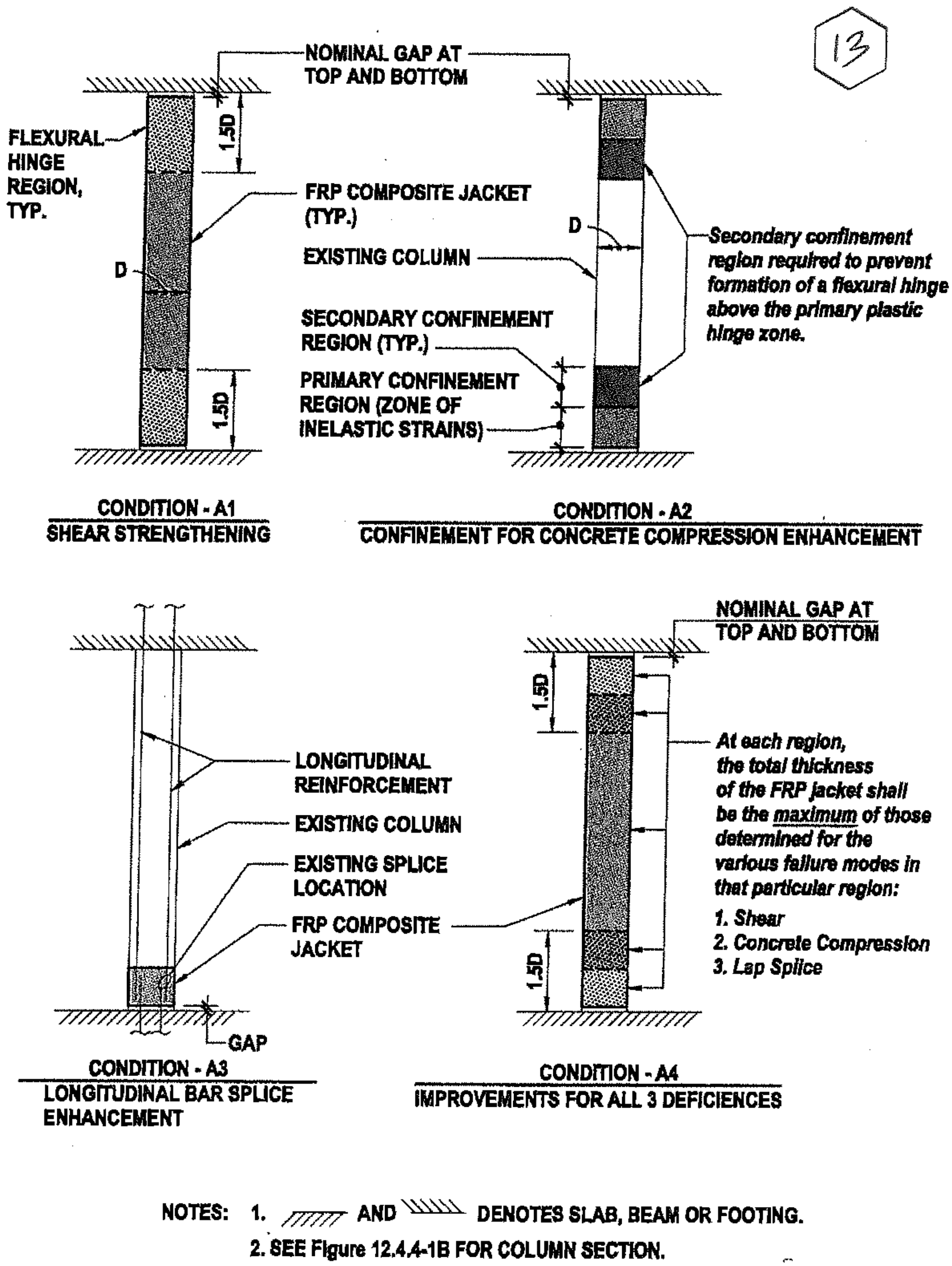


Figure 12.4.4-1A: Seismic Retrofit of Columns Using FRP Composites

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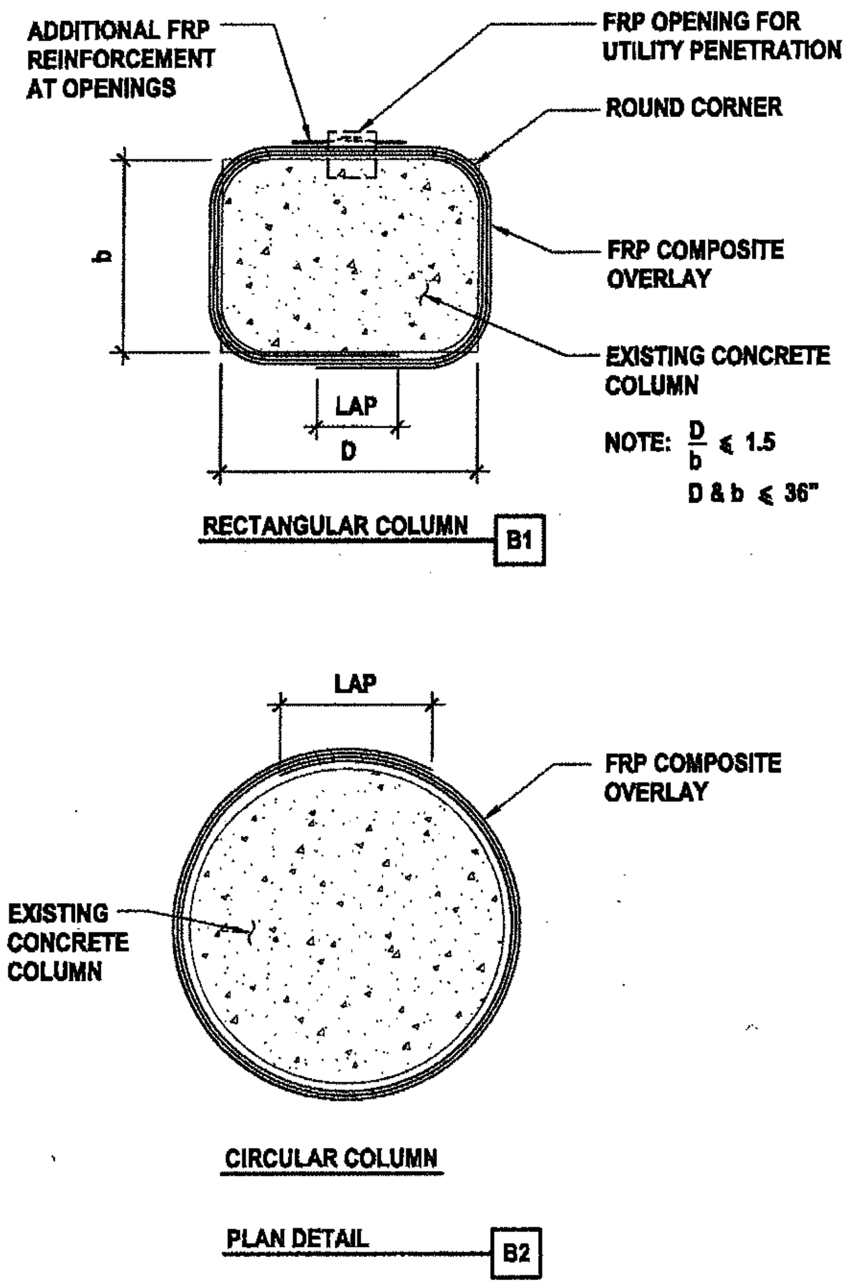

Figure 12.4.4-1B: Seismic Retrofit of Columns Using FRP Composites

aggregate interlock over the crack length. This contribution is a by-product of the hoop tension required for the confinement, so FRP composite thickness for shear need not be added to that required for confinement.

With successful mitigation of the three deficiencies, column flexural hinges can be developed and deformation capacity will be increased.

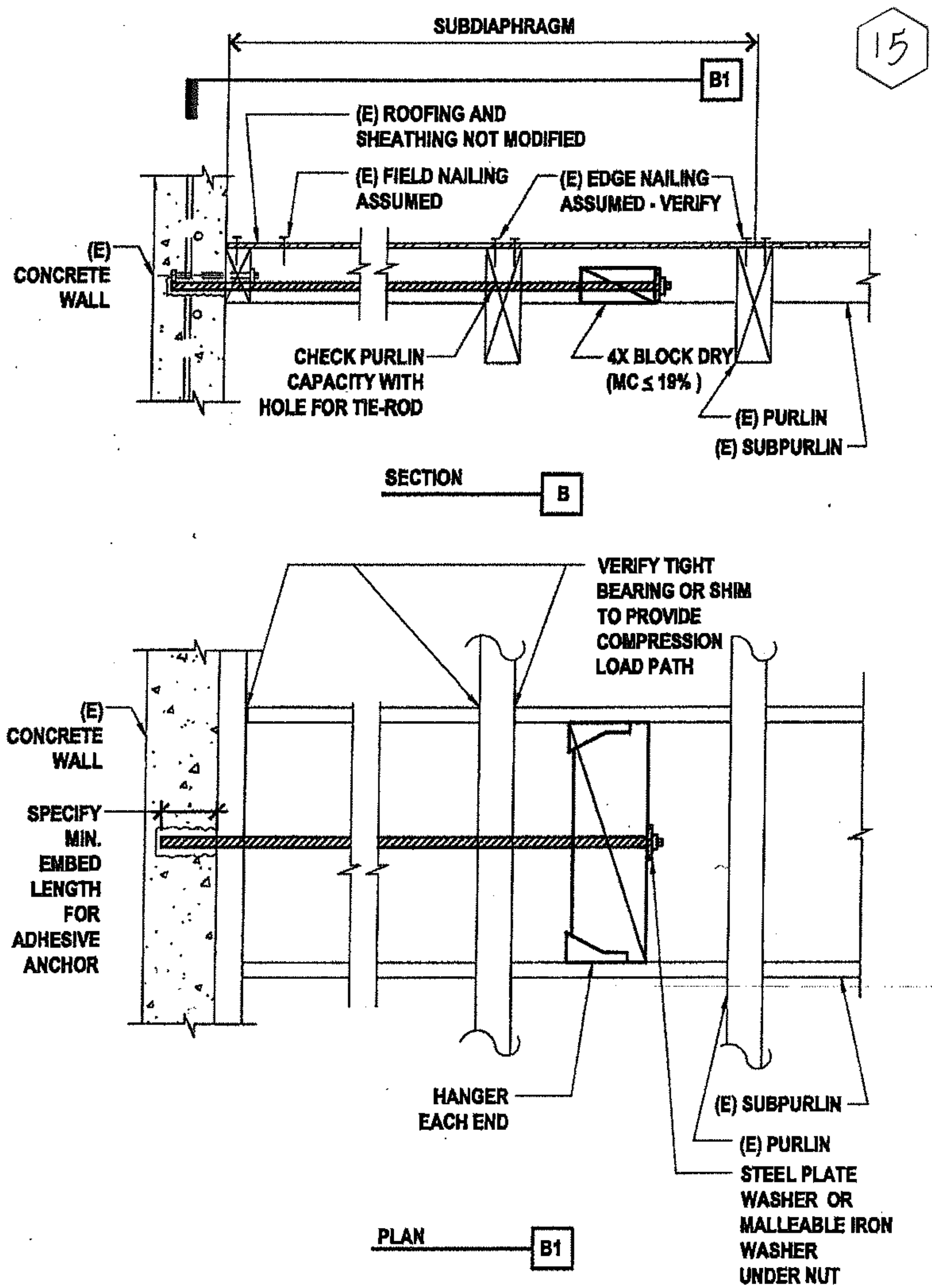

Figure 16.4.1-1B: Wall Out-of-Plane Anchorage for Flexible Wood Diaphragm at Subpurlins – Roofing Not Removed

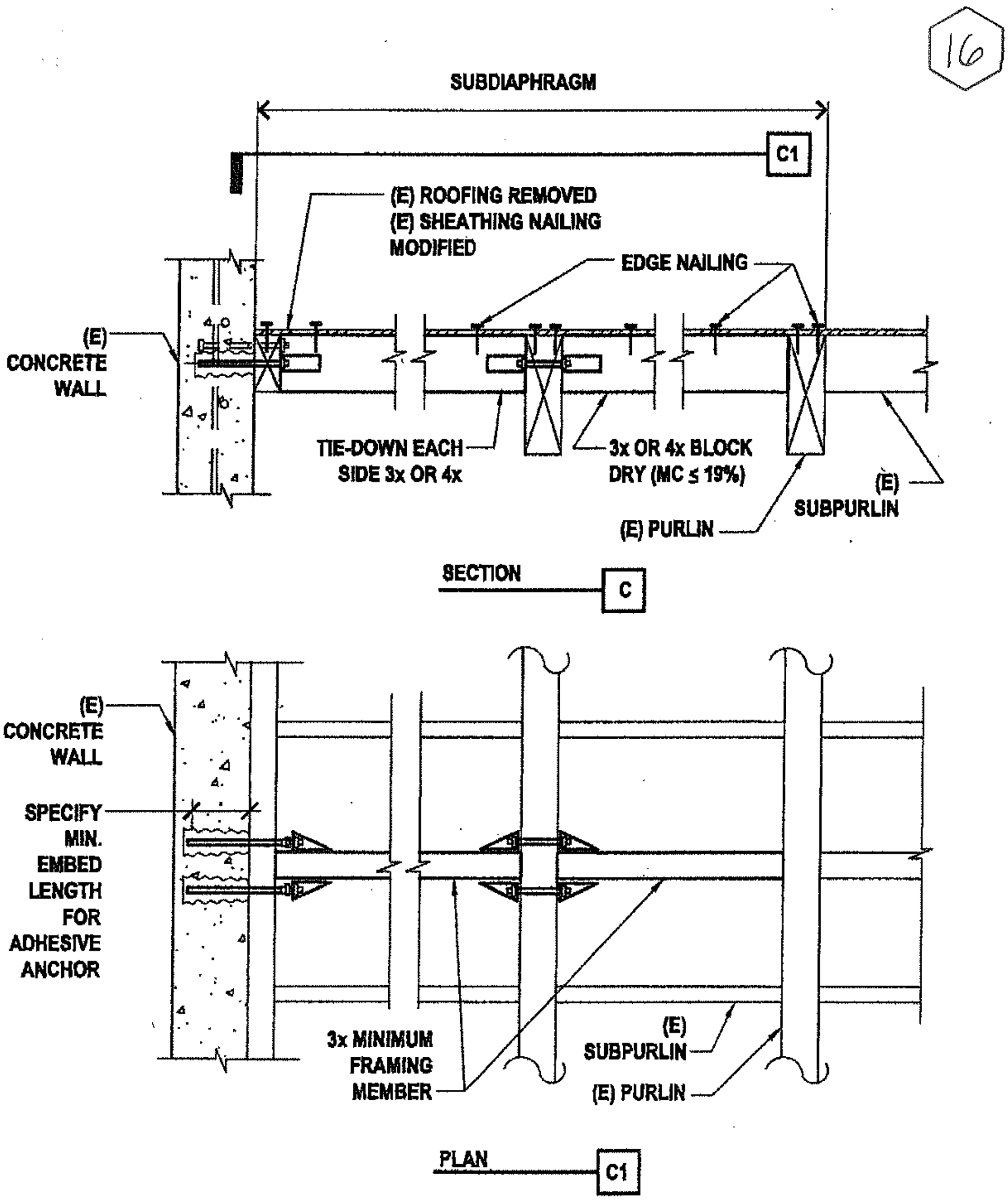

Figure 16.4.1-1C: Wall Out-of-Plane Anchorage for Flexible Wood Diaphragm at Subpurlins – Roofing Removed

Figure 16.4.1-1D illustrates anchorage of the north and south walls to a purlin. In this case, the purlin is long enough to extend across the subdiaphragm width (extending between Lines 1-2 and 3-4), so additional pairs of tie-downs are not needed. As is previous details, both tension and compression load paths must be maintained.

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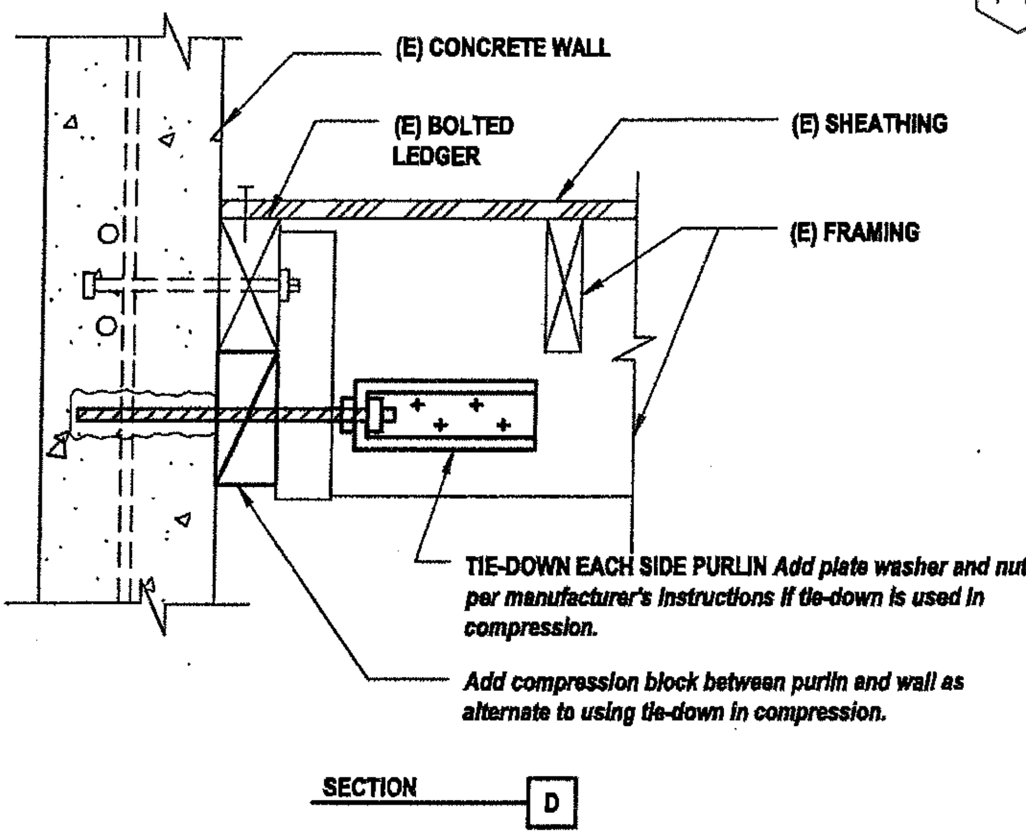

Figure 16.4.1-1D: Wall Out-of-Plane Anchorage for Flexible Wood Diaphragm at Purlins

Figure 16.4.1-2A illustrates a similar roof plan for a **PC1** building with a steel deck diaphragm. It is important to note in this figure that subdiaphragms (as shown in Figure 16.4.1-1A) are not used. Instead, the steel deck provides a continuous cross-tie in the east-west direction, while in the north-south direction open web joists provide direct cross-ties across the entire diaphragm width at each wall anchor location. This is the primary approach used in new steel deck diaphragm construction. Subdiaphragm concepts can be applied to steel deck construction, but are not common.

Figures 16.4.1-2B and 16.4.1-2C provide wall to diaphragm anchorage details. In Figure 16.4.1-2B, wall anchorage forces are transmitted to the steel deck. The deck section, deck edge fastening, and deck end splices need to be checked for wall anchorage tension and compression forces. Justification of the capacity may be by calculation or testing. The balance of the load path also needs to be checked and enhanced as required. In the detail shown, supplemental adhesive

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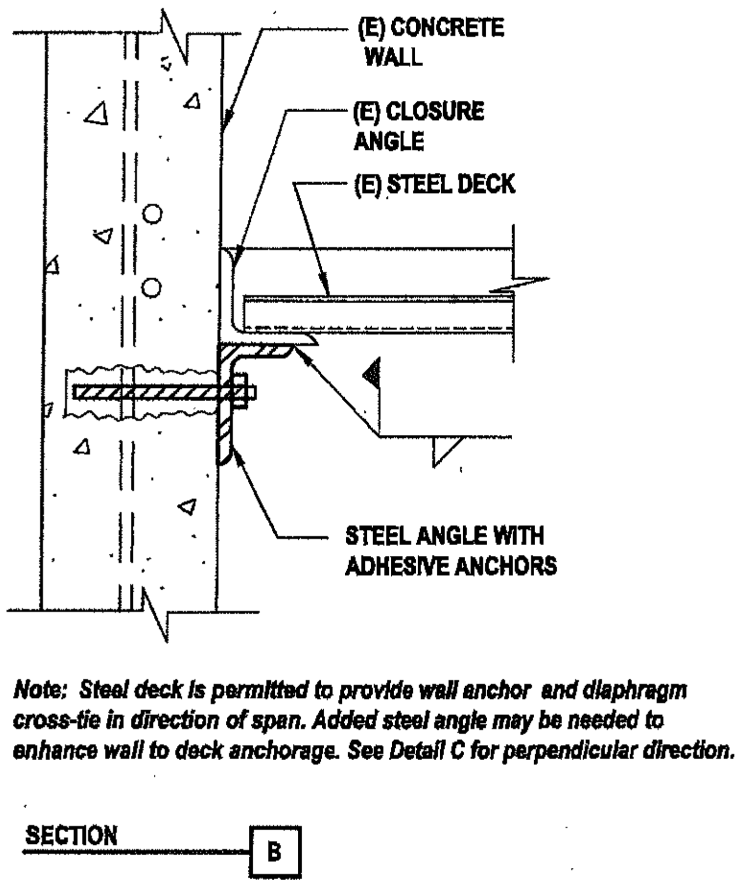

Figure 16.4.1-2B: Wall Out-of-Plane Anchorage for Flexible Steel Diaphragm – to Decking for Load Parallel to Flutes

Design and Detailing Considerations

Research basis: No research applicable to the performance or adequacy of enhanced anchorage methods has been identified; however, the demands created in flexible diaphragms have been studied by Fonseca, Wood and Hawkins (1996); Hamburger and McCormick (1994); Ghosh and Dowty (2000); and Freeman, Searer, and Gilmartin (2002).

As discussed in Section 16.1, even wall anchorages constructed or rehabilitated in the 1980s and early 1990s were observed to have been damaged in the 1994 Northridge earthquake. The reader is referred to the extensive discussion in the *SEAONC Guidelines* for design and detailing considerations and lessons learned.

Anchor type and installation: A variety of proprietary anchors are available for anchorage to existing concrete walls. Both manufacturer literature and ICC Evaluation Service reports should be consulted for information on conditions of use, allowable loads, and installation and inspection requirements. It is important to make sure that the anchor type is appropriate for the material to which it will be connected and is approved for seismic loads. The diameter of drilled holes is specified in installation requirements for each anchor type; variation from this size often

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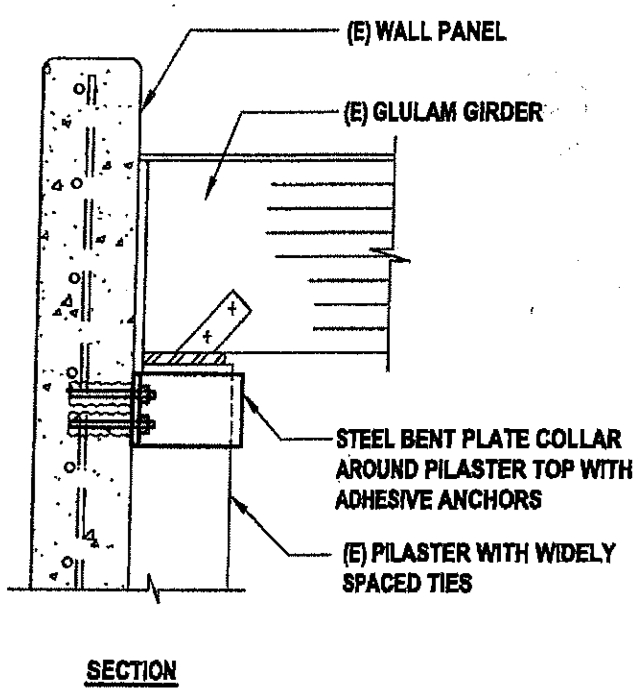

Figure 16.4.2-1: Enhanced Girder Connection – Collar at Pilaster
Adapted From SEAONC (2001)

Girders that are supported directly on a flat wall panel using a steel U-bracket bolted or welded to the panel (Figure 16.4.2-3) will also attract wall out-of-plane forces. As is true with wall pilasters, a girder and U-bracket are likely to provide a stiffer load path for wall out-of-plane loads than adjacent anchors. For this reason, use of a wall anchorage force greater than used for adjacent anchors is encouraged. The girder connection should have the ability to resist wall anchorage loads in combination with gravity loads. Anchorage of the bracket to the panel will often be adequate for both gravity and lateral loads; however, the bracket attachment to a wood girder will often not have the quantity or placement of bolts required for tension loads. Addition of steel tabs and bolts will add capacity and place bolts where end distances are adequate for tension loads. Where the steel connection to the concrete is not adequate, the out-of-plane anchor might bypass the existing connection and connect the girder directly to the wall. Figure 16.4.2-2 shows two approaches, one with a tie-down on each side of the girder and a second with a tie-down on the girder bottom. The out-of-plane wall anchor should be as stiff as possible to minimize damage to the gravity connection.

Design and Detailing Considerations

Research basis: No research applicable to this rehabilitation measure has been identified.

See Section 16.4.1 wall anchorage and the *SEAONC Guidelines* for additional detailed discussion.

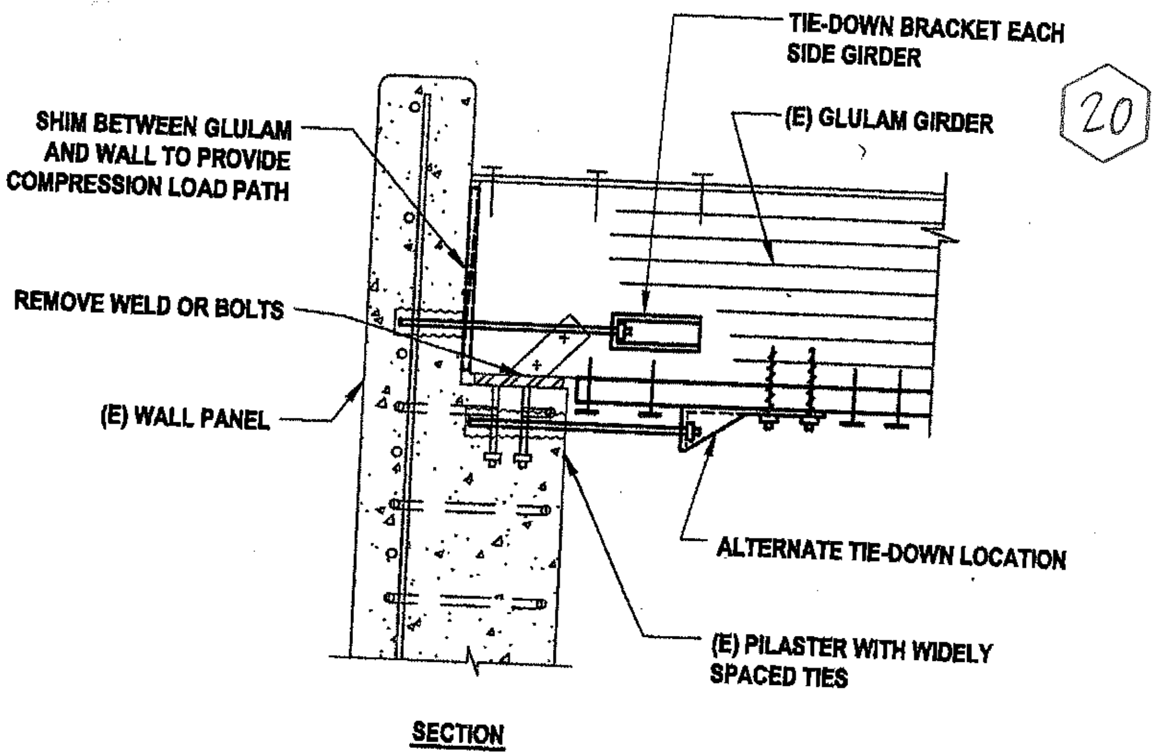

Figure 16.4.2-3: Enhanced Girder Connection at Pilaster
Adapted From SEAONC (2001)

Variations in base conditions include 1) older **PC1** buildings that may not have any doweling because friction was relied on to resist forces at the base of the panel and 2) welded connections between cast-in embeds in the wall panel and slab, similar to PC2 wall panel connections.

Design and Detailing Considerations

Research basis: No research applicable to this rehabilitation technique has been identified.

The *SEAONC Guidelines* provide discussion of a variety of possible existing conditions, changes in code requirements, and implications for retrofit.

Proprietary Concerns

There are no proprietary concerns with this rehabilitation technique, other than the use of proprietary adhesive anchors as part of the assemblage.

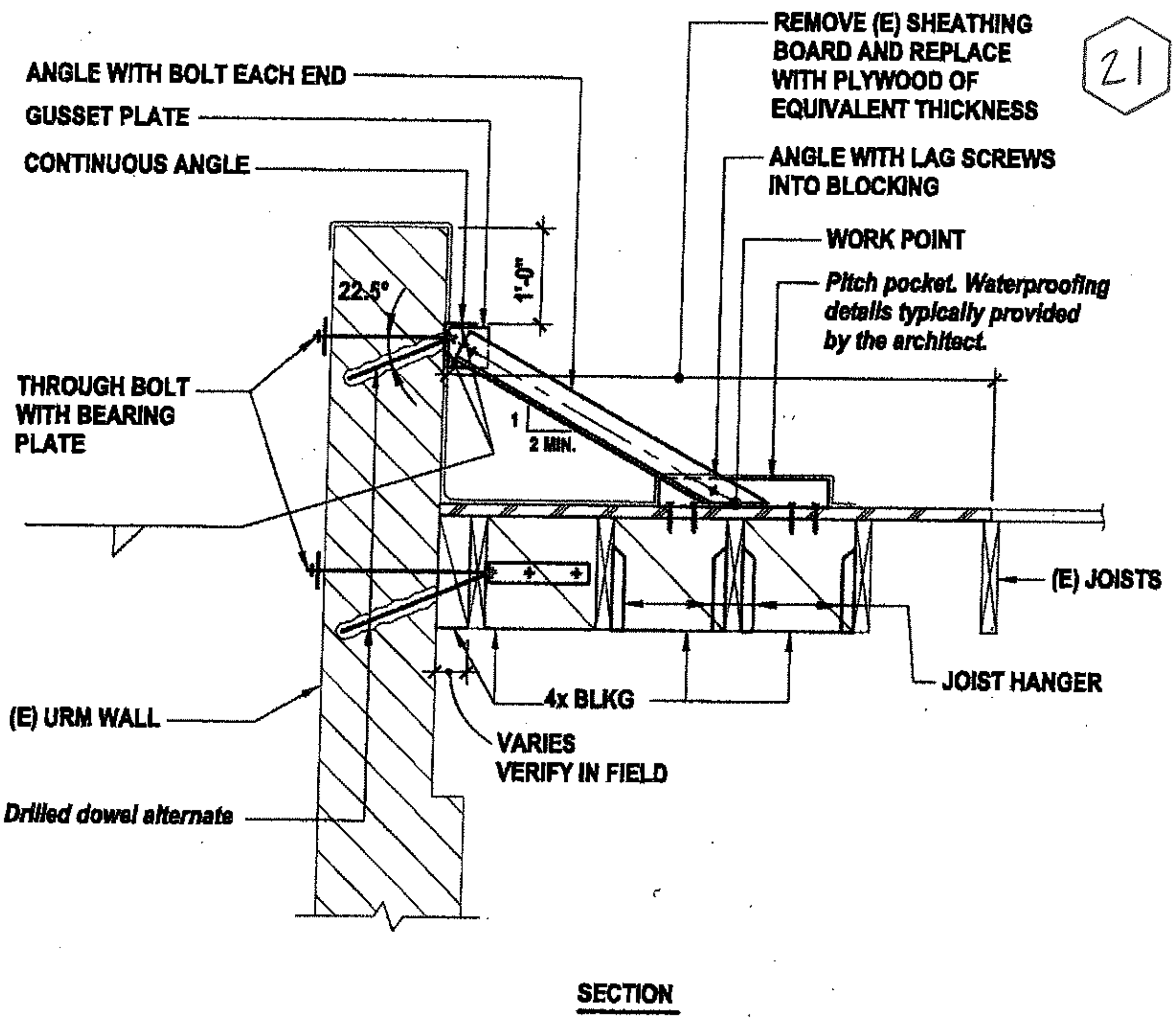

Figure 21.4.1-1: Parapet Bracing

Detailing and Construction Considerations

Parapet anchorage types: Drilled dowels connecting the top of the bracing to the masonry can be with through bolts or adhesive anchors. See Section 21.4.2 for detailed discussion of drilled dowels.

Top angle: Figure 21.4.1-1 shows a continuous angle running between braces in the roof. This angle can be used to span between braces to reduce the number of bracing points. It also increases redundancy over a localized connection of the brace to the parapet.

Load in the roof framing: The vertical reactions at the base of the brace are typically resisted by roof framing. In Figure 21.4.1-1 the added blocking beneath the base of brace workpoint helps to engage three joists in resisting vertical loads. Tall parapets can generate substantial brace forces that existing wood roof joists may not be able to resist. Additional joists can be added, or more braces can be used to distribute the load. Horizontal loads from the brace are distributed by the blocking and new wood structural panel.

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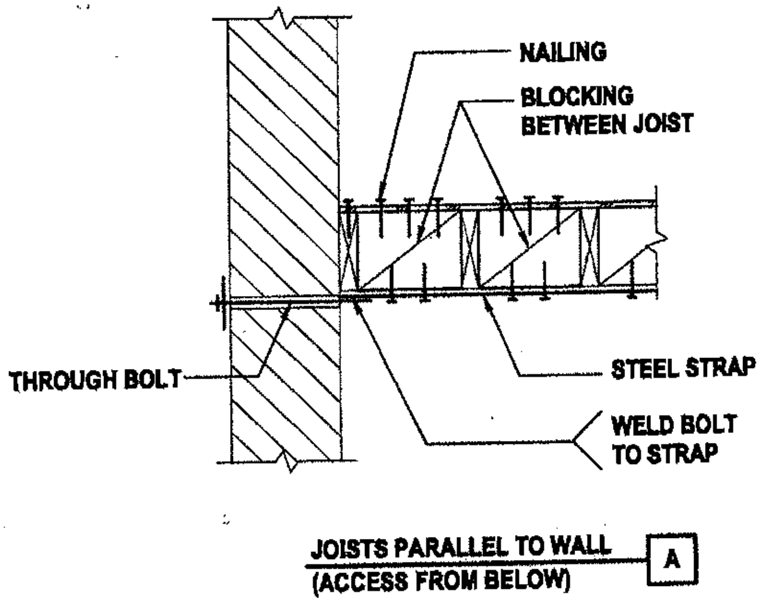

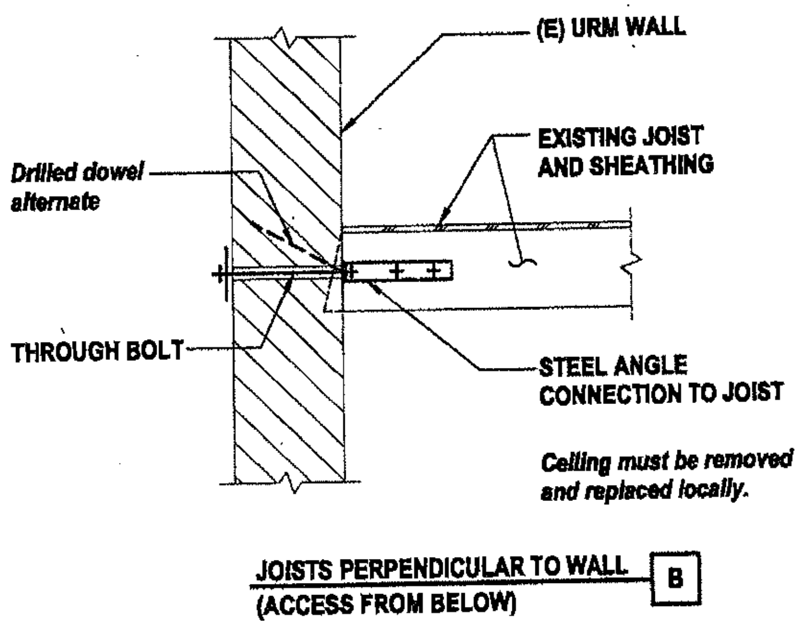

Figure 21.4.2-3: Tension Anchors Installed from Below the Floor

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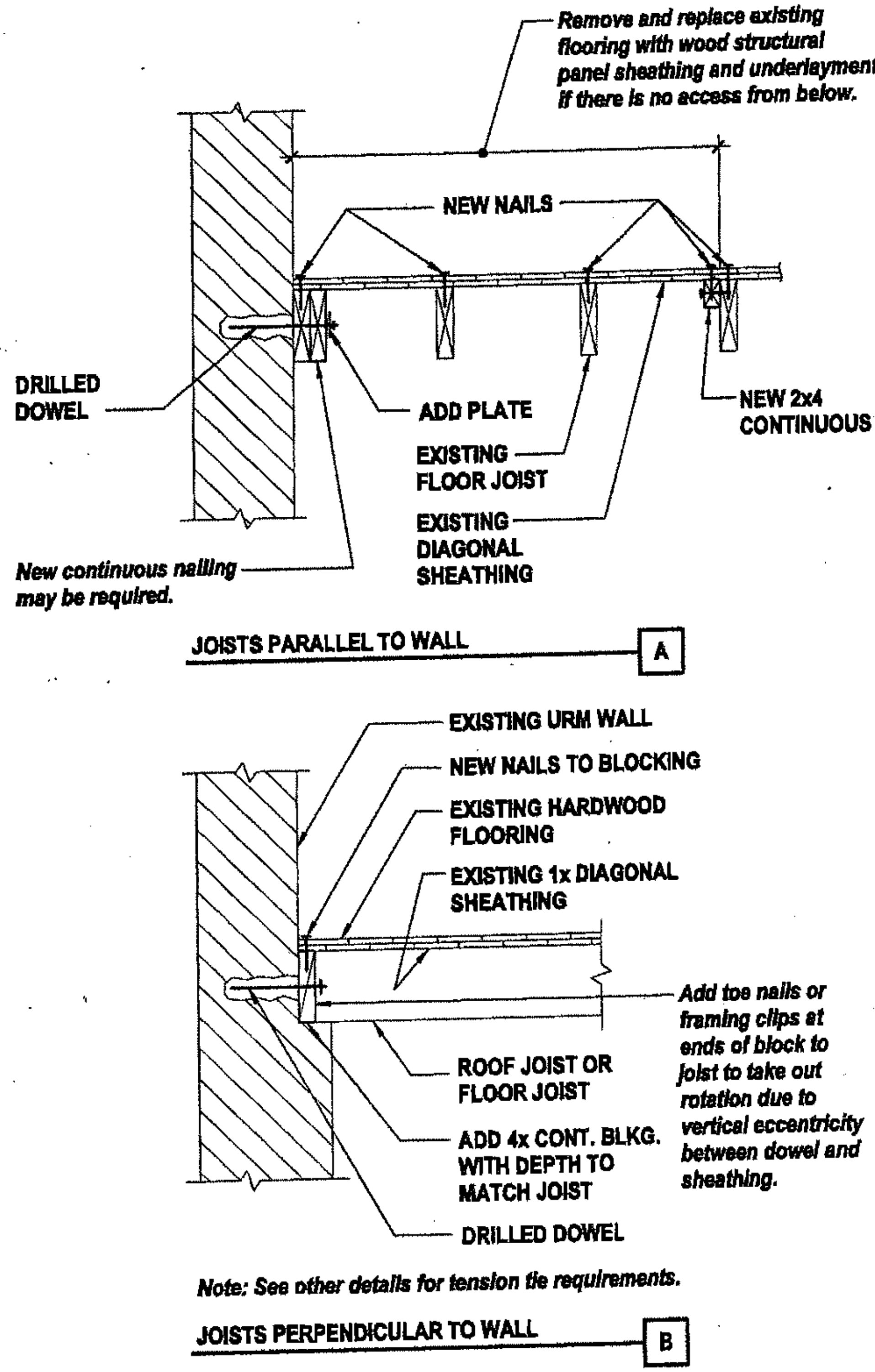

Figure 21.4.2-5: Floor-to-Wall Shear Anchors

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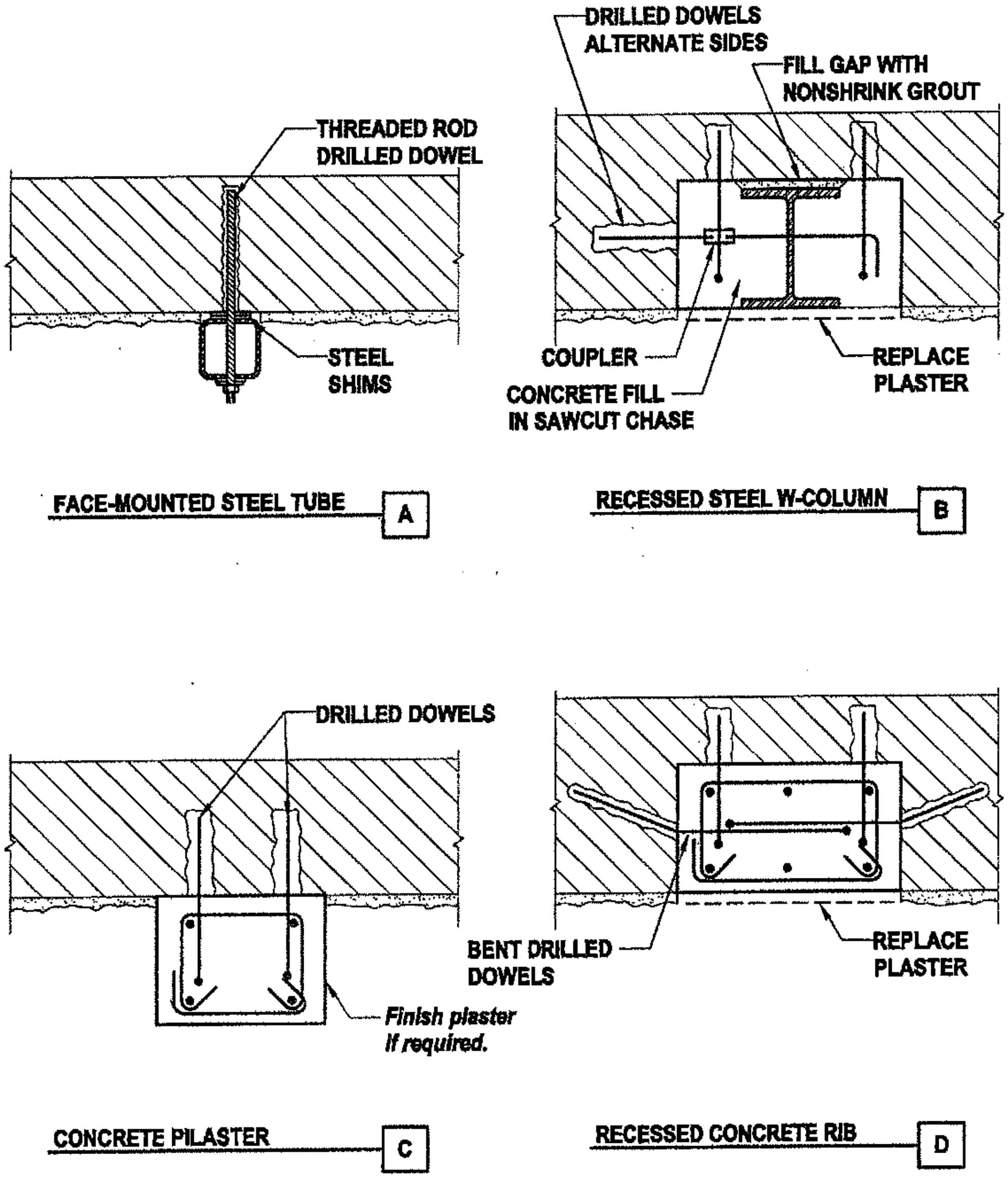

Figure 21.4.3-2: Vertical Bracing Alternatives

Recessed steel and concrete and surface-mounted concrete: Provisions in the 1997 UCBC and 2003 IEBC do not explicitly consider the approaches shown in Figures 21.4.3-2B, 21.4.3-2C and 21.4.3-2D. These approaches are unusual, but they can be used when a more sensitive aesthetic approach or higher loads are needed.

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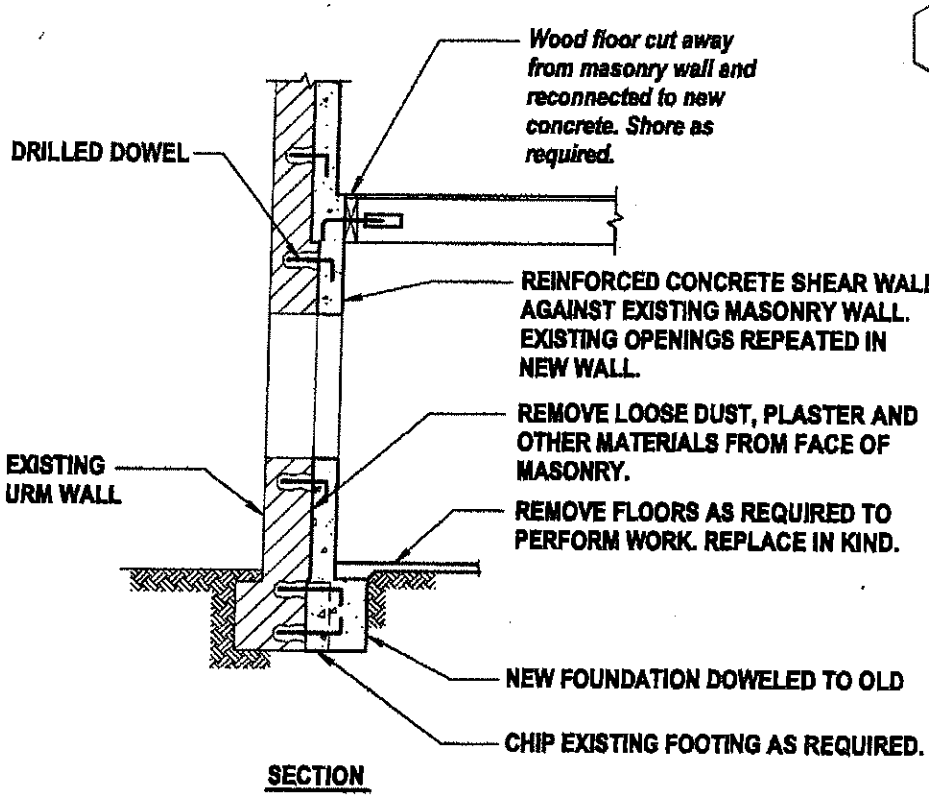

Figure 21.4.5-1: Concrete or Shotcrete Wall Overlay

to significant improvements. A saturated masonry surface was recommended. Testing by Abrams and Lynch (2001) aimed at increasing the shear capacity to lead to flexural yielding of the tension bars in the shotcrete. Strength increased by about a factor of 3, but displacement capacity did not increase.

Design criteria: When a concrete overlay is used, there are several common force-based design approaches for the wall, due to the relatively high strength of the concrete compared to the masonry. One is to take 100% of the demand tributary to the strengthened wall line in the concrete overlay itself and ignore the masonry. While this may sound conservative, it can mean that the masonry will be significantly damaged before the concrete ever sees the majority of its design load. Another approach is to share the load, by relative rigidity, between the masonry and the concrete. When this is done, both the masonry and the concrete must be checked to confirm they are not overstressed. The most conservative approach is to use the overlay to resist 100% of the tributary load, but to also check that the masonry can resist the loads it will actually attract. Displacement-based design approaches inherently consider the relative rigidity of the concrete and masonry, but they are less commonly employed.

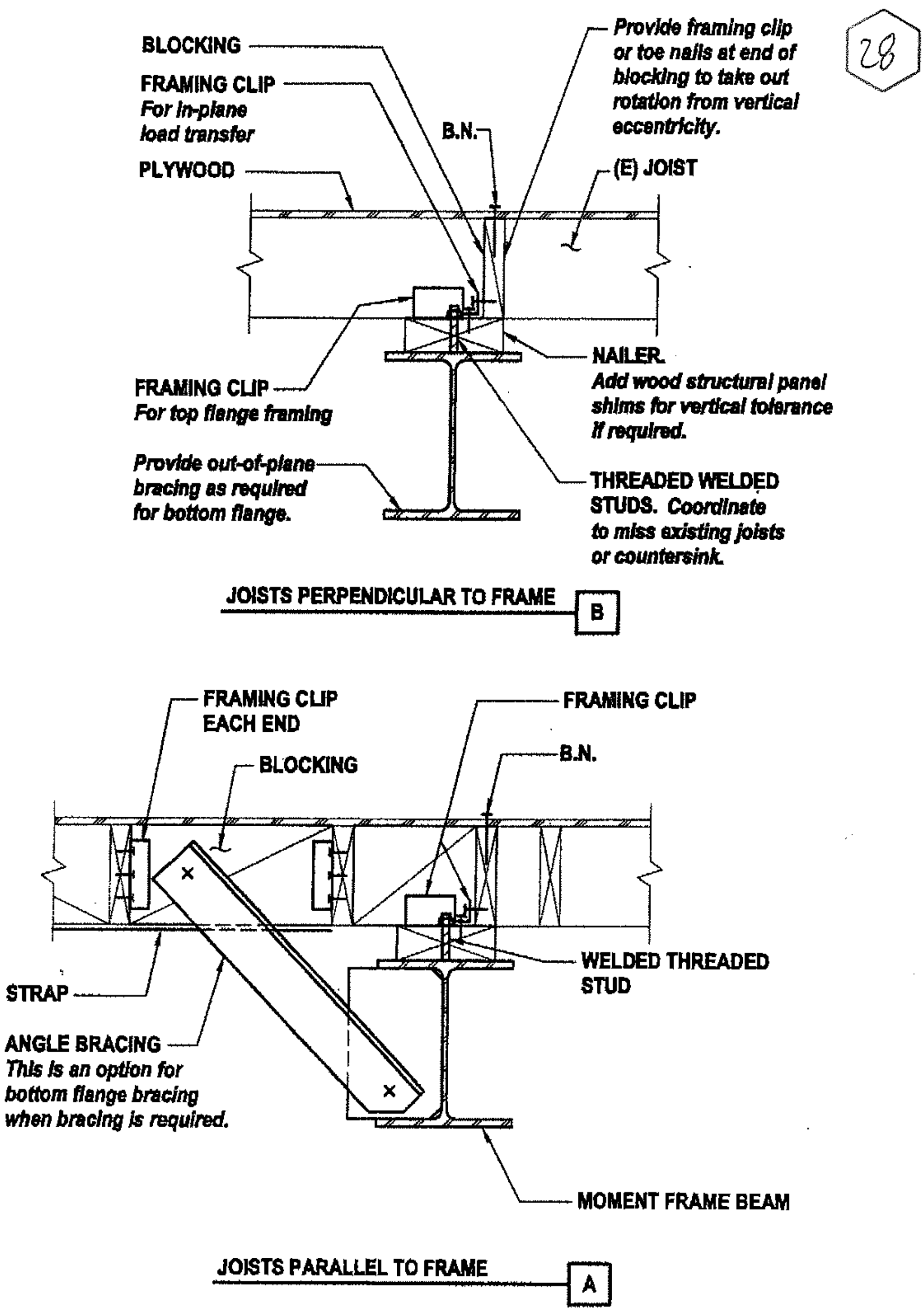

Figure 21.4.9-2: New Interior Steel Moment Frame to an Existing Wood Floor

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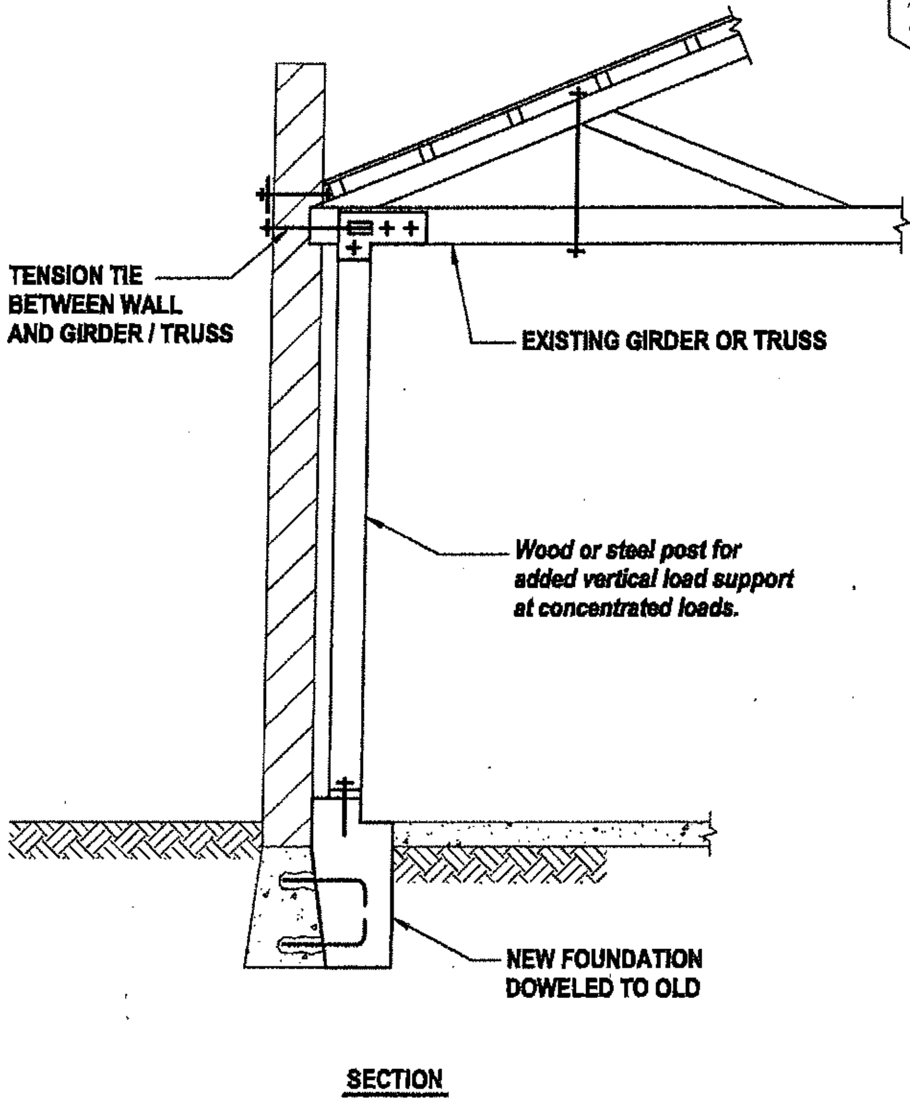

Figure 21.4.11-1: Supplemental Vertical Support

Cost/Disruption

The relative cost of adding supplemental supports depends on the number used, whether they continue down to the ground and whether a new foundation is installed. Interior occupants will be disrupted locally as the posts are installed, and the usable space in the vicinity of the posts will be reduced.

Proprietary Considerations

There are no known proprietary concerns with employing supplemental vertical supports.

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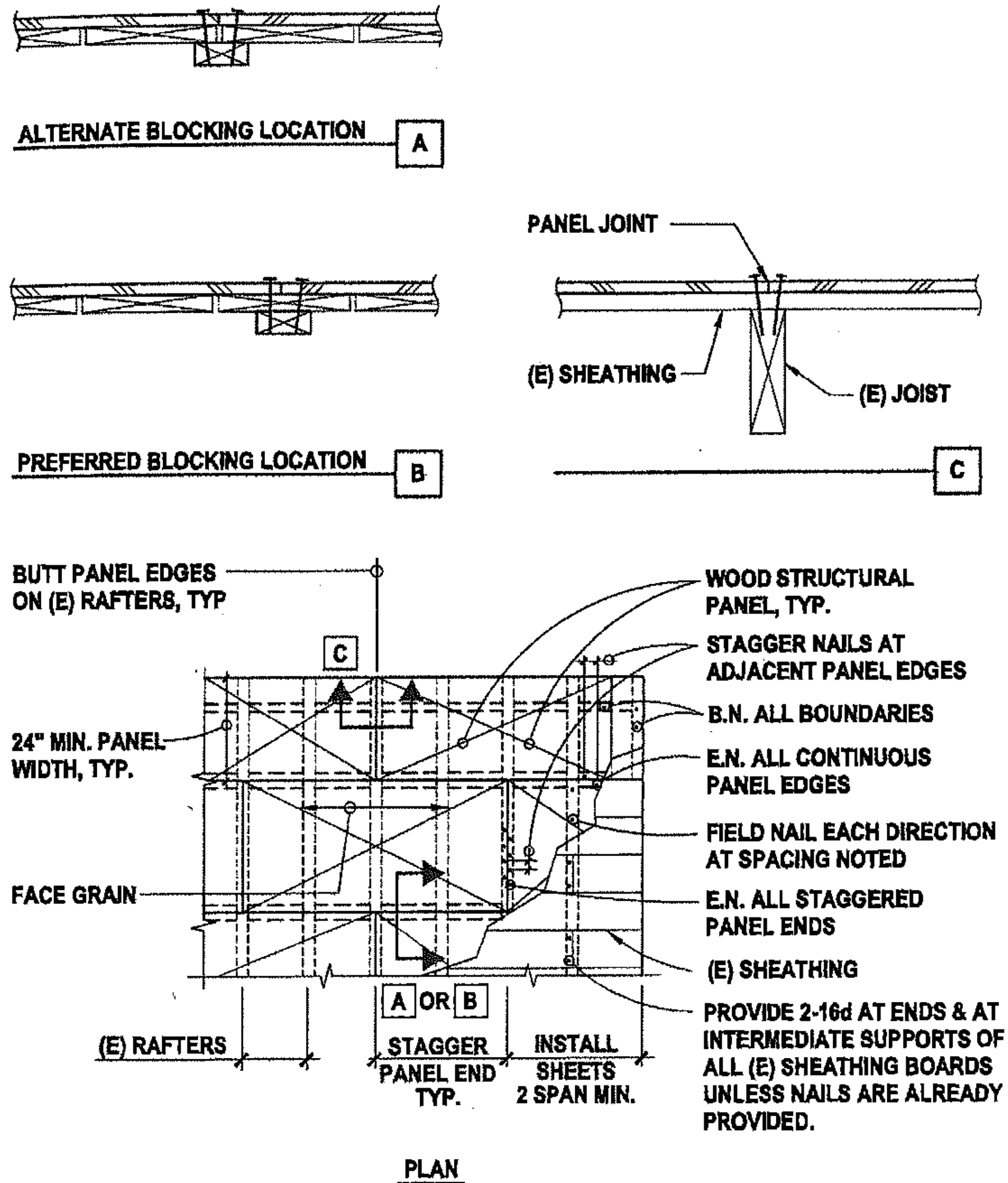

Figure 22.2.1-2: Wood Panel Overlay with Blocking Over Existing Sheathing

with the estimates, a reduced thickness and reduced lateral and buckling capacities of the pile can be calculated.

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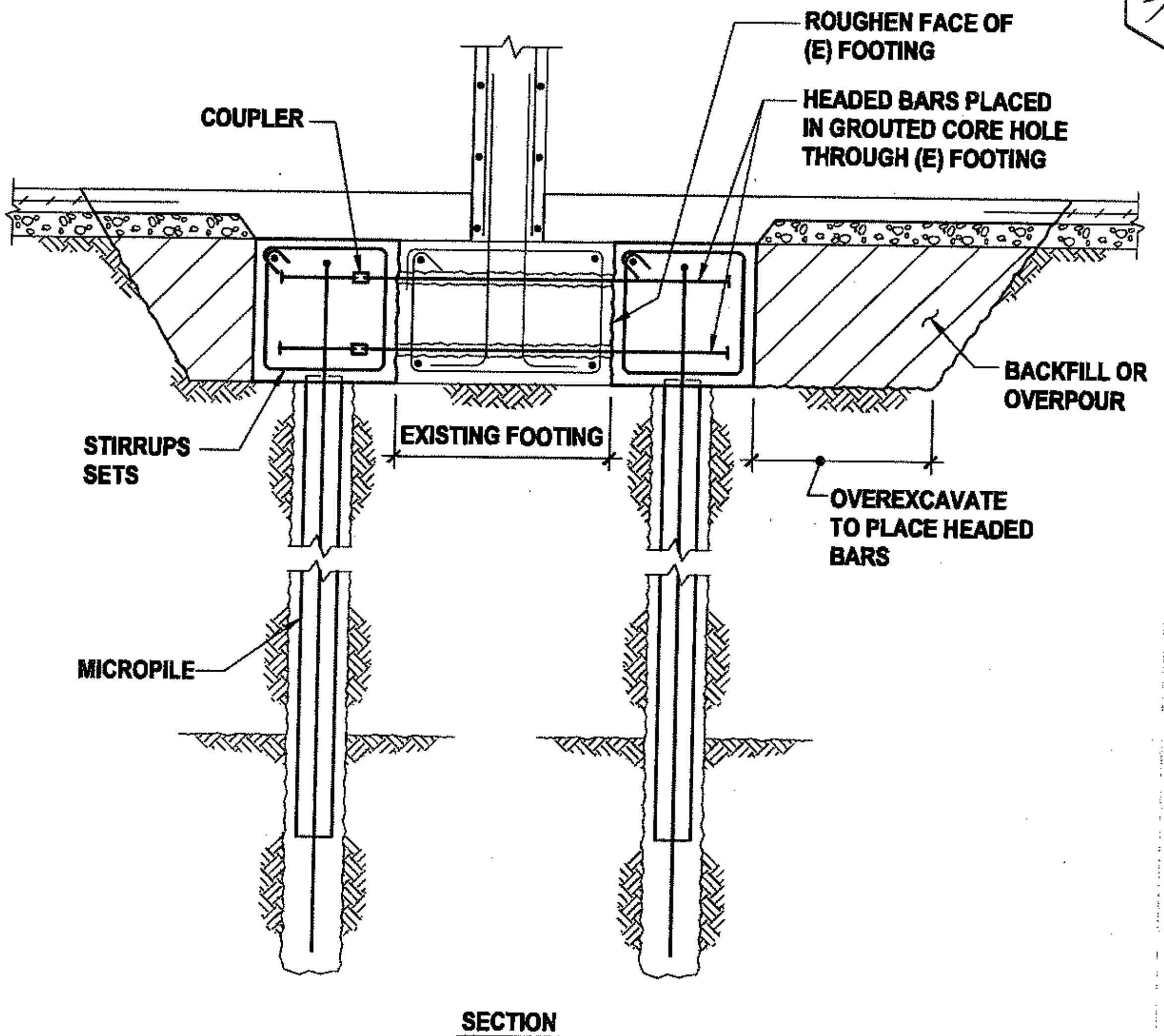

Figure 23.7.2.-1: Micropile Enhancement to Existing Strip Footing

Testing: Performance and proof load testing are performed at the start of and periodically during construction to verify that specified design capacities will be achieved. During performance testing, the test piles are usually loaded to 2.0 to 2.5 times the design load. Proof testing, on the other hand, involves testing the pile to 1.33 to 1.67 times the design load. Proof testing is usually limited to a percentage of the production piles. Creep tests are typically performed as part of the performance and proof tests, especially if the micropiles are to be bonded in clayey soils that are susceptible to creep. PTI (1996) provides guidelines on performing and evaluating performance, proof, and creep tests on foundation elements.

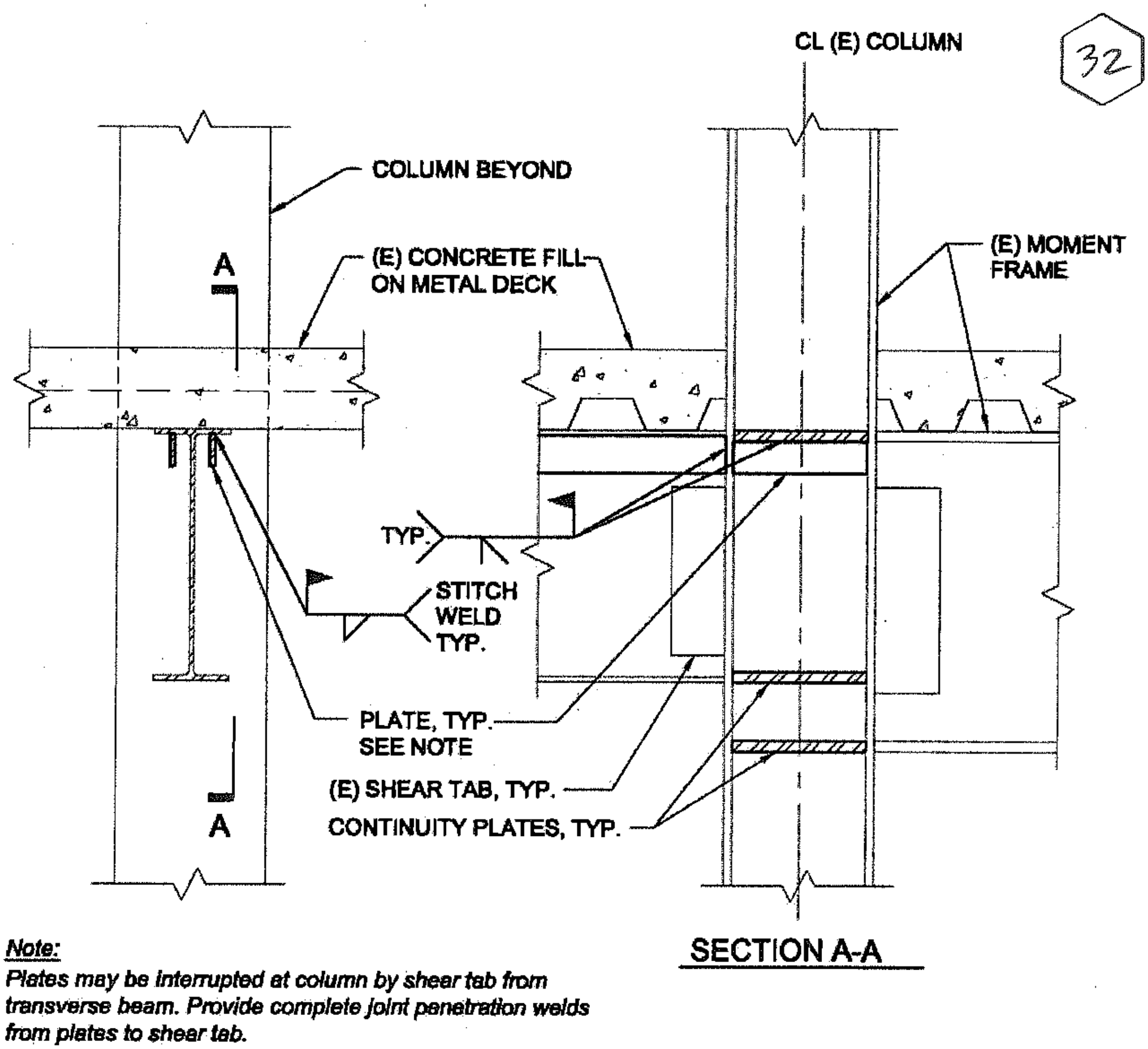

Figure 8.4.4-1: Plate Collectors at Existing Beam

8.4.5 Enhance Connection of Steel Column to Foundation

Deficiency Addressed by Rehabilitation Technique

Frame columns are subject to axial (including possible tension), flexural, and shear forces. To this end, columns with inadequate anchorage to the foundation limit the capacity of a frame. The columns could be part of an existing lateral force-resisting system that do not meet current standards or part of an upgraded system with larger forces resulting from increased stiffness.

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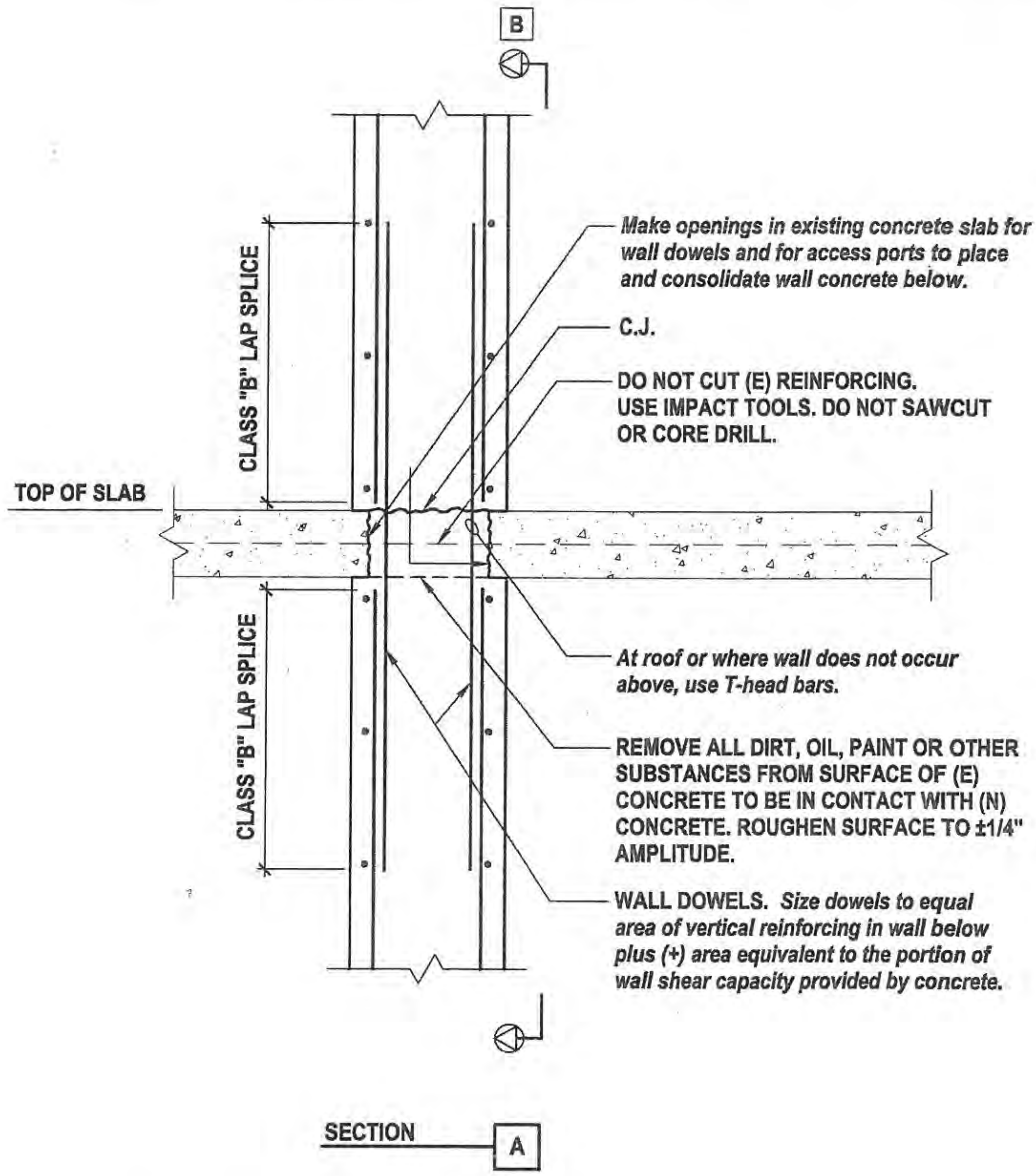

Figure 12.4.2-1A: Concrete Wall Connection to Concrete Slab

pipes or structural shapes. The holes made through the existing slab must serve not only to install the dowels, but also to allow for placement and consolidation of the wall concrete. The concrete head created by placement up to the top of slab coupled with cleaning and roughening the existing concrete contact surface by either sandblasting or chipping will provide the best joint available. The larger holes through the slab will also be more like intermittent shear keys. The holes should be drilled or made with impact tools instead of saws or core drills to avoid cutting or damaging existing slab reinforcement. Prior to cutting the holes, temporary shores may be required below the slab along each side of the row of holes. The concrete should be placed through the slab openings into the forms below, up to top of slab, to provide some head on the joint at the underside of the diaphragm.

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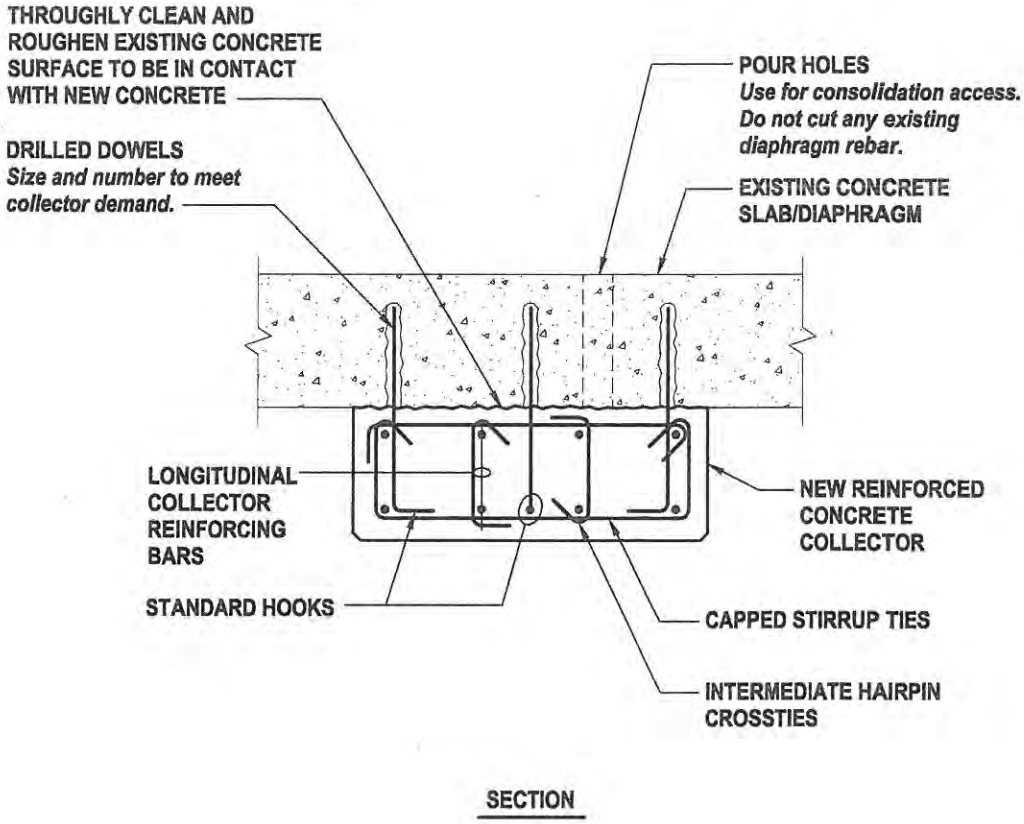

Figure 12.4.3-1: Concrete Collector at Concrete Slab

The required length of collector will be determined primarily by the existing diaphragm shear capacity. Lightly reinforced diaphragms can deliver only a limited load per foot, requiring long collectors. Also, for thin diaphragm slabs, the shear capacity of each drilled dowel will be limited, requiring more dowels. If the collector crosses any existing beam or girder, a splice must be made through the existing member. Horizontal holes can be drilled through the member and dowels installed to lap with the main collector reinforcing bars on each side. Care must be taken to avoid cutting any reinforcement, either main longitudinal bars or stirrups, in the existing beam.

If the existing floor or roof diaphragm is a waffle or pan joist system, the continuous collector will almost always be placed below the ribs, as shown in Figure 12.4.3-2, to avoid excessive drilling and rebar splicing. In this condition, the voids between the ribs, above the dropped collector, will be filled with reinforced concrete. Advantages of this condition are that the drilled dowels can be installed into the sides of the ribs instead of the relatively thin cover slab, and making pour ports through the slab is likely to be less problematic. Also, although the new collector may weigh more in this condition, the waffle or joist ribs are much more likely to have adequate strength to support the added weight.

APPENDIX F

Retrofit Cost Estimates for 12 Prototype Buildings

City of Palo Alto - Seismic Risk Mitigation

Replacement and Retrofit Cost

Date: May 9, 2016 & revised on November 9, 2016

Proposed Hazus Default Full Replacement Cost Models

Proposed Hazus Default Full Replacement Cost Models

Project: City of Palo Alto - Seismic Risk Mitigation

Title: Replacement and Retrofit Cost Estimate

Date: May 9, 2016 & revised on November 9, 2016

Hazus Occupancy Class	Definition	Average $/SF Cost of New Bldg. - 2016 Costs	Demo & Minimal Sitework (5' around Bldg.) $/SF	Average $/SF of Replaced Bldg. - 2016 Cost	Soft Cost Premium[2]	Average $/SF of Replaced Bldg. w/ Soft Costs - 2016 Cost	Retrofit $/SF 2016	Soft Cost Premium[2]	Average $/SF of Retrofit w/ Soft Costs - 2016 Cost	Ratio
RES3A	Multi Family Dwelling – duplex	$201	$17.50	$219	20%	$263	$0	25%	$0	N/A
RES3B	Multi Family Dwelling – triplex/quad	$177	$17.50	$195	20%	$233	$0	25%	$0	N/A
RES3C	Multi Family Dwelling – 5-9 units	$318	$17.50	$335	20%	**$402**	$0	25%	$0	N/A
RES3D	Multi Family Dwelling – 10-19 units	$299	$17.50	$316	20%	$380	$0	25%	$0	N/A
RES3E	Multi Family Dwelling – 20-49 units	$327	$17.50	$344	20%	$413	$0	25%	$0	N/A
RES3F	Multi Family Dwelling – 50+ units	$308	$17.50	$325	20%	**$390**	$0	25%	$0	N/A
RES4	Temp. Lodging	$335	$17.50	$353	20%	$424	$0	25%	$0	N/A
RES5	Institutional Dormitory	$401	$25.00	$426	20%	$511	$0	25%	$0	N/A
RES6	Nursing Home	$400	$25.00	$425	20%	$510	$0	25%	$0	N/A
COM1	Retail Trade	$241	$17.50	$258	20%	**$310**	$0	25%	$0	N/A
COM2	Wholesale Trade	$208	$17.50	$225	20%	$270	$0	25%	$0	N/A
COM3	Personal and Repair Services	$253	$17.50	$270	20%	$324	$0	25%	$0	N/A
COM4	Professional/ Technical/Business Service	$359	$17.50	$377	20%	**$452**	$0	25%	$0	N/A
COM5	Banks	$442	$25.00	$467	20%	$560	$0	25%	$0	N/A
COM6	Hospital	$595	$35.00	$630	20%	$756	$0	25%	$0	N/A
COM7	Medical Office/Clinic	$354	$17.50	$371	20%	**$445**	$0	25%	$0	N/A
COM8	Entertainment & Recreation	$334	$25.00	$359	20%	$431	$0	25%	$0	N/A
COM9	Theaters	$261	$25.00	$286	20%	$343	$0	25%	$0	N/A
COM10	Parking	$112	$17.50	$129	20%	$155	$0	25%	$0	N/A
IND1	Heavy	$199	$17.50	$216	20%	$260	$0	25%	$0	N/A
IND2	Light	$162	$17.50	$180	20%	$216	$0	25%	$0	N/A
IND3	Food/Drugs/Chemicals	$334	$17.50	$352	20%	$422	$0	25%	$0	N/A
IND4	Metals/Minerals Processing	$334	$17.50	$352	20%	$422	$0	25%	$0	N/A
IND5	High Technology	$366	$17.50	$384	20%	**$461**	$0	25%	$0	N/A
IND6	Construction	$169	$17.50	$186	20%	$224	$0	25%	$0	N/A
REL1	Church	$185	$25.00	$210	20%	$252	$0	25%	$0	N/A
AGR1	Agriculture	$245	$17.50	$263	20%	$315	$0	25%	$0	N/A
GOV1	General Services	$235	$17.50	$253	35%	$341	$0	35%	$0	N/A
GOV2	Emergency Response	$414	$25.00	$439	35%	$593	$0	35%	$0	N/A
EDU1	Schools/Libraries	$292	$25.00	$317	35%	$428	$0	35%	$0	N/A
EDU2	Colleges/Universities	$349	$25.00	$374	35%	$505	$0	35%	$0	N/A

Notes:

1. RS Means average cost includes location factors to adjust national average to Palo Alto of 15% for residential and 11% for commercial.
2. Soft costs include architect and engineer design fees, testing and inspection, utility connection fee, permits, and an allowance for owner change order contingency.

Project: City of Palo Alto - Seismic Risk Mitigation
Title: Replacement and Retrofit Cost Estimate
Date: May 9, 2016 & revised on November 9, 2016

Detailed

Estimate

Project: City of Palo Alto - Seismic Risk Mitigation

Title: Replacement and Retrofit Cost Estimate

Date: May 9, 2016 & revised on November 9, 2016

DESCRIPTION	QTY	UNIT	MH / UNIT	CREW	MH COST	UNIT			TOTAL COST					UNIT COST	TOTAL COST
						MATL	EQUIP	SUB	LABOR	MATL	EQUIP	SUB	DIRECT		
Building 1 - Wood Light Frame (RES 3B -3D)	**5,320 SF, 2 story**														
Structural upgrade - See detail	1	LS			$0.00	0.00	0.00	31,100.00	$0	$0	$0	$31,100	$31,100	$31,100.00	$31,100
Remover & replace drywall at shear wall area	5	LOC	2.000	carp	$86.89	250.00	0.00	0.00	$869	$1,250	$0	$0	$2,119	$524.39	$2,622
Remover & replace SOG - see detail			0.000		$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0.00	$0
Remover & replace drywall at moment frame & collector	2	LOC	4.000	carp	$86.89	400.00	50.00	0.00	$695	$800	$100	$0	$1,595	$989.77	$1,980
Allowance to reroute SS Drain	2	LS			$0.00	0.00	0.00	250.00	$0	$0	$0	$500	$500	$250.00	$500
Allowance to reroute water line	2	LS			$0.00	0.00	0.00	150.00	$0	$0	$0	$300	$300	$150.00	$300
Allowance to reroute electrical	2	LS			$0.00	0.00	0.00	500.00	$0	$0	$0	$1,000	$1,000	$500.00	$1,000
Paint and patch - final clean-up	2	LS			$0.00	0.00	0.00	350.00	$0	$0	$0	$700	$700	$350.00	$700
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0.00	$0
Add for General Conditions & Design Contingency	30%	LS			$0.00	0.00	0.00	38,201	$0	$0	$0	$11,460	$11,460	$38,201	$11,460
Add for Soft Cost Premium	25%	LS						49,662						$49,662	$12,415
Total Construction Cost of:															
Building 1 - Wood Light Frame (RES 3B -3D)	**5,320**	**SF**							**$1,564**	**$2,050**	**$100**	**$45,060**	**$48,774**	**$11.67**	**$62,100**
Building 2 - Multi Unit Wood Frame (COM 3C -3F)	**9,500 SF, 2 story**														
Structural upgrade - See detail	1	LS			$0.00	0.00	0.00	55,400.00	$0	$0	$0	$55,400	$55,400	$55,400.00	$55,400
Remover & replace drywall at shear wall area	4	LOC	2.000	carp	$86.89	250.00	0.00	0.00	$695	$1,000	$0	$0	$1,695	$524.39	$2,098
Remover & replace SOG - see detail			0.000		$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0.00	$0
Remover & replace drywall at moment frame & collector	2	LOC	6.000	carp	$86.89	600.00	50.00	0.00	$1,043	$1,200	$100	$0	$2,343	$1,455.16	$2,910
Allowance to reroute SS Drain	1	LS			$0.00	0.00	0.00	750.00	$0	$0	$0	$750	$750	$750.00	$750
Allowance to reroute water line	1	LS			$0.00	0.00	0.00	500.00	$0	$0	$0	$500	$500	$500.00	$500
Allowance to reroute electrical	1	LS			$0.00	0.00	0.00	1,500.00	$0	$0	$0	$1,500	$1,500	$1,500.00	$1,500
Paint and patch - final clean-up	1	LS			$0.00	0.00	0.00	1,000.00	$0	$0	$0	$1,000	$1,000	$1,000.00	$1,000
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0.00	$0
Add for General Conditions & Design Contingency	30%	LS			$0.00	0.00	0.00	64,158	$0	$0	$0	$19,247	$19,247	$64,158	$19,247
Add for Soft Cost Premium	25%	LS						83,405						$83,405	$20,851
Total Construction Cost of:															
Building 2 - Multi Unit Wood Frame (COM 3C -3F)	**9,500**	**SF**							**$1,738**	**$2,200**	**$100**	**$78,397**	**$82,435**	**$10.98**	**$104,300**
Building 3 - Multi Story & Multi Unit Wood Frame (COM 3C -3F)	**30,000 SF, 3 Story**														
Structural upgrade - See detail	1	LS			$0.00	0.00	0.00	85,300.00	$0	$0	$0	$85,300	$85,300	$85,300.00	$85,300
Remover & replace drywall at shear wall area, back wall	4	LOC	2.000	carp	$86.89	250.00	0.00	0.00	$695	$1,000	$0	$0	$1,695	$524.39	$2,098
Remover & replace drywall at shear wall area, side wall	5	LOC	4.000	carp	$86.89	600.00	0.00	0.00	$1,738	$3,000	$0	$0	$4,738	$1,166.77	$5,834
Remover & replace SOG - see detail			0.000		$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0.00	$0
Remover & replace drywall at moment frame & collector	8	LOC	6.000	carp	$86.89	600.00	50.00	0.00	$4,171	$4,800	$400	$0	$9,371	$1,455.16	$11,641
Allowance to reroute SS Drain	4	LS			$0.00	0.00	0.00	250.00	$0	$0	$0	$1,000	$1,000	$250.00	$1,000
Allowance to reroute water line	4	LS			$0.00	0.00	0.00	150.00	$0	$0	$0	$600	$600	$150.00	$600
Allowance to reroute electrical	4	LS			$0.00	0.00	0.00	500.00	$0	$0	$0	$2,000	$2,000	$500.00	$2,000
Paint and patch - final clean-up	4	LS			$0.00	0.00	0.00	350.00	$0	$0	$0	$1,400	$1,400	$350.00	$1,400
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0.00	$0
Add for General Conditions & Design Contingency	30%	LS			$0.00	0.00	0.00	109,873	$0	$0	$0	$32,962	$32,962	$109,873	$32,962
Add for Soft Cost Premium	25%	LS						142,834						$142,834	$35,709
Total Construction Cost of:															
Building 3 - Multi Story & Multi Unit Wood Frame (COM 3C -3F)	**30,000**	**SF**							**$6,604**	**$8,800**	**$400**	**$123,262**	**$139,065**	**$5.95**	**$178,500**

Project: City of Palo Alto - Seismic Risk Mitigation

Title: Replacement and Retrofit Cost Estimate

Date: May 9, 2016 & revised on November 9, 2016

DESCRIPTION	QTY	UNIT	MH / UNIT	CREW	MH COST	UNIT MATL	UNIT EQUIP	UNIT SUB	TOTAL COST LABOR	TOTAL COST MATL	TOTAL COST EQUIP	TOTAL COST SUB	TOTAL COST DIRECT	UNIT COST	TOTAL COST
Building 4 - Commercial and Industrial Wood Frame (COM 1, COM 2, COM 3, COM 4, COM 7, COM 8)	**10,000 SF, 2 Story**														
Structural upgrade - See detail	1	LS			$0.00	0.00	0.00	59,100.00	$0	$0	$0	$59,100	$59,100	$59,100.00	$59,100
Remover & replace drywall at shear wall area, side wall	8	LOC	2.000	carp	$86.89	250.00	0.00	0.00	$1,390	$2,000	$0	$0	$3,390	$524.39	$4,195
Remover & replace drywall at shear wall area, back wall	2	LOC	8.000	carp	$86.89	1,000.00	0.00	0.00	$1,390	$2,000	$0	$0	$3,390	$2,097.54	$4,195
Remover & replace SOG - see detail			0.000		$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0.00	$0
Remover & replace drywall at moment frame & collector	4	LOC	8.000	carp	$86.89	750.00	50.00	0.00	$2,780	$3,000	$200	$0	$5,980	$1,861.54	$7,446
Remover & replace casework on first floor	3	LOC	4.000	carp	$86.89	100.00	0.00	0.00	$1,043	$300	$0	$0	$1,343	$576.77	$1,730
Allowance to reroute SS Drain	4	LS			$0.00	0.00	0.00	250.00	$0	$0	$0	$1,000	$1,000	$250.00	$1,000
Allowance to reroute water line	4	LS			$0.00	0.00	0.00	150.00	$0	$0	$0	$600	$600	$150.00	$600
Allowance to reroute electrical	4	LS			$0.00	0.00	0.00	1,000.00	$0	$0	$0	$4,000	$4,000	$1,000.00	$4,000
Paint and patch, floors - final clean-up	2	LS			$0.00	0.00	0.00	1,500.00	$0	$0	$0	$3,000	$3,000	$1,500.00	$3,000
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0.00	$0
Add for General Conditions & Design Contingency	30%	LS			$0.00	0.00	0.00	85,267	$0	$0	$0	$25,580	$25,580	$85,267	$25,580
Add for Soft Cost Premium	25%	LS						110,847						$110,847	$27,712
Total Construction Cost of: Building 4 - Commercial and Industrial Wood Frame (COM 1, COM 2, COM 3, COM 4, COM 7, COM 8)	**10,000**	**SF**							**$6,604**	**$7,300**	**$200**	**$93,280**	**$107,384**	**$13.86**	**$138,600**

DESCRIPTION	QTY	UNIT	MH / UNIT	CREW	MH COST	UNIT MATL	UNIT EQUIP	UNIT SUB	TOTAL COST LABOR	TOTAL COST MATL	TOTAL COST EQUIP	TOTAL COST SUB	TOTAL COST DIRECT	UNIT COST	TOTAL COST
Building 5 - Steel Moment Frame (COM 1 - COM 10, IND 1 - IND 6)	**43,900 SF, 2 Story**														
Structural upgrade - See detail	1	LS			$0.00	0.00	0.00	221,600.0	$0	$0	$0	$221,600	$221,600	$221,600.00	$221,600
Remover & replace suspended ceiling at braced frame bays - both floors	8	LOC	8.000	carp	$86.89	400.00	100.00	0.00	$5,561	$3,200	$800	$0	$9,561	$1,507.54	$12,060
Remover furring walls at braced frame bays, both floors	8	LOC	8.000	carp	$86.89	600.00	0.00	0.00	$5,561	$4,800	$0	$0	$10,361	$1,625.54	$13,004
Chip down concrete fill locally in braced frame bays, both floors	8	LOC	4.000	clab	$60.77	50.00	100.00	0.00	$1,945	$400	$800	$0	$3,145	$497.85	$3,983
Remover & replace suspended ceiling along new frame collector of 2nd floor	4	LOC	4.000	carp	$86.89	200.00	50.00	0.00	$1,390	$800	$200	$0	$2,390	$753.77	$3,015
Remover & replace drywall at shear wall area, back wall	2	LOC	8.000	carp	$86.89	1,000.00	0.00	0.00	$1,390	$2,000	$0	$0	$3,390	$2,097.54	$4,195
Remover & replace SOG - see detail			0.000		$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0.00	$0
Allowance to reroute SS Drain	1	LS			$0.00	0.00	0.00	1,000.00	$0	$0	$0	$1,000	$1,000	$1,000.00	$1,000
Allowance to reroute water line	1	LS			$0.00	0.00	0.00	1,500.00	$0	$0	$0	$1,500	$1,500	$1,500.00	$1,500
Allowance to reroute electrical	16	LS			$0.00	0.00	0.00	750.00	$0	$0	$0	$12,000	$12,000	$750.00	$12,000
Paint and patch, floors - final clean-up	1	LS			$0.00	0.00	0.00	5,000.00	$0	$0	$0	$5,000	$5,000	$5,000.00	$5,000
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0.00	$0
Add for General Conditions & Design Contingency	30%	LS			$0.00	0.00	0.00	277,358	$0	$0	$0	$83,207	$83,207	$277,358	$83,207
Add for Soft Cost Premium	25%	LS						360,565						$360,565	$90,141
Total Construction Cost of: Building 5 - Steel Moment Frame (COM 1 - COM 10, IND 1 - IND 6)	**43,900**	**SF**							**$15,847**	**$11,200**	**$1,800**	**$324,307**	**$353,154**	**$10.27**	**$450,700**

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DESCRIPTION	QTY	UNIT	MH / UNIT	CREW	MH COST	UNIT MATL	UNIT EQUIP	UNIT SUB	TOTAL COST LABOR	TOTAL COST MATL	TOTAL COST EQUIP	TOTAL COST SUB	TOTAL COST DIRECT	UNIT COST	TOTAL COST
Building 6 - Concrete Shear Wall (COM 1 - COM 10, IND 1 - IND 6)	**5,000 SF, 1 Story**														
Structural upgrade - See detail	1	LS			$0.00	0.00	0.00	61,300.00	$0	$0	$0	$61,300	$61,300	$61,300.00	$61,300
Remove and replace roof, insulation & roof accessories	5,000	SF	0.082	rofc	$74.83	4.60	0.50	0.00	$30,680	$23,000	$2,500	$0	$56,180	$14.12	$70,587
Remove and replace ceiling at the building perimeter for access - 8 to 10 lf wide	300	LF	0.260	carp	$86.89	17.00	0.80	0.00	$6,777	$5,100	$240	$0	$12,117	$50.82	$15,247
Allowance to reroute SS Drain	1	LS			$0.00	0.00	0.00	500.00	$0	$0	$0	$500	$500	$500.00	$500
Allowance to reroute water line	1	LS			$0.00	0.00	0.00	1,000.00	$0	$0	$0	$1,000	$1,000	$1,000.00	$1,000
Allowance to reroute electrical	1	LS			$0.00	0.00	0.00	2,000.00	$0	$0	$0	$2,000	$2,000	$2,000.00	$2,000
Paint and patch, floors - final clean-up	1	LS			$0.00	0.00	0.00	2,500.00	$0	$0	$0	$2,500	$2,500	$2,500.00	$2,500
Remove & replace casework on first floor	3	LOC	4.000	carp	$86.89	100.00	0.00	0.00	$1,043	$300	$0	$0	$1,343	$576.77	$1,730
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0.00	$0
Add for General Conditions & Design Contingency	30%	LS			$0.00	0.00	0.00	154,865	$0	$0	$0	$46,460	$46,460	$154,865	$46,460
Add for Soft Cost Premium	25%	LS						201,325						$201,325	$50,331
Total Construction Cost of:															
Building 6 - Concrete Shear Wall (COM 1 - COM 10, IND 1 - IND 6)	**5,000**	**SF**							**$38,500**	**$28,400**	**$2,740**	**$113,760**	**$183,399**	**$50.34**	**$251,700**
Building 7 - Concrete Shear Wall (COM 1 - COM 10, IND 1 - IND 6)	**17,280 SF, 2 Story**														
Structural upgrade - See detail	1	LS			$0.00	0.00	0.00	271,700.00	$0	$0	$0	$271,700	$271,700	$271,700.00	$271,700
Remove and replace drywall furring at new shear walls	1,056	SF	0.096	carp	$86.89	4.00	0.50	0.00	$8,808	$4,224	$528	$0	$13,560	$16.32	$17,234
Remove and replace drywall furring at new collectors	3,168	SF	0.096	carp	$86.89	4.00	0.50	0.00	$26,425	$12,672	$1,584	$0	$40,681	$16.32	$51,703
Remove and replace drywall furring at columns for new shear walls	576	SF	0.115	carp	$86.89	4.80	0.50	0.00	$5,765	$2,765	$288	$0	$8,818	$19.47	$11,213
Remove and replace floor / ceiling finishes at shear walls / collectors	720	LF	0.200	carp	$86.89	12.00	2.00	0.00	$12,512	$8,640	$1,440	$0	$22,592	$39.46	$28,410
Remove / replace / patch roof finishes at shear walls / collectors	216	LF	0.250	rofc	$74.83	15.00	2.00	0.00	$4,041	$3,240	$432	$0	$7,713	$44.75	$9,667
Allowance to reroute SS Drain	2	LS			$0.00	0.00	0.00	1,500.00	$0	$0	$0	$3,000	$3,000	$1,500.00	$3,000
Allowance to reroute water line	6	LS			$0.00	0.00	0.00	1,000.00	$0	$0	$0	$6,000	$6,000	$1,000.00	$6,000
Allowance to reroute electrical	6	LS			$0.00	0.00	0.00	2,000.00	$0	$0	$0	$12,000	$12,000	$2,000.00	$12,000
Paint and patch - final clean-up	17,280	SF			$0.00	0.00	0.00	1.00	$0	$0	$0	$17,280	$17,280	$1.00	$17,280
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0.00	$0
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0.00	$0
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0.00	$0
Add for General Conditions & Design Contingency	30%	LS			$0.00	0.00	0.00	428,207	$0	$0	$0	$128,462	$128,462	$428,207	$128,462
Add for Soft Cost Premium	25%	LS						556,670						$556,670	$139,167
Total Construction Cost of:															
Building 7 - Concrete Shear Wall (COM 1 - COM 10, IND 1 - IND 6)	**17,280**	**SF**							**$57,552**	**$31,541**	**$4,272**	**$438,442**	**$531,807**	**$40.27**	**$695,800**

Project: City of Palo Alto - Seismic Risk Mitigation

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DESCRIPTION	QTY	UNIT	MH / UNIT	CREW	MH COST	UNIT MATL	UNIT EQUIP	UNIT SUB	TOTAL COST LABOR	TOTAL COST MATL	TOTAL COST EQUIP	TOTAL COST SUB	TOTAL COST DIRECT	UNIT COST	TOTAL COST
Building 8 - Tilt-up Concrete Shear Walls (COM1-4, COM7, COM9, IND1-IND6)	**18,435 SF, 1 story**														
Structural upgrade - See detail	1	LS			$0.00	0.00	0.00	134,800.0	$0	$0	$0	$134,800	$134,800	$134,800.00	$134,800
Remove and replace roof, insulation and roof accessories around perimeter	11,520	SF	0.082	rofc	$74.83	4.60	0.50	0.00	$70,687	$52,992	$5,760	$0	$129,439	$14.12	$162,634
Remove and replace ceiling at the building perimeter for access - 8 to 10 lf wide	528	LF	0.260	carp	$86.89	17.00	0.80	0.00	$11,928	$8,976	$422	$0	$21,326	$50.82	$26,835
Allowance to reroute SS Drain	1	LS			$0.00	0.00	0.00	1,000.00	$0	$0	$0	$1,000	$1,000	$1,000.00	$1,000
Allowance to reroute water line	1	LS			$0.00	0.00	0.00	1,500.00	$0	$0	$0	$1,500	$1,500	$1,500.00	$1,500
Allowance to reroute electrical	1	LS			$0.00	0.00	0.00	2,000.00	$0	$0	$0	$2,000	$2,000	$2,000.00	$2,000
Paint and patch - final clean-up	1	LS			$0.00	0.00	0.00	2,500.00	$0	$0	$0	$2,500	$2,500	$2,500.00	$2,500
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0.00	$0
Add for General Conditions & Design Contingency	30%	LS			$0.00	0.00	0.00	331,269	$0	$0	$0	$99,381	$99,381	$331,269	$99,381
Add for Soft Cost Premium	25%	LS						430,649						$430,649	$107,662
Total Construction Cost of:															
Building 8 - Tilt-up Concrete Shear Walls (COM1-4, COM7, COM9, IND1-IND6)	**18,435**	**SF**							**$82,615**	**$61,968**	**$6,182**	**$241,181**	**$391,946**	**$29.20**	**$538,300**
Building 9 - Tilt-up Concrete Shear Walls (COM1-4, COM7, COM9, IND1-IND6)	**38,400 SF, 2 Story**														
Structural upgrade - See detail	1	LS			$0.00	0.00	0.00	299,600.0	$0	$0	$0	$299,600	$299,600	$299,600.00	$299,600
Remove and replace roof, insulation and roof accessories around perimeter	11,712	SF	0.082	rofc	$74.83	4.60	0.50	0.00	$71,865	$53,875	$5,856	$0	$131,596	$14.12	$165,344
Remove and replace ceiling at the building perimeter for access - 8 to 10 lf wide	488	LF	0.260	carp	$86.89	17.00	0.80	0.00	$11,024	$8,296	$390	$0	$19,711	$50.82	$24,802
Allowance to reroute SS Drain	2	LS			$0.00	0.00	0.00	1,000.00	$0	$0	$0	$2,000	$2,000	$1,000.00	$2,000
Allowance to reroute water line	2	LS			$0.00	0.00	0.00	1,500.00	$0	$0	$0	$3,000	$3,000	$1,500.00	$3,000
Allowance to reroute electrical	2	LS			$0.00	0.00	0.00	2,000.00	$0	$0	$0	$4,000	$4,000	$2,000.00	$4,000
Paint and patch - final clean-up	2	LS			$0.00	0.00	0.00	1,500.00	$0	$0	$0	$3,000	$3,000	$1,500.00	$3,000
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0.00	$0
Add for General Conditions & Design Contingency	30%	LS			$0.00	0.00	0.00	501,746	$0	$0	$0	$150,524	$150,524	$501,746	$150,524
Add for Soft Cost Premium	25%	LS						652,270						$652,270	$163,068
Total Construction Cost of:															
Building 9 - Tilt-up Concrete Shear Walls (COM1-4, COM7, COM9, IND1-IND6)	**38,400**	**SF**							**$82,889**	**$62,171**	**$6,246**	**$462,124**	**$613,431**	**$21.23**	**$815,300**
Building 10 - Reinforced Masonry Bearing Wall (COM1-COM5, COM8, IND1-IND6)	**2,750 SF, 1 Story**														
Structural upgrade - See detail	1	LS			$0.00	0.00	0.00	70,000.00	$0	$0	$0	$70,000	$70,000	$70,000.00	$70,000
Remove and replace roof, insulation & roof accessories	2,750	SF	0.082	rofc	$74.83	4.60	0.50	0.00	$16,874	$12,650	$1,375	$0	$30,899	$14.12	$38,823
Remove and replace ceiling at the building perimeter for access - 8 to 10 lf wide	210	LF	0.260	carp	$86.89	17.00	0.80	0.00	$4,744	$3,570	$168	$0	$8,482	$50.82	$10,673
Allowance to reroute SS Drain	1	LS			$0.00	0.00	0.00	1,000.00	$0	$0	$0	$1,000	$1,000	$1,000.00	$1,000
Allowance to reroute water line	1	LS			$0.00	0.00	0.00	1,500.00	$0	$0	$0	$1,500	$1,500	$1,500.00	$1,500
Allowance to reroute electrical	1	LS			$0.00	0.00	0.00	2,000.00	$0	$0	$0	$2,000	$2,000	$2,000.00	$2,000
Paint and patch, floors - final clean-up	1	LS			$0.00	0.00	0.00	1,500.00	$0	$0	$0	$1,500	$1,500	$1,500.00	$1,500
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0.00	$0
Add for General Conditions & Design Contingency	30%	LS			$0.00	0.00	0.00	125,496	$0	$0	$0	$37,649	$37,649	$125,496	$37,649
Add for Soft Cost Premium	25%	LS						163,145						$163,145	$40,786
Total Construction Cost of:															
Building 10 - Reinforced Masonry Bearing Wall (COM1-COM5, COM8, IND1-IND6)	**2,750**	**SF**							**$21,618**	**$16,220**	**$1,543**	**$113,649**	**$153,030**	**$74.15**	**$203,900**

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DESCRIPTION	QTY	UNIT	MH	CREW	MH	UNIT			TOTAL COST					UNIT	TOTAL
			/ UNIT		COST	MATL	EQUIP	SUB	LABOR	MATL	EQUIP	SUB	DIRECT	COST	COST
Building 11 - Reinforced Masonry Bearing Wall (RES3D - 3F, RES4, RES5, RES6, COM1-COM9, IND1-IND6)	**8,150 SF, 2 Story**														
Structural upgrade - See detail	1	LS			$0.00	0.00	0.00	114,500.0	$0	$0	$0	$114,500	$114,500	$114,500.00	$114,500
Remove and replace roof, insulation & roof accessories	3,925	SF	0.082	rofc	$74.83	4.60	0.50	0.00	$24,084	$18,055	$1,963	$0	$44,101	$14.12	$55,411
Remove and replace ceiling for access at 1st floor new shear walls & 2nd floor anchor walls	300	LF	0.520	carp	$86.89	34.00	1.60	0.00	$13,540	$10,189	$479	$0	$24,208	$101.65	$30,461
Remove and replace ceiling for access at roof level	3,925	SF	0.026	carp	$86.89	1.70	0.08	0.00	$8,867	$6,673	$314	$0	$15,853	$5.08	$19,948
Allowance to reroute SS Drain	1	LS			$0.00	0.00	0.00	1,000.00	$0	$0	$0	$1,000	$1,000	$1,000.00	$1,000
Allowance to reroute water line	1	LS			$0.00	0.00	0.00	1,250.00	$0	$0	$0	$1,250	$1,250	$1,250.00	$1,250
Allowance to reroute electrical	2	LS			$0.00	0.00	0.00	1,000.00	$0	$0	$0	$2,000	$2,000	$1,000.00	$2,000
Paint and patch, floors - final clean-up	2	LS			$0.00	0.00	0.00	2,000.00	$0	$0	$0	$4,000	$4,000	$2,000.00	$4,000
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0.00	$0
Add for General Conditions & Design Contingency	30%	LS			$0.00	0.00	0.00	228,570	$0	$0	$0	$68,571	$68,571	$228,570	$68,571
Add for Soft Cost Premium	25%	LS						297,141						$297,141	$74,285
Total Construction Cost of:															
Building 11 - Reinforced Masonry Bearing Wall (RES3D - 3F, RES4, RES5, RES6, COM1-COM9, IND1-IND6)	**8,150**	**SF**							**$46,490**	**$34,916**	**$2,756**	**$191,321**	**$275,483**	**$45.57**	**$371,400**
Building 12 - Unreinforced Masonry Bearing Wall (COM1, COM2, COM3, COM4, COM5, COM8)	**5,000 SF, 1 Story**														
Structural upgrade - See detail	1	LS			$0.00	0.00	0.00	238,500.0	$0	$0	$0	$238,500	$238,500	$238,500.00	$238,500
Remove and replace roof, insulation & roof accessories	5,000	SF	0.082	rofc	$74.83	4.60	0.50	0.00	$30,680	$23,000	$2,500	$0	$56,180	$14.12	$70,587
Remove and replace ceiling at 2nd floor of the building perimeter for access - 8 to 10 lf wide	210	LF	0.260	carp	$86.89	17.00	0.80	0.00	$4,744	$3,570	$168	$0	$8,482	$50.82	$10,673
Remove and replace ceiling for access at moment frame & collector - both levels, 8 to 10 lf wide	1,000	SF	0.026	carp	$86.89	1.70	0.08	0.00	$2,259	$1,700	$80	$0	$4,039	$5.08	$5,082
Remover and replace furring walls at supplemental supports	14	LOC	2.000	carp	$86.89	96.00	25.00	0.00	$2,433	$1,344	$350	$0	$4,127	$372.17	$5,210
Allowance to reroute SS Drain	1	LS			$0.00	0.00	0.00	1,000.00	$0	$0	$0	$1,000	$1,000	$1,000.00	$1,000
Allowance to reroute water line	1	LS			$0.00	0.00	0.00	1,500.00	$0	$0	$0	$1,500	$1,500	$1,500.00	$1,500
Allowance to reroute electrical	2	LS			$0.00	0.00	0.00	1,500.00	$0	$0	$0	$3,000	$3,000	$1,500.00	$3,000
Paint and patch, floors - final clean-up	2	LS			$0.00	0.00	0.00	1,500.00	$0	$0	$0	$3,000	$3,000	$1,500.00	$3,000
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0.00	$0
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0.00	$0
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0.00	$0
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0.00	$0
Add for General Conditions & Design Contingency	30%	LS			$0.00	0.00	0.00	338,553	$0	$0	$0	$101,566	$101,566	$338,553	$101,566
	25%	LS						440,119						$440,119	$110,030
Total Construction Cost of:															
Building 12 - Unreinforced Masonry Bearing Wall (COM1, COM2, COM3, COM4, COM5, COM8)	**5,000**	**SF**							**$40,116**	**$29,614**	**$3,098**	**$348,566**	**$421,394**	**$110.02**	**$550,100**

Structural Cost Estimate

Project: City of Palo Alto - Seismic Risk Mitigation

Title: Replacement and Retrofit Cost Estimate

Date: May 9, 2016 & revised on November 9, 2016

DESCRIPTION	QTY	UNIT	MH / UNIT	CREW	MH COST	UNIT MATL	UNIT EQUIP	UNIT SUB	TOTAL COST LABOR	TOTAL COST MATL	TOTAL COST EQUIP	TOTAL COST SUB	TOTAL COST DIRECT	TOTAL COST w/MU	UNIT COST
Bldg 1															
Sawcut & remove concrete, excavate for new footing	4	LOC	4.000	b89	$55.59	0.00	150.00	0.00	$889	$0	$600	$0	$1,489	$1,882	$470.53
New concrete footing / SOG with dowel to existing	4	LOC	4.000	b5	$67.34	600.00	100.00	0.00	$1,077	$2,400	$400	$0	$3,877	$4,726	$1,181.55
Add moment frame with all connections	2	LOC	16.000	skwk	$81.42	4,568.75	500.00	0.00	$2,605	$9,138	$1,000	$0	$12,743	$15,401	$7,700.65
Add new collector with all connections	2	LOC	4.000	skwk	$81.42	1,000.00	150.00	0.00	$651	$2,000	$300	$0	$2,951	$3,574	$1,786.88
Add plywood, hold downs and anchor bolts	5	LOC	4.000	carp	$86.89	350.00	50.00	0.00	$1,738	$1,750	$250	$0	$3,738	$4,654	$930.77
Load & move debris + clean area	2	LS	4.000	clab	$60.77	0.00	100.00	0.00	$486	$0	$200	$0	$686	$878	$438.85
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
Bldg 1 total	**1**	**LS**	**0.000**		**$0.00**	**15,287.50**	**2,750.00**	**0.00**	**$7,448**	**$15,288**	**$2,750**	**$0**	**$25,485**	**$31,100**	**$31,100.00**
Bldg 2															
Sawcut & remove concrete, excavate for new footing	4	LOC	4.000	b89	$55.59	0.00	150.00	0.00	$889	$0	$600	$2,000	$3,489	$3,882	$970.53
New concrete footing / SOG with dowel to existing	4	LOC	4.000	b5	$67.34	600.00	100.00	0.00	$1,077	$2,400	$400	$0	$3,877	$4,726	$1,181.55
Add moment frame with all connections	2	LOC	20.000	skwk	$81.42	5,443.75	500.00	0.00	$3,257	$10,888	$1,000	$0	$15,144	$18,326	$9,163.03
Add new collector with all connections	2	LOC	6.000	skwk	$81.42	2,000.00	200.00	0.00	$977	$4,000	$400	$0	$5,377	$6,482	$3,240.82
Add plywood, hold downs and anchor bolts	5	LOC	4.000	carp	$86.89	350.00	50.00	0.00	$1,738	$1,750	$250	$0	$3,738	$4,654	$930.77
Load & move debris + clean area	1	LS	8.000	clab	$60.77	0.00	250.00	0.00	$486	$0	$250	$0	$736	$937	$936.71
Sawcut & remove concrete, excavate for new grade beam - 25 LF	1	LOC	10.000	b89	$55.59	0.00	250.00	0.00	$556	$0	$250	$0	$806	$1,029	$1,028.84
New concrete grade beam / SOG with dowel to existing footing - 25 LF	1	LOC	18.000	b5	$67.34	3,500.00	750.00	0.00	$1,212	$3,500	$750	$0	$5,462	$6,615	$6,614.98
New shear wall w/plywood on both sides, 25 LF	1	LOC	24.000	Carp	$86.89	4,800.00	250.00	0.00	$2,085	$4,800	$250	$0	$7,135	$8,712	$8,711.62
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
Bldg 2 total	**1**	**LS**	**0.000**		**$0.00**	**27,337.50**	**4,150.00**	**2,000.00**	**$12,278**	**$27,338**	**$4,150**	**$2,000**	**$45,765**	**$55,400**	**$55,400.00**
Bldg 3															
Sawcut & remove concrete, excavate for new footing	8	LOC	4.000	b89	$55.59	0.00	150.00	0.00	$1,779	$0	$1,200	$3,000	$5,979	$6,764	$845.53
New concrete footing / SOG with dowel to existing	8	LOC	4.000	b5	$67.34	600.00	100.00	0.00	$2,155	$4,800	$800	$0	$7,755	$9,452	$1,181.55
Add moment frame with all connections	4	LOC	16.000	skwk	$81.42	4,568.75	500.00	0.00	$5,211	$18,275	$2,000	$0	$25,486	$30,803	$7,700.65
Add new collector with all connections	8	LOC	6.000	skwk	$81.42	2,000.00	200.00	0.00	$3,908	$16,000	$1,600	$0	$21,508	$25,927	$3,240.82
Add plywood, hold downs and anchor bolts - back walls	4	LOC	4.000	carp	$86.89	350.00	50.00	0.00	$1,390	$1,400	$200	$0	$2,990	$3,723	$930.77
Add plywood, hold downs and anchor bolts - side walls	5	LOC	6.000	carp	$86.89	500.00	75.00	0.00	$2,607	$2,500	$375	$0	$5,482	$6,833	$1,366.66
Load & move debris + clean area	4	LS	4.000	clab	$60.77	0.00	100.00	0.00	$972	$0	$400	$0	$1,372	$1,755	$438.85
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
Bldg 3 total	**1**	**LS**	**0.000**		**$0.00**	**42,975.00**	**6,575.00**	**3,000.00**	**$18,022**	**$42,975**	**$6,575**	**$3,000**	**$70,572**	**$85,300**	**$85,300.00**

Project: City of Palo Alto - Seismic Risk Mitigation

Title: Replacement and Retrofit Cost Estimate

Date: May 9, 2016 & revised on November 9, 2016

DESCRIPTION	QTY	UNIT	MH	CREW	MH	UNIT			TOTAL COST						UNIT
			/ UNIT		COST	MATL	EQUIP	SUB	LABOR	MATL	EQUIP	SUB	DIRECT	w/MU	COST
Bldg 4															
Sawcut & remove concrete, excavate for new footing	6	LOC	4.000	b89	$55.59	0.00	150.00	0.00	$1,334	$0	$900	$0	$2,234	$2,823	$470.53
New concrete footing / SOG with dowel to existing	6	LOC	4.000	b5	$67.34	600.00	100.00	0.00	$1,616	$3,600	$600	$0	$5,816	$7,089	$1,181.55
Add moment frame with all connections	3	LOC	16.000	skwk	$81.42	5,163.75	500.00	0.00	$3,908	$15,491	$1,500	$0	$20,899	$25,208	$8,402.75
Add new collector with all connections	2	LOC	6.000	skwk	$81.42	2,000.00	200.00	0.00	$977	$4,000	$400	$0	$5,377	$6,482	$3,240.82
Add for mid span collector with all connections	1	LOC	10.000	skwk	$81.42	3,000.00	200.00	0.00	$814	$3,000	$200	$0	$4,014	$4,851	$4,850.70
Add plywood, hold downs and anchor bolts - side walls	8	LOC	4.000	carp	$86.89	350.00	50.00	0.00	$2,780	$2,800	$400	$0	$5,980	$7,446	$930.77
Add plywood, hold downs and anchor bolts - back walls	2	LOC	8.000	carp	$86.89	600.00	75.00	0.00	$1,390	$1,200	$150	$0	$2,740	$3,428	$1,714.04
Load & move debris + clean area	2	LS	8.000	clab	$60.77	0.00	200.00	0.00	$972	$0	$400	$0	$1,372	$1,755	$877.71
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
Bldg 4 total	**1**	**LS**	**0.000**		**$0.00**	**30,091.25**	**4,550.00**	**0.00**	**$13,792**	**$30,091**	**$4,550**	**$0**	**$48,434**	**$59,100**	**$59,100.00**
Bldg 5															
Sawcut & remove concrete, excavate for new footing & micropile	28	LOC	4.000	b89	$55.59	0.00	150.00	0.00	$6,226	$0	$4,200	$0	$10,426	$13,175	$470.53
New concrete footing / SOG with dowel to existing + headed bars	28	LOC	4.000	b5	$67.34	800.00	100.00	0.00	$7,542	$22,400	$2,800	$0	$32,742	$39,691	$1,417.55
Drill thru (E) footings for new headed bar	14	LOC	8.000	b5	$67.34	100.00	250.00	0.00	$7,542	$1,400	$3,500	$0	$12,442	$15,737	$1,124.10
New micropile	28	LOC	8.000	skwk	$81.42	350.00	100.00	0.00	$18,237	$9,800	$2,800	$0	$30,837	$38,941	$1,390.76
Add HSS brace frame all connections at (E) frames	8	LOC	16.000	skwk	$81.42	5,408.73	500.00	0.00	$10,421	$43,270	$4,000	$0	$57,691	$69,535	$8,691.82
Add new collector with all connections	4	LOC	8.000	skwk	$81.42	1,500.00	200.00	0.00	$2,605	$6,000	$800	$0	$9,405	$11,463	$2,865.76
Add for mobilization and special requirements	1	LS			$0.00	0.00	25,000.00	0.00	$0	$0	$25,000	$0	$25,000	$29,500	$29,500.00
Load & move debris + clean area	8	LS	4.000	clab	$60.77	0.00	100.00	0.00	$1,945	$0	$800	$0	$2,745	$3,511	$438.85
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
Bldg 5 total	**1**	**LS**	**0.000**		**$0.00**	**82,869.82**	**43,900.00**	**0.00**	**$54,519**	**$82,870**	**$43,900**	**$0**	**$181,289**	**$221,600**	**$221,600.00**
Bldg 6															
Sawcut & remove concrete, excavate for new footing	4	LOC	4.000	b89	$55.59	0.00	150.00	0.00	$889	$0	$600	$0	$1,489	$1,882	$470.53
New concrete footing / SOG with dowel to existing	4	LOC	6.000	b5	$67.34	800.00	100.00	0.00	$1,616	$3,200	$400	$0	$5,216	$6,381	$1,595.33
Add moment frame with all connections	2	LOC	20.000	skwk	$81.42	6,804.38	500.00	0.00	$3,257	$13,609	$1,000	$0	$17,865	$21,537	$10,768.56
Drill hole in concrete wall, add anchor tie down - roof to wall - tight working area	35	LOC	2.000	skwk	$81.42	150.00	25.00	0.00	$5,699	$5,250	$875	$0	$11,824	$14,750	$421.44
Add new plywood sheathing over (E) at roof	5,000	SF	0.006	carp	$86.89	2.00	0.10	0.00	$2,607	$10,000	$500	$0	$13,107	$15,831	$3.17
Load & move debris + clean area	2	LS	4.000	clab	$60.77	0.00	100.00	0.00	$486	$0	$200	$0	$686	$878	$438.85
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
Bldg 6 total	**1**	**LS**	**0.000**		**$0.00**	**32,058.75**	**3,575.00**	**0.00**	**$14,554**	**$32,059**	**$3,575**	**$0**	**$50,188**	**$61,300**	**$61,300.00**

Project: City of Palo Alto - Seismic Risk Mitigation

Title: Replacement and Retrofit Cost Estimate

Date: May 9, 2016 & revised on November 9, 2016

DESCRIPTION	QTY	UNIT	MH	CREW	MH	UNIT			TOTAL COST						UNIT
			/ UNIT		COST	MATL	EQUIP	SUB	LABOR	MATL	EQUIP	SUB	DIRECT	w/MU	COST
Bldg 7															
Sawcut & remove concrete, excavate for new footing / micropile- at perimeter	2	LOC	8.000	b89	$55.59	0.00	250.00	0.00	$889	$0	$500	$0	$1,389	$1,764	$882.07
Sawcut & remove concrete, excavate for new footing / micropile - interior	1	LOC	10.000	b89	$55.59	0.00	300.00	0.00	$556	$0	$300	$0	$856	$1,088	$1,087.84
New concrete footing / SOG with dowel to existing footing / pile cap	2	LOC	12.000	b5	$67.34	1,200.00	250.00	0.00	$1,616	$2,400	$500	$0	$4,516	$5,555	$2,777.65
New concrete footing / SOG at interior	1	LOC	12.000	b5	$67.34	1,250.00	250.00	0.00	$808	$1,250	$250	$0	$2,308	$2,837	$2,836.65
New micropile	12	LOC	10.000	skwk	$81.42	450.00	250.00	0.00	$9,770	$5,400	$3,000	$0	$18,170	$22,808	$1,900.70
New concrete shear wall with dowel to existing columns - first & 2nd floors	1,056	SF	0.700	b5	$67.34	15.00	5.00	0.00	$49,777	$15,840	$5,280	$0	$70,897	$90,627	$85.82
New concrete shear wall at interior - first & 2nd floors	576	SF	0.600	b5	$67.34	12.50	3.00	0.00	$23,272	$7,200	$1,728	$0	$32,200	$41,255	$71.62
Shore slab during construction	136	LF	0.500	carp	$86.89	25.00	15.00	0.00	$5,908	$3,400	$2,040	$0	$11,348	$14,218	$104.55
Core drill / opening in first floor slab & roof for dowel / shear wall	136	LF	0.200	b89	$55.59	15.00	5.00	0.00	$1,512	$2,040	$680	$0	$4,232	$5,206	$38.28
Core drill / dowel and new concrete collector below 2nd floor & roof + patch pour hole	264	LF	1.250	b5	$67.34	80.00	15.00	0.00	$22,222	$21,120	$3,960	$0	$47,302	$58,927	$223.21
Clean and prep col surface	2	LS	2.000	clab	$60.77	25.00	25.00	0.00	$243	$50	$50	$0	$343	$439	$219.43
Add FRP at the column surface	300	SF	0.180	skwk	$81.42	35.00	10.00	0.00	$4,397	$10,500	$3,000	$0	$17,897	$21,733	$72.44
Load & move debris + clean area	12	LS	4.000	clab	$60.77	0.00	100.00	0.00	$2,917	$0	$1,200	$0	$4,117	$5,266	$438.85
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
Bldg 7 total	**1**	**LS**	**0.000**		**$0.00**	**69,200.00**	**22,488.00**	**0.00**	**$123,888**	**$69,200**	**$22,488**	**$0**	**$215,576**	**$271,700**	**$271,700.00**
Bldg 8															
Drill hole in concrete wall, add anchor tie down - roof to wall two walls - tight working area	30	LOC	2.000	skwk	$81.42	150.00	25.00	0.00	$4,885	$4,500	$750	$0	$10,135	$12,643	$421.44
Drill hole in concrete wall, add anchor at sub-purlin - roof to wall two walls - tight working area	48	LOC	6.000	skwk	$81.42	200.00	50.00	0.00	$23,448	$9,600	$2,400	$0	$35,448	$45,111	$939.82
Add new collector with all connections	4	LOC	10.000	skwk	$81.42	1,500.00	200.00	0.00	$3,257	$6,000	$800	$0	$10,057	$12,323	$3,080.70
Add new plywood sheathing over (E) roof at perimeter	11,520	SF	0.006	carp	$86.89	2.00	0.10	0.00	$6,006	$23,040	$1,152	$0	$30,198	$36,474	$3.17
Load & move debris + clean area	1	LS	12.000	clab	$60.77	0.00	200.00	0.00	$729	$0	$200	$0	$929	$1,199	$1,198.56
Continuity ties (subpurlin, girder, purlin)	90	LOC	2.000	carp	$86.89	50.00	10.00	0.00	$15,640	$4,500	$900	$0	$21,040	$27,017	$300.19
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
Bldg 8 total	**1**	**LS**	**0.000**		**$0.00**	**47,640.00**	**6,202.00**	**0.00**	**$53,965**	**$47,640**	**$6,202**	**$0**	**$107,807**	**$134,800**	**$134,800.00**

Project: City of Palo Alto - Seismic Risk Mitigation

Title: Replacement and Retrofit Cost Estimate

Date: May 9, 2016 & revised on November 9, 2016

DESCRIPTION	QTY	UNIT	MH	CREW	MH	UNIT			TOTAL COST						UNIT
			/ UNIT		COST	MATL	EQUIP	SUB	LABOR	MATL	EQUIP	SUB	DIRECT	w/MU	COST
Bldg 9															
Drill hole in concrete wall, add enhanced girder connection	14	LOC	4.000	skwk	$81.42	250.00	25.00	0.00	$4,559	$3,500	$350	$0	$8,409	$10,561	$754.38
Drill hole in concrete wall, add anchor tie down - roof to wall along two walls - tight working area	25	LOC	2.000	skwk	$81.42	150.00	25.00	0.00	$4,071	$3,750	$625	$0	$8,446	$10,536	$421.44
Drill hole in concrete wall, add anchor at sub-purlin - roof to wall along two walls - tight working area	96	LOC	6.000	skwk	$81.42	200.00	50.00	0.00	$46,896	$19,200	$4,800	$0	$70,896	$90,223	$939.82
Drill hole in concrete wall, add steel angle & anchor at floor level - wall all around - tight working area	196	LOC	4.000	skwk	$81.42	125.00	25.00	0.00	$63,831	$24,500	$4,900	$0	$93,231	$118,949	$606.88
Add new plywood sheathing over (E) roof at perimeter	11,712	SF	0.006	carp	$86.89	2.00	0.10	0.00	$6,106	$23,424	$1,171	$0	$30,701	$37,082	$3.17
Load & move debris + clean area	2	LS	8.000	clab	$60.77	0.00	150.00	0.00	$972	$0	$300	$0	$1,272	$1,637	$818.71
Continuity ties (subpurlin, girder, purlin)	102	LOC	2.000	carp	$86.89	50.00	10.00	0.00	$17,725	$5,100	$1,020	$0	$23,845	$30,619	$300.19
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
Bldg 9 total	**1**	**LS**	**0.000**		**$0.00**	**79,474.00**	**13,166.20**	**0.00**	**$144,160**	**$79,474**	**$13,166**	**$0**	**$236,800**	**$299,600**	**$299,600.00**
Bldg 10															
Sawcut & remove concrete, excavate for new footing & micropile	2	LOC	4.000	b89	$55.59	0.00	150.00	0.00	$445	$0	$300	$0	$745	$941	$470.53
New concrete footing / SOG with dowel to existing + headed bars	2	LOC	6.000	b5	$67.34	1,500.00	250.00	0.00	$808	$3,000	$500	$0	$4,308	$5,197	$2,598.33
Drill thru (E) footings for new headed bar	0	LOC	8.000	b5	$67.34	100.00	250.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
New micropile	0	LOC	8.000	skwk	$81.42	350.00	100.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
New concrete footing / SOG with dowel to existing	2	LOC	6.000	b5	$67.34	800.00	100.00	0.00	$808	$1,600	$200	$0	$2,608	$3,191	$1,595.33
Add moment frame with all connections	2	LOC	20.000	skwk	$81.42	6,804.38	500.00	0.00	$3,257	$13,609	$1,000	$0	$17,865	$21,537	$10,768.56
Add brace frame W24x76 & W12x96 with all connections	0	LOC	32.000	skwk	$81.42	6,475.00	500.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
Add HSS brace frame all connections at (E) frames	0	LOC	16.000	skwk	$81.42	5,408.73	500.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
Add new collector with all connections	1	LOC	8.000	skwk	$81.42	1,500.00	200.00	0.00	$651	$1,500	$200	$0	$2,351	$2,866	$2,865.76
Drill hole in concrete wall, add enhanced girder connection	2	LOC	4.000	skwk	$81.42	250.00	25.00	0.00	$651	$500	$50	$0	$1,201	$1,509	$754.38
Drill hole in concrete wall, add anchor tie down - roof to wall - tight working area	12	LOC	2.000	skwk	$81.42	150.00	25.00	0.00	$1,954	$1,800	$300	$0	$4,054	$5,057	$421.44
Drill hole in concrete wall, add anchor at sub-purlin - roof to wall along one bay - tight working area	14	LOC	6.000	skwk	$81.42	200.00	50.00	0.00	$6,839	$2,800	$700	$0	$10,339	$13,157	$939.82
Add new continuity ties (subpurlin, girder, purlin)	22	LOC	2.000	carp	$86.89	50.00	10.00	0.00	$3,823	$1,100	$220	$0	$5,143	$6,604	$300.19
Add new plywood sheathing over (E) roof at perimeter	2,750	SF	0.006	carp	$86.89	2.00	0.10	0.00	$1,434	$5,500	$275	$0	$7,209	$8,707	$3.17
New blocking where wall anchor does not allow - Allowance	0	LS	8.000	carp	$86.89	500.00	50.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
Load & move debris + clean area	1	LS	12.000	clab	$60.77	0.00	200.00	0.00	$729	$0	$200	$0	$929	$1,199	$1,198.56
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
Bldg 10 total	**1**	**LS**	**0.000**		**$0.00**	**31,408.75**	**3,945.00**	**0.00**	**$21,399**	**$31,409**	**$3,945**	**$0**	**$56,753**	**$70,000**	**$70,000.00**

Project: City of Palo Alto - Seismic Risk Mitigation

Title: Replacement and Retrofit Cost Estimate

Date: May 9, 2016 & revised on November 9, 2016

DESCRIPTION	QTY	UNIT	MH / UNIT	CREW	MH COST	UNIT MATL	UNIT EQUIP	UNIT SUB	TOTAL COST LABOR	TOTAL COST MATL	TOTAL COST EQUIP	TOTAL COST SUB	TOTAL COST DIRECT	TOTAL COST w/MU	UNIT COST
Bldg 11															
Sawcut & remove concrete, excavate for new grade beam - 25 LF	2	LOC	10.000	b89	$55.59	0.00	250.00	0.00	$1,112	$0	$500	$0	$1,612	$2,058	$1,028.84
New concrete grade beam / SOG with dowel to existing footing - 25 LF	2	LOC	18.000	b5	$67.34	3,500.00	750.00	0.00	$2,424	$7,000	$1,500	$0	$10,924	$13,230	$6,614.98
New shear wall w/plywood on both sides, 25 LF	2	LOC	24.000	Carp	$86.89	4,800.00	250.00	0.00	$4,171	$9,600	$500	$0	$14,271	$17,423	$8,711.62
Drill hole in concrete wall, add anchor tie down - roof to wall along two walls - tight working area	40	LOC	2.000	skwk	$81.42	150.00	25.00	0.00	$6,513	$6,000	$1,000	$0	$13,513	$16,858	$421.44
Drill hole in concrete wall, install floor to wall anchor at floor level	40	LOC	6.000	skwk	$81.42	200.00	50.00	0.00	$19,540	$8,000	$2,000	$0	$29,540	$37,593	$939.82
Add new purlin continuity ties	25	LOC	2.000	carp	$86.89	50.00	10.00	0.00	$4,344	$1,250	$250	$0	$5,844	$7,505	$300.19
Add new collector with all connections at second floor	1	LOC	10.000	skwk	$81.42	1,500.00	200.00	0.00	$814	$1,500	$200	$0	$2,514	$3,081	$3,080.70
Add new collector with all connections at roof	1	LOC	10.000	skwk	$81.42	1,500.00	200.00	0.00	$814	$1,500	$200	$0	$2,514	$3,081	$3,080.70
Add new plywood sheathing over (E) roof	3,925	SF	0.006	carp	$86.89	2.00	0.10	0.00	$2,046	$7,850	$393	$0	$10,289	$12,427	$3.17
Load & move debris + clean area	1	LS	12.000	clab	$60.77	0.00	200.00	0.00	$729	$0	$200	$0	$929	$1,199	$1,198.56
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
Bldg 11 total	**1**	**LS**	**0.000**		**$0.00**	**42,700.00**	**6,742.50**	**0.00**	**$42,508**	**$42,700**	**$6,743**	**$0**	**$91,951**	**$114,500**	**$114,500.00**
Bldg 12															
Sawcut & remove concrete, excavate for new footing	4	LOC	4.000	b89	$55.59	0.00	150.00	0.00	$889	$0	$600	$0	$1,489	$1,882	$470.53
New concrete footing / SOG with dowel to existing	4	LOC	4.000	b5	$67.34	600.00	100.00	0.00	$1,077	$2,400	$400	$0	$3,877	$4,726	$1,181.55
Add moment frame with all connections - 12'-6" span	1	LOC	16.000	skwk	$81.42	5,382.50	500.00	0.00	$1,303	$5,383	$500	$0	$7,185	$8,661	$8,660.87
Add moment frame with all connections - 25' span	1	LOC	20.000	skwk	$81.42	6,804.38	500.00	0.00	$1,628	$6,804	$500	$0	$8,933	$10,769	$10,768.56
Allowance for increased footing size at 25' span moment frame	1	LOC	2.000	b5	$67.34	200.00	50.00	0.00	$135	$200	$50	$0	$385	$473	$472.78
Add moment frame with all connections per detail 28 - NOT APPLICABLE DETAIL	0	LOC	0.000		$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
Add new collector with all connections, 25' span	1	LOC	6.000	skwk	$81.42	1,500.00	150.00	0.00	$489	$1,500	$150	$0	$2,139	$2,592	$2,591.82
Add new collector with all connections, 37' span	1	LOC	10.000	skwk	$81.42	2,000.00	200.00	0.00	$814	$2,000	$200	$0	$3,014	$3,671	$3,670.70
Drill hole in URM wall, add supplemental vertical support - 14 LOCATIONS	14	LOC	20.000	skwk	$81.42	2,500.00	250.00	0.00	$22,797	$35,000	$3,500	$0	$61,297	$75,522	$5,394.40
Drill hole in URM wall, add anchor tie down - roof to wall along each wall - tight working area	75	LOC	2.000	skwk	$81.42	150.00	25.00	0.00	$12,213	$11,250	$1,875	$0	$25,338	$31,608	$421.44
Drill hole in URM wall, add parapet brace - along each wall	38	LOC	6.000	skwk	$81.42	1,250.00	50.00	0.00	$18,563	$47,500	$1,900	$0	$67,963	$82,795	$2,178.82
Add new plywood sheathing over (E) roof	5,000	SF	0.006	carp	$86.89	2.00	0.10	0.00	$2,607	$10,000	$500	$0	$13,107	$15,831	$3.17
Load & move debris + clean area	1	LS	12.000	clab	$60.77	0.00	200.00	0.00							
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
					$0.00	0.00	0.00	0.00	$0	$0	$0	$0	$0	$0	$0.00
Bldg 12 total	**1**	**LS**	**0.000**		**$0.00**	**122,036.88**	**10,175.00**	**0.00**	**$62,514**	**$122,037**	**$10,175**	**$0**	**$194,726**	**$238,500**	**$238,500.00**

Cost Model

Methodology

Cost Model Methodology - Palo Alto Seismic Risk Management Program project

In order to gauge the impact of seismic retrofitting potentially hazardous building types and perform loss estimates on the building stock with and without the retrofits, a conceptual cost estimates for the retrofits has been developed, to compare the cost of retrofit with the losses.

R+C has developed a conceptual retrofits for a selected set of representative buildings. Vanir provided the retrofit cost of these building for the seismic upgrade as well as the collateral cost of performing seismic works. The conceptual cost estimate is based on Vanir cost model from seismic retrofit of various building types modified and adjusted for the scope of these buildings, current construction market as well as the location impact -Palo Alto across the town, including downtown areas.

Cost of retrofit includes:

- Structural costs: The cost that a subcontractor charges a general contractor to perform structural work.
- Architectural refinishing or collateral costs: The cost for architectural work associated with the structural work that a subcontractor charges the general contractor. Included are items such as demolition and replacement costs for wall and ceiling finishes, removal and reinstallation of electrical and mechanical equipment, and reroofing. Assume an "average" level of finishes.
- Overhead and profit: Overhead includes bonds, insurance, and general conditions, and it covers administration and management of subcontractors.
- Design contingency: Use and identify a design contingency that is appropriate to the conceptual retrofit level of the retrofit descriptions to cover unknown costs of work not specified but which will likely be necessary.
- All costs are current – 4th quarter of 2016 costs – escalation to the mid-point of construction to be added at a later time based on the schedule of the construction work.

Soft costs: including but not limited to:

- Architect and engineer design fees
- Testing and inspection fees
- Permit and plan check fees
- An allowance for owner change order contingency
- Advertising, printing, and mailing fees

Cost Categories exclude the cost / fee of the following items:

- Hazardous material abatement costs, such as asbestos, lead paint, or soil contamination.
- Occupants-in-place costs, (assumed building will be vacant for the seismic retrofit)
- Relocation of the occupants / interim housing / swing space
- Relocation of the building content – furniture and similar
- Loss of use during construction
- Accessibility / ADA upgrade
- Cost of code upgrade
- Premium for Historic buildings
- Repair of existing conditions / differed maintenance
- Renovation / retrofit over and beyond seismic work
- Upgrade / enhancement of finishes / equipment / infrastructure
- Project and construction management
- Environmental documentation fees
- Financing costs
- Legal fees

RUTHERFORD + CHEKENE
Structural | Geotechnical
375 Beale Street, Suite 310
San Francisco, CA 94105

Dewberry

ARCHITECTS ENGINEERS CONSULTANTS

CITY OF
PALO ALTO

Threat and Hazard Identification and Risk Assessment

August 2014

PREPARED BY:
City of Palo Alto
Office of Emergency Services

Threat and Hazard Identification and Risk Assessment Report

Prepared by

City of Palo Alto
Office of Emergency Services

With the assistance of

Dewberry

Unrestricted – For Public Release

15 August 2014

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1 Executive Summary

To evaluate the City of Palo Alto's capabilities for addressing all hazard events, the City of Palo Alto Office of Emergency Services (OES) conducted a collaborative planning process in order to develop the City of Palo Alto 2014 Threat and Hazard Identification and Risk Assessment (THIRA). This assessment provides the outcomes of this process and is compliant with the U.S. Department of Homeland Security (DHS) Comprehensive Preparedness Guide (CPG) 201.

This THIRA report will be used to inform ongoing planning efforts throughout the city.

Palo Alto OES established a Planning Team of key stakeholders to ensure development of a well-rounded, inclusive assessment of all relevant threats/hazards and the City's capabilities to address the five mission areas of prevention, protection, mitigation, response, and recovery.

The Planning Team met in person for two full day workshops and additionally provided input via virtual reviews conducted through email correspondence. Prior to the Planning Team workshops, the executive committee met to draft Desired Outcomes. This preliminary coordination by the leadership set the tone for the THIRA planning process and established guidelines for the Planning Team.

The two full day workshops were designed to follow CPG 201. Each workshop was facilitated to emphasize comprehensive discussion and integrate expertise by Planning Team members for relevant topics. The first workshop focused on confirming the threats and hazards of concern (CPG 201 Step 1) and developing context (CPG 201 Step 2) to help evaluate potential impacts. The second workshop was a facilitated discussion to validate the potential impacts for each of the developed scenarios. The Planning Team developed Capability Targets based on the greatest estimated impact for each of the 31 Core Capabilities (CPG 201 Step 3). Once the Capability Targets were approved, the Planning Team examined each of the core capabilities against the Capability Target and identified gaps and recent advances in Planningorganization, equipment, Training, and Exercise (POETE). For each of the identified gaps, subject matter experts identified initial recommendations on how to address these gaps (CPG 201 Step 4).

As the City of Palo Alto moves forward with the results of the THIRA, it is recommended that the identified gaps be further discussed and analyzed in order to identify the root cause of the gap. Once the root cause is determined by the stakeholders, the identified recommendations should be revised, corrective actions determined and resource estimations be made in order to implement and prioritize the recommendations.

This document is published as Unrestricted – For Public Release. There is content published in the Restricted version of this document which is not included in this report due to the sensitive nature of this information. This includes Chapters 6 (Hazard Context), 7 (Vulnerability Assessment), and 8 (Capability Target Statements and Evaluation).

2 Introduction

The City of Palo Alto is at risk from a variety of natural and non-natural hazards. Stanford University and other nearby communities are also at risk to many of these same hazards. Preventing, protecting from, mitigating, responding to, and recovering from hazards and threats requires extensive coordination among City agencies and local partners, including Stanford. The City's Office of Emergency Services (OES) leads that coordination with the goal of "developing, maintaining, and sustaining a citywide, comprehensive, all hazard, risk-based emergency management program that engages the whole community"[1]. The Stanford University Department of Public Safety and the Stanford University Environmental Health & Safety (EH&S) Department partner with the City to enhance their emergency preparedness, mitigation, and response capabilities. Under separate contracts, the City provides all 911 Public Safety Answering Point (PSAP) dispatch services to Stanford, and is also the prime Fire and EMS provider to the University. Together, the City's OES and representatives from Stanford University supported the formulation of this plan.

To better understand and effectively prioritize risk reduction measures, OES conducted a collaborative planning process with an Executive Committee and a broader Stakeholder Group to evaluate current capabilities with regard to prevention, protection, mitigation, response, and recovery. This THIRA is the result of the collaborative planning process. It is compliant with the U.S. Department of Homeland Security (DHS) Comprehensive Preparedness Guide (CPG) 201, Second Edition, released in August 2013, which outlines a process to help communities identify capability targets and resource requirements necessary to address anticipated and unanticipated risks.

The result of the THIRA process is an organized evaluation of vulnerability and implementation measures based on the necessary capabilities to deal with the hazards/threats of most concern. This report should inform ongoing City and University planning efforts including, but not limited to, the following:

- Emergency Operations Plan
- Hazard Mitigation Plan
- Emergency Planning & Homeland Security Strategic Plan
- Operating Budget
- Capital Budget
- Office of Emergency Services Annual Report
- Comprehensive Plan

DHS requires annual THIRAs from States and Tier 1 Urban Area Security Initiative (UASI) organizations. The City of Palo Alto THIRA, as a local government assessment, may be shared as appropriate with the San Francisco Bay Area UASI and California Governor's Office of Emergency Services (Cal OES) to ensure consistency in vulnerability analyses. Both the California State THIRA and San Francisco Bay Area UASI THIRA were consulted in the preparation of this City of Palo Alto THIRA.

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[1] Office of Emergency Services (OES): Executive Summary (Rev. 8/24/12)

3 Goal Setting

Presidential Policy Directive 8: National Preparedness sets forth a national goal for "a secure and resilient Nation with the capabilities required across the whole community to prevent, protect against, mitigate, respond to, and recover from the threats and hazards that pose the greatest risk"[2]. To achieve this, the National Preparedness Goal identifies 31 necessary core capabilities. The City of Palo Alto Executive Team reviewed the National Preparedness Goal and through discussion established a more refined set of desired outcomes for the City based on the 31 core capabilities.

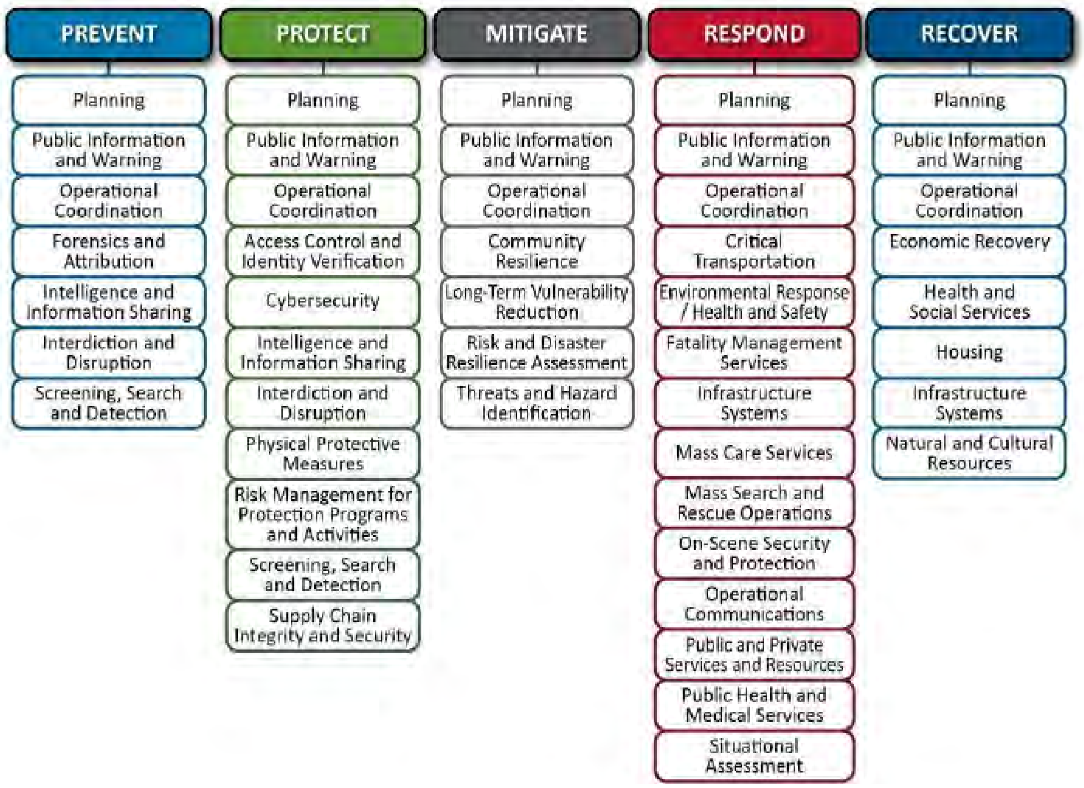

Figure 3-1 National Preparedness Core Capabilities

The following statements represent an ideal condition of the whole community's capability to prevent, protect against, mitigate, respond to, and recover from the threats and hazards of most concern.

1. ***Planning***

Conduct a consolidated, coordinated, integrated planning process to ensure participation by the whole community using an all hazards approach and defined planning cycles.

[2] National Preparedness Goal

2. ***Public Information and Warning***

Provide information in a timely and appropriate manner to the affected population, including those with functional needs. Information should be consistent with the threat or hazard and enable people to take appropriate actions or protective measures.

3. ***Operational Coordination***

Establish and maintain a unified and coordinated operational Incident Command System (ICS) compliant structure and process that appropriately integrates all critical stakeholders to include private/public partners (e.g. hospitals, residents, Emergency Services Volunteers, schools, businesses, etc.) and supports the execution of core capabilities.

Prevention

4. ***Forensics and Attribution***

Conduct investigation, evidence collection, and analysis for criminal prosecution as well as assist in preventing initial or follow-on terrorist acts.

5. ***Intelligence and Information Sharing***

Interface with allied public safety agencies, regional planning entities, and other relevant stakeholders to collect, analyze, and disseminate timely, accurate, and actionable information.

6. ***Interdiction and Disruption***

Coordinate with other agencies to facilitate interdiction of cargo and persons that could present a threat to the City of Palo Alto and Stanford University.

7. ***Screening Search and Detection***

Screen and search cargo, packages, and persons if/when legally permissible and justified. For example, observe safety protocols with those entering Stanford Stadium for certain security-risk events.

Protection

8. ***Access Control and Identity Verification***

Establish verification of identity to authorize, grantor deny physical and cyber access to critical infrastructure, key asset locations, and networks.

9. ***Cybersecurity***

Protect against malicious activity directed toward critical infrastructure, key resources, and networks.

10. *Physical Protective Measures*

Protect people, structures, materials, products, and systems of key operational activities and critical infrastructure sectors against identified or perceived threats.

11. *Risk Management for Protection Programs and Activities*

Complete and/or encourage risk assessments, using standardized methodologies/models, for critical infrastructure/key resources (CIKR) and assets.

12. *Supply Chain Integrity and Security*

Accounting for reliance on digital technology and modern management practices, work with and encourage private sector to build resiliency in the supply chain and develop tangible and intellectual methods to protect it.

Mitigation

13. *Community Resilience*

Engage the whole community in improving resilience through development and implementation of local risk management plans, techniques, strategies, training, and exercises.

14. *Long–term Vulnerability Reduction*

Implement ongoing strategies to achieve measurable decreases in the long-term vulnerability of critical infrastructure, systems, and community features at risk to identified threats and hazards.

15. *Risk and Disaster Resilience Assessment*

Maintain a risk assessment that includes identification and analysis of information about security gaps, localized vulnerabilities and risk consequences in City systems and facilities.

16. *Threats and Hazards Identification*

Continually review/identify/maintain the assessment of identified threats and hazards.

Response

17. *Critical Transportation*

Establish physical access through appropriate transportation corridors and deliver required resources in an effort to save lives and to meet the needs of disaster survivors.

18. *Environmental Response/Health and Safety*

Conduct health and safety hazard and critical systems assessments and disseminate guidance and resources, including the deployment of hazardous materials teams, to support environmental health and safety actions for response personnel and the affected population and area. Conduct water sampling from established locations to determine potential access breach and/or contamination.

19. *Fatality Management Services*

Conduct operations to recover fatalities in coordination with Operational Area/regional/state, federal, and NGO partners.

20. *Mass Care Services*

Move and deliver resources and capabilities to meet the needs of disaster survivors, including individuals with access and functional needs and others who may be considered at-risk. Coordinate operations with government and NGO assistance partners.

21. *Mass Search and Rescue Operations*

Conduct search and rescue operations to locate and rescue persons in distress.

22. *On-Scene Security and Protection*

Establish a safe and secure environment for the affected area.

23. *Operational Communications*

Establish and maintain the capability and capacity for timely and sufficient integrated communications in support of security, situational awareness, and operations. This includes redundant capabilities and resilient systems and facilities.

24. *Public and Private Services and Resources*

Mobilize and coordinate governmental, nongovernmental, and private sector resources within and outside the affected areas to save lives, sustain lives, meet basic human needs, stabilize the incident, and transition to recovery.

25. *Public Health and Medical Services*

With operational area support as needed, complete triage and initial stabilization of casualties and begin coordination of transport to definitive care for those likely to survive their injuries.

26. *Situational Assessment*

Deliver information sufficient to inform City decisions, through collaboration with key partners, regarding immediate life-saving and -sustaining activities and engage governmental, private, and civic-sector resources within and outside of the affected area to meet basic human needs and stabilize the incident and maintain public services.

27. *Infrastructure Systems*

Decrease and stabilize immediate infrastructure threats to the affected population, following all City EOP procedures.

Recovery

28. *Economic Recovery*

Develop a plan with whole community partners, with a specified timeline for redeveloping community infrastructures to contribute to resiliency, accessibility, and sustainability.

29. *Health and Social Services*

Restore basic health and social services functions with support from Operational Area/state/federal, and NGO partners.

30. *Housing*

Assess preliminary housing impacts and needs, identify currently available options for temporary housing, and plan for permanent housing in coordination with Operational Area/state/federal, and NGO partners.

31. *Natural and Cultural Resources*

Mitigate impacts, stabilize natural and cultural resources, and conduct a preliminary assessment of the impacts to identify and implement protections during the various stages of incident management—from stabilization through recovery.

4 Hazard Identification and Prioritization

4.1 Identified Hazards and Threats

Several City and regional emergency management and planning documents were reviewed to identify a comprehensive list of hazards for consideration. These documents address both natural and human caused hazards that have the potential to impact Palo Alto and the Bay Area. Many of these documents estimate the impacts that result from the identified hazards. City policies that aid in emergency prevention, protection, mitigation, response, and recovery are highlighted in these documents. The reviewed documents which were integral in providing key information are listed below:

City of Palo Alto Emergency Operations Plan, June 2007

Palo Alto City Council Priority Update on Emergency Preparedness, September 2010

City of Palo Alto Local Hazard Mitigation Plan, 2011

City of Palo Alto Energy Assurance Plan, July 2013

After Action Report Power Outage and Plane Crash, May 2010

After Action Report Winter Storm of December 23, 2012, February 2013

City of Palo Alto Emergency Planning Strategic Plan, November 2009

State of California THIRA Draft, December 2012

Bay Area Urban Area Security Initiative THIRA, December 2012

San Francisco THIRA, 2012

National Planning Scenarios (See table 4-1 below)

San Francisco Bay Area Regional Emergency Coordination Plan, March 2008

City of Palo Alto Comprehensive Plan, July 2007[3]; Land Use Designation Map, March 2011; Housing Element, November 2013; Updated version to be released in 2014/2015

In addition to the documents listed above, the Infrastructure Blue Ribbon Commission Final Report on Palo Alto's Infrastructure: Catching Up, Keeping Up, and Moving Ahead (December 2011) specifically helped to identify the City's critical facilities and infrastructure used in estimating impacts and assessing vulnerability.

Table 4-1 National Planning Scenarios

Scenario 1: Nuclear Detonation
Scenario 2: Biological Attack – Aerosol Anthrax
Scenario 3: Biological Disease Outbreak – Pandemic Influenza
Scenario 4: Biological Attack - Plague
Scenario 5: Chemical Attack – Blister Agent
Scenario 6: Chemical Attack – Toxic Industrial Chemicals
Scenario 7: Chemical Attack – Nerve Agent
Scenario 8: Chemical Attack – Chlorine Tank Explosion
Scenario 9: Natural Disaster – Major Earthquake
Scenario 10: Natural Disaster – Major Hurricane
Scenario 11: Radiological Attack – Radiological Dispersal Devices
Scenario 12: Explosives Attack – Bombing Using Improvised Explosive Devices
Scenario 13: Biological Attack – Food Contamination
Scenario 14: Biological Attack – Foreign Animal Disease (Foot and Mouth Disease)
Scenario 15: Cyber Attack

[3] The City is in the process of updating the 1998-2010 Palo Alto Comprehensive Plan which will contain updated goals, policies, and programs relating to safety and natural hazards. The update is expected to be completed by the end of 2015 and will have an expected horizon year of 2030. The updated Comprehensive Plan will be consistent with this Threat and Hazard Identification and Risk Assessment.

Table 4-2 Comprehensive List of Hazards and Definitions presents the comprehensive list of hazards as approved by the Executive Committee and considered by the Stakeholder Group.

Table 4-2 Comprehensive List of Hazards and Definitions

Natural Hazard	Definition
Earthquake	An earthquake is a phenomenon resulting from the sudden release of stored energy in the crust of the Earth in the form of seismic waves. They can devastate regions and destroy nearly any type of asset. They can cause injuries and death due to falling debris and broken glass. A major earthquake could trigger significant landslides, spark fires, and release toxic chemicals. If an earthquake occurred during the rainy winter season, landslides would be worsened and flooding could occur, exacerbated by damaged creek culverts and storm drains.
Extreme Heat	A heat wave is defined as prolonged periods of excessive heat, often combined with excessive humidity. Extreme heat is defined as temperatures that hover ten degrees or more above the average high temperature for the region and last for several weeks. The main concern in periods of extreme heat is the potential public health impact, such as heat exhaustion or heat stroke.
Flood/Winter Storm	A flood is any high flow, overflow or inundation by water which causes or threatens damage. Flooding is often caused by winter storms in the City of Palo Alto. Flooding can contaminate potable water, wastewater, and irrigation systems, which may negatively affect the quality of the water supply and result in an increase of water and food borne diseases. Severe winter storms can cause flooding.
High Wind	Wind is associated with multiple natural hazards. In some hazards, wind is the primary cause of damage, while in others, wind plays a contributory or auxiliary role. Damaging wind is primarily associated with hurricanes, tornadoes, downbursts, severe thunderstorms, and winter storms. Wind plays a contributory role in wildfire generation and propagation and can exacerbate severe droughts as well as cause trees to fall on power lines.
Landslides	In a landslide, masses of rock, earth or debris move down a slope. Landslides may be small or large, slow or rapid. They are activated by storms, earthquakes, fires, alternate freezing and thawing, and steepening of slopes by erosion or human modification.

Public Health Pandemic	The most readily apparent public health emergency is an outbreak of influenza pandemic, although other public health emergencies are just as likely. An influenza pandemic is a worldwide outbreak of disease that occurs when a new influenza virus appears in human population, causes serious illness and then spreads easily from person to person worldwide. Pandemics are different from seasonal outbreaks of the flu. Since 2005, a high virulent strain of bird flu (H5N1), which developed in Asia, has steadily spread in birds to the Middle East, Africa, and Europe. The fatality rate of this particular strain is more than 50 percent. The Center for Disease Control and Prevention (CDC) has estimated that, in the US alone, a "minor" influenza pandemic could infect up to 200 million people and cause between 100,000-200,000 deaths. The potential financial impact on the US of this type of pandemic is estimated at $166 billion. Pandemics could continue for up to 24 months and cause major disruptions in supply chains for essential goods and services. Other outbreaks could include H1N1, Whooping Cough, Salmonella, E. coli, and Measles.
Tornado	A tornado appears as a rotating, funnel-shaped cloud that extends from a thunderstorm to the ground with whirling winds that can reach 300 miles per hour. Damage paths can be in excess of one mile wide and fifty miles long. Waterspouts are tornadoes that form over water.
Tsunami	A tsunami is a sea wave of local or distant origin that results from large-scale seafloor displacements associated with large earthquakes, major submarine slides or exploding volcanic islands.
Wildland Fire	A wildfire is an uncontrollable fire beginning in a wilderness area, typified by its large size, and ability to spread quickly or change direction suddenly. High temperatures and drought followed by an active period of vegetation growth provide the most dangerous conditions. Wildfires can affect any type of asset and may threaten major population centers when they breakout on the rural-urban fringe.
Technological	**Definition**

Hazard	
Airplane Accident	Aviation accidents may be caused by problems originating from mechanical difficulties, pilot error or acts of terrorism. Airplane accidents can result from aircraft experiencing trouble while in flight or from mid-air collisions between aircraft flying over or near Palo Alto since the City lies in the flight path of two international airports: San Jose and San Francisco. There is also the potential for this type of accident to occur over water.
Dam Failure	Flooding inundation areas in the event of dam failure extend across a wide region of northeastern Palo Alto. Reservoir failures that would affect Palo Alto include Felt Lake, Searsville Lake, and Foothills Park (Boronda Lake).
Financial Disruption	A situation where the markets cease to function in a regular manner, typically characterized by rapid and large market declines. Market disruptions can result from both physical threats to the stock exchange or unusual trading (as in a crash). In either case, the disruption typically causes panic and results in disorderly market conditions.
Food/Water Contamination	A water system can become contaminated as a result of flooding or by saltwater intrusion. Food contamination refers to the presence in food of harmful chemicals and microorganisms which can cause consumer illness.
Hazardous Materials Spill	The release of a hazardous material to the environment could cause a multitude of problems. Although these incidents can happen almost anywhere, certain areas of the city are at higher risk, such as near roadways that are frequently used for transporting hazardous materials and locations with industrial facilities that use, store or dispose of such materials. Areas crossed by railways, waterways, airways, and pipelines also have increased potential for mishaps. Hazards can occur during production, storage, transportation, use or disposal. Communities can be at risk if a chemical is used unsafely or released in harmful amounts into the environment. Hazardous materials can cause death, serious injury, long-lasting health effects, and damage to buildings, the environment, homes, and other property.

Oil Spill	An oil spill is the release of a liquid petroleum hydrocarbon into the environment due to human activity or technological error. The term is usually applied to marine oil spills, but spills can also occur on land. Spills may be due to releases of oil from tankers, offshore platforms, and drilling rigs and wells. An oil spill represents an immediate fire hazard and can contaminate drinking water supplies. Contamination can also have an economic impact on tourism and marine resource extraction industries. Clean up and recovery is time and cost consuming.
Power Blackout/Energy Shortage/Utilities Failure	Energy disruptions are considered to be a form of Lifeline System Failure. This can be the consequence of any of the other hazards identified or as a primary hazard, absent of an outside trigger. A failure could involve the City's potable water system, power system, natural gas system, wastewater system, communication system or transportation system.
Train Accident	Most train accidents are caused by human error, often relating to communications, speed limits, and braking. Train accidents also can occur because of equipment failure. Rail accidents include derailment, collisions, railroad grade crossing, obstruction, explosion or fire/violent rupture.
Urban Fire	In addition to the areas within the City limits considered to be in the Wildland Urban Interface (WUI), the more densely built "flatlands" are also at risk. The City has over 25,000 housing units and a significant business base. The proximity of structures to each other within the City creates additional exposure to widespread urban fire. Localized, single-structure fires sometimes occur in Palo Alto. Major uncontrolled events are a possibility, but rarely occur.
Human Caused Hazard	**Definition**
Agro-Terrorism	Agro-terrorism is the use of a biological or chemical agent against crops, livestock or poultry. The agent could be any of a wide range of pathogens or toxins. Agro-terrorism may be used to endanger public heath, to reduce the food supply or as a strategic economic weapon.
Aircraft as a weapon	Aircraft as a weapon (AAW) is a suicide attack using an airplane to target an asset. The primary explosive is the airplane's fuel supply. Aircraft include but are not limited to large commercial passenger craft, cargo craft, small single or double engine private craft, gliders, helicopters, and lighter-than-aircraft.

Biological Attack (contagious and non-contagious)	A contagious biological attack is an attack on a population using a communicable, infectious disease. Effects occur after an incubation period which varies with the biological strain in use. They can quickly infect large populations. Bioterrorism can cause mass panic and societal disruption.
Chemical Agent/Toxic Inhalation Release	Chemical weapons kill by attacking the nervous system and lungs or by interfering with a body's ability to absorb oxygen. Some are designed to incapacitate by producing severe burns and blisters. These include such agents as mustard, tabun, sarin (GB), and nerve gas. Chemical agents could be introduced through an HVAC system or air inlets in buildings such as apartments, commercial offices or public facilities.
Civil Disorder	Civil disorder refers to unrest caused by a group of people and may include terrorist activities. Public demonstrations have the potential to lead to looting and rioting. There are many potential causes for civil disorder including: animal rights, labor disputes, civil rights, campus related issues, abortion rights, neighboring jurisdictions, political issues, events (sports, music, etc.), and spontaneous miscellaneous events. Potential consequences from acts of civil disorder include: disruptions of police and city services, closure of roads, rioting, property damage, and injuries to protesters, police officers, and uninvolved parties.
Conventional Attack	Light armed attack (small arms (ballistics) which include guns and rockets or stand-off weapons such as rocket propelled grenades or mortars) with one or more people acting for a terrorist group, anti-government/anti-political group, etc.
Major Crime	A major criminal incident (shooting, homicide, kidnapping) including multiple suspects or multiple victims with an ongoing threat to the community.
Cyber Attack	A cyber terrorist can infiltrate many institutions including banking, medical, education, government, military, and communication and infrastructure systems. The majority of effective malicious cyber-activity has become web-based. Recent trends indicate that hackers are targeting users to steal personal information and moving away from targeting computers by causing system failure.

Hostage/Assassin	A hostage situation includes a person or group of people seized or held as security for the fulfillment of a condition. An assassin is a person who murders an important person in a surprise attack for political or religious reasons.
IED	Improvised Explosive Devices (IEDs) are constructed using conventional explosives and flammable materials. There are a variety of detonation methods. Conventional explosives include, but are not limited to: ammonium nitrate and fuel oil, TATP, TNT, RDX, PETN, C4, Semtex or Dynamite. Flammable materials include, but are not limited to: gasoline, kerosene, alcohol, iodine crystals, magnesium, glycerin or aluminum powder. An IED is likely to cause localized consequence primarily in the form of casualties and economic impact.
Nuclear Attack/Acts of War	The detonation of a nuclear weapon meets the US DODs definition of a Weapon of Mass Destruction, which includes any weapon or device that is intended or has the capability to cause death or serious bodily injury to a significant number of people through the release of toxic or poisonous chemicals or their precursors, a disease organism or radiation or radioactivity. A nuclear bomb attack could occur without warning and cause mass devastation within seconds. Radiation can exist in the atmosphere and in the ground for years after an event. A nuclear attack would cause more damage in a metropolitan area.
Radiological Dispersion Device (RDD)	RDDs (commonly known as “dirty bombs”) consist of radioactive materials wrapped in conventional explosives, which upon detonation release deadly radioactive particles into the environment.
Sabotage/Theft	Sabotage is a deliberate action aimed at weakening another entity through subversion, destruction, obstruction or destruction. The result of sabotage could be the destruction or damage of a vital facility. Some criminals have engaged in sabotage for reasons of extortion. Political sabotage is sometimes used to harass or damage the reputation of a political opponent.
Terrorism	Terrorist activities include bombings, kidnappings, shootings, and hijackings. 80% of terrorist activity is perpetrated through the use of explosives, and the other 20% is a combination of arson, vandalism, and assassination. The actual use of terrorist chemical, nuclear, and biological weapons has occurred less than a handful of times in the last 50 years. The common kinds of terrorist situations (explosions, fires, vandalism, and shootings) are the same kind of critical incidents first responders handle on a daily

	basis. Terrorist activity can be conducted by an active shooter, an individual actively engaging in killing or attempting to kill people in a confined and populated area using a firearm. Targets of an armed attack vary; however, in recent history, schools, office buildings, federal/state owned buildings, religious institutions, military installations, and large public areas have all been subject to armed attacks. An active shooter may be a disgruntled student or group of students, an employee or an anti-government/anti-political/extremist citizen or group.
Vehicle Born IED	Vehicle Born Improvised Explosive Devices (VBIEDs) are constructed using conventional explosives and flammable materials. VBIEDs involve the use of cars, trucks, and other vehicles as the package/container to deliver explosive payloads to a target. Larger vehicles enable larger amounts of explosives, resulting in a greater impact. Functioning of devices can vary within the same methods as the package types and can have the same common characteristics as other IEDs. Some examples in the U.S. include the 1993 World Trade Center bombing (a precursor to 9/11) and the Murrah Federal Building in Oklahoma City.
Workplace Violence	Workplace violence is violence or the threat of violence against workers. It includes any act or threat of physical violence, harassment, intimidation or other threatening disruptive behavior that occurs at the worksite. It can occur at or outside the workplace and can range from threats and verbal abuse to physical assaults and homicide. It can affect and involve employees, clients, customers, and visitors. Workplace violence includes locations such as churches, malls, etc. and may be the result of a person acting alone.

The Stakeholder Group, through a facilitated exercise reviewed the comprehensive list of hazards/threats and prioritized them to identify those of most concern. The prioritization methodology is presented in the following sections.

4.2 Natural Hazard Prioritization

Each natural hazard was rated by the sum of three criteria. The first criterion was estimated likelihood of future occurrence on a scale of 1 - 4. The second criterion was potential impacts on a scale of 1 -4. Both of these scales are presented in Table 4-3 Natural Hazards Rating Criteria. The third criterion was based on results from a public survey conducted during the 2012 local hazard mitigation planning process. Respondents were asked to select the five hazards of most concern. The percentage of responses for the identified hazards was scored on a 10 point scale. For each hazard, the three criteria were summed, and the natural hazards with the highest rating were included in the hazards of most concern for the City of Palo Alto.

Table 4-3 Natural Hazards Rating Criteria

Natural Hazards Probability Rating Criteria	
Based on estimated likelihood of occurrence from historical data	*Score*
Unlikely (Less than 1% probability in next 100 years or has a recurrence interval of greater than every 100 years.)	1
Somewhat Likely (Between 1 and 10% probability in next year or has a recurrence interval of 11 to 100 years.)	2
Likely (Between 10 and 100% probability in next year or has a recurrence interval of 10 years or less.)	3
Highly Likely (Near 100% probability in next year or happens every year.)	4
Natural Hazards Potential Impacts Rating Criteria	
Based on percentage of damage to typical facility in community	*Score*
Negligible - less than 10% damage	1
Limited - between 10% and 25% damage	2
Critical - between 25% and 50% damage	3
Catastrophic - more than 50% damage	4

Table 4-4 Natural Hazard Rating Results

Natural Hazard	Probability	Impact	Survey	**Rating Score**
Earthquake	2	4	9	15
Extreme Heat	2	1	0	3
Flood*	3	2	4	9
High Wind	2	1	0	3
Landslides	3	1	0	4
Public Health Pandemic	2	3	2	7
Severe Winter Storm*	3	2	6	11
Tornado	1	1	0	2
Tsunami	1	1	0	2
Wildland Fire	3	3	1	7

*Most severe impacts of winter storms are flooding. These two hazards were combined for a Rating Score of 10.

4.3 Technological Hazard Prioritization

Each technological hazard was reviewed for its potential to occur. The Stakeholder Group shared knowledge, concerns, and other pertinent information to come to a consensus on rating each technological hazard as low, medium, high or very high.

Table 4-5 Technological Hazards Rating Criteria

Technological Hazards Ranking Criteria	Rating
An event is imminent. Experts have confirmed potential for occurrence.	Very High
An event is expected/probable. Experts have confirmed potential for occurrence.	High
An event is possible. Potential for occurrence is assumed but not verified.	Medium
An event is unlikely. Potential for occurrence is extremely limited.	Low

Table 4-6 Technological Hazard Rating Results

Technological Hazard	Rating
Airplane Accident	High
Dam Failure*	Low
Financial Disruption	Low
Food/Water Contamination	Medium
Hazardous Materials Spill	High
Oil Spill	Medium
Power Blackout/Energy Shortage/Utilities Failure	Medium
Train Accident	Medium
Urban Fire	High

* Rating results shown have been considered as independent hazards and do not include secondary or cascading events. Dam failure includes technological failure risk (engineering) and does not include secondary risk from an earthquake.

4.4 Human Caused Threat Prioritization

Each human caused threat was reviewed for its potential to occur. The Stakeholder Group shared knowledge, concerns, and other pertinent information to come to a consensus on rating each human caused threat as low, medium, high or very high.

Table 4-7 Human Caused Threat Rating Criteria

Human Caused Threat Ranking Criteria	Rating
The likelihood of a threat, weapon, and tactic being used against a site or building is **imminent**. Internal decision makers and/or external law enforcement and intelligence agencies determine *the threat is credible*.	Very High
The likelihood of a threat, weapon, and tactic being used against a site or building is **expected**. Internal decision makers and/or external law enforcement and intelligence agencies determine *the threat is credible*.	High
The likelihood of a threat, weapon, and tactic being used against a site or building is **possible**. Internal decision makers and/or external law enforcement and intelligence agencies determine *the threat is known, but is not verified*.	Medium
The likelihood of a threat, weapon, and tactic being used in the region or against the site or building is **negligible**. Internal decision makers and/or external law enforcement and intelligence agencies determine *the threat is non-existent or extremely unlikely*.	Low

Table 4-8 Human Caused Threat Rating Results

Human Caused Threat	Rating
Agro-Terrorism	Medium
Aircraft as a weapon	Low
Biological Attack	Medium
Chemical Agent/Toxic Inhalation Release	Medium
Civil Disorder	Medium
Conventional Attack	Medium
Major Crime	Very High
Cyber Attack	Very High
Hostage/Assassin	High
IED	Medium
Nuclear Attack/Acts of War	Low
Radiological Dispersion Device	Medium

Human Caused Threat	Rating
Sabotage/Theft	High
Terrorism	Medium
Vehicle Born IED	Medium
Workplace Violence	Very High

4.5 Threats and Hazards of Most Concern

The prioritization process resulted in a pared down listing of natural, technological, and human caused hazards/threats of most concern to the City of Palo Alto and its local partners. These are presented in Table 4-9 Summary of All Hazards Prioritization.

To complete the THIRA process, we researched each of these hazards/threats to develop a more complete understanding of their characteristics. Section 5 presents detailed hazard and threat profiles.

Table 4-9 Summary of All Hazards Prioritization

Threats and Hazards of Most Concern		
Natural	Technological	Human-caused
Earthquake	Airplane Accident	Major Crime
Flood/Severe Winter Storm	Hazardous Waste/ Materials Spill	Cyber Attack
	Urban Fire	Hostage/Assassin
		Sabotage/Theft
		Workplace Violence

5 Hazard Profiles

This section contains profiles detailing the characteristics of the hazards of most concern.

5.1 Non-Natural Hazard Profile Structure

Technological and human caused threats and hazards require a different approach to evaluating likelihood and potential impacts as compared to natural hazards. With natural hazards, as done in the local hazard mitigation planning process, an evaluation is based on past occurrences, weather patterns, geography, and other relevant earth science. Technological and human caused threats and hazards are not dependent upon earth science and do not occur with regular patterns. For that reason, a modified approach is appropriate for evaluating the potential of technological and human caused threats and hazards.

Each technological or human caused hazard profile contains the following components:

Application Mode: describing the human act(s) or unintended event(s) necessary to cause the hazard to occur.

Duration: the anticipated length of time the hazard is present on the target. For example, the duration of an earthquake may be just seconds, but a chemical warfare agent such as mustard gas, if un-remediated, can persist for days or weeks under the right conditions.

Dynamic/Static Characteristic: describing the hazard's tendency or that of its effects, to either expand, contract or remain confined in time, magnitude, and space. For example, the physical destruction caused by an earthquake is generally confined to the place in which it occurs, and it does not usually get worse, unless there are aftershocks or other cascading failures; in contrast, a cloud of chlorine gas leaking from a storage tank can change location by drifting with the wind and can diminish in danger by dissipating over time.

Mitigating Conditions: characteristics of the target and its physical environment that can reduce the effects of a hazard. For example, earthen berms can provide protection from bombs; exposure to sunlight can render some biological agents ineffective; and effective perimeter lighting and surveillance can minimize the likelihood of someone approaching a target unseen.

Exacerbating Conditions: characteristics that can enhance or magnify the effects of a hazard. For example, depressions or low areas in terrain can trap heavy vapors, and proliferation of street furniture (trash receptacles, newspaper vending machines, mail boxes, etc) can provide concealment opportunities for explosive devises.

5.2 Earthquake Hazard Summary

Past land use decisions in Palo Alto have not always taken hazards into consideration. Moreover, older buildings and infrastructure reflect the construction and engineering standards of their era, which in most cases fall short of current standards for seismic safety. As a result, a portion of the City, including 130 soft story structures, would be at some risk in the event of a major earthquake. The greatest hazards are associated with fault rupture and ground shaking, although liquefaction hazards are significant in the area east of Highway 101 due to the porous nature and high water content of the soil. Landslides, a hazard that is common in the foothills of Palo Alto, may result from heavy rain, erosion, removal of vegetationor human activities. Settlement and subsidence due to groundwater withdrawal has historically been a problem in the southern and eastern areas of the City of Palo Alto, but has been largely halted by groundwater recharge efforts and reduced pumping. Seismically-induced flooding is a hazard due to the possibility of dam failure at Felt Lake and Searsville Lake and the potential for levee failure near the San Francisco Bay.

To help mitigate the damages that may result from a potential earthquake, Palo Alto strictly enforces uniform building code seismic safety restrictions and provides incentives for seismic retrofits of structures in the University Avenue/Downtown area. The City also allows development rights achieved through seismic upgrading of specified sites to be transferred to designated eligible receiver sites per Program N - 71 in the Comprehensive Plan and per the Palo Alto Municipal Code, Section 18.18.080. Palo Alto has completed seismic improvements to facilities and critical infrastructure as part of its mitigation planning, including City Hall, library buildings, the Art Center, and water reservoirs among others.

5.3 Flood/Severe Winter Storm Hazard Summary

Flood hazards, including tidal flooding from overtopping of coastal levees during extreme high tide events in the Bay and fluvial flooding from creeks overflowing their banks, are likely to continue to occur in Palo Alto. Winter storms, which generate large amounts of rain and heavy winds, can result in flooding.

As noted in the 2011 LHMP, the City minimizes exposure to flood hazards through its participation in the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program (NFIP). FEMA makes NFIP flood insurance available to Palo Alto residents and businesses as a result of the City's adoption of required floodplain management regulations into its Municipal Code (Chapter 16.52) that promote public health, safety and general welfare, and minimize damages due to flood conditions. City staff reviews proposed development in flood prone areas and enforces the floodplain management regulations for specified building activity in Special Flood Hazard Areas, as depicted on FEMA's Flood Insurance Rate Maps (FIRMs). In 1990, the City created an independent enterprise fund to fund needed improvements to the storm drain system with revenue generated through user fees and developed a Storm Drain Master Plan in 1993 to identify and prioritize a set of projects to increase system capacity and reduce the incidence of street flooding. Property owners approved a ballot measure in 2005 to increase the City's monthly storm drain fee and thereby provided funding to implement a set of seven high-priority capital improvement projects to upgrade the storm drain system. The City has long been a partner with the Santa Clara Valley Water

District (SCVWD) who constructed channel upgrades (100-year flood protection) in the 1980's and 1990's to reduce flood risks from Adobe, Matadero, and Barron Creeks. San Francisquito Creek remains a substantial flood risk to the community, along with tidal flooding during extreme high tide events. Following the historic 1998 flood, five local agencies from two counties (the cities of Palo Alto, Menlo Park, and East Palo Alto, the County of San Mateo Flood Control District, and the Santa Clara Valley Water District) formed the San Francisquito Creek Joint Powers Authority (SFCJPA) to plan, design, and implement flood, environmental, and recreational projects. Specifically, the San Francisquito Creek Joint Powers Authority is developing a comprehensive regional plan for the San Francisquito Creek watershed that will improve the level of flood protection to Palo Alto and surrounding communities. The SFCJPA's initial capital project, being planned in conjunction with the City of Palo Alto, is designed to increase creek flow capacity to protect people and property from fluvial flooding along a critical urban section of the creek between Highway 101 and San Francisco Bay.

Palo Alto, along with the entire Bay Area, is also subject to increasing flood risk as a result of rising sea levels, requiring city planners to collaborate with regional organizations and projects, such as the SCVWD, SFCJPA, the US Army Corps of Engineers' South San Francisco Bay Shoreline Study, and the State Coastal Conservancy Salt Pond Restoration Project, who have each initiated studies on impacts of sea level rise in the vicinity of Palo Alto.

5.4 Airplane Accident Profile

Aircraft accidents in Palo Alto can result from an aircraft experiencing trouble or from mid-air collisions between aircraft flying over or near Palo Alto as they approach the three Bay Area Airports (San Francisco, Oakland, and San Jose), as well as Moffett Field. In February 2010, a small aircraft left the Palo Alto Airport and collided with power lines, causing a City-wide power outage. The Palo Alto electrical utility feedpoint to PG&E (and the grid) is a single point, near the airport.

Application mode: Aviation accidents may be caused by problems originating from mechanical difficulties, pilot error or acts of terrorism. Extreme weather conditions may also increase the potential of an accident. Airplane accidents can result from major aircraft experiencing trouble while in flight or from mid-air collisions between aircraft flying over or near Palo Alto. There is also the potential for this type of accident to occur over water.[4]

Duration: An airplane accident can occur in an instant and without notice or could be reported but not remediated, lasting a few hours. Clean up after an accident could take days to weeks. Longer term actions include repairing any buildings and infrastructure that may have been damaged due to the accident and investigating the cause of the incident.

Dynamic/static characteristics: The number of fatalities/injuries and the area damaged by the aircraft accident can vary depending on the type and magnitude of the accident. While damage may be concentrated to the location of the incident, secondary impacts from the accident, such as explosion and fire, as well as debris and hazardous materials, could spread from the initial area of impact.

[4] City of Palo Alto EOP (2007)

Mitigating conditions: The City's Emergency Operations Plan (EOP) outlines a response plan to airplane accidents. The EOP also notes that consequences of an airplane accident from a small aircraft associated with Palo Alto airport would be low. Issues in responding to the February 2010 incident were identified in an After Action Report. These issues have been addressed to provide better response to a potential future incident.

Exacerbating conditions: The City of Palo Alto lies between two international airports, San Jose and San Francisco. Within the boundaries of Palo Alto, Santa Clara County operates the Palo Alto Municipal Airport, a general aviation airport. There is potential for an accident to occur in the air or on the ground near these locations as well as over water in Palo Alto's jurisdiction.

5.5 Hazardous Waste/Materials Spill Profile

Hazardous waste/materials are widely used or created at facilities such as hospitals, wastewater treatment plants, universities and industrial/manufacturing warehouses. Several household products such as cleaning supplies and paint are also considered hazardous materials and can be found in households and stores. Hazardous materials include:

- Explosives;
- Flammable, non-flammable, and poison gas;
- Flammable liquids;
- Flammable, spontaneously combustible, and dangerous when wet solids;
- Oxidizers and organic peroxides;
- Poisons and infectious substances;
- Radioactive materials; and
- Corrosive materials.[5]

The release of a hazardous material to the environment could cause a multitude of problems. Although these incidents can happen almost anywhere, certain areas of the City are at higher risk, such as near roadways that are frequently used for transporting hazardous materials and locations with industrial facilities that use, store or dispose of such materials. Areas crossed by railways, waterways, airways, and pipelines also have increased potential for mishaps. Incidences can occur during production, storage, transportation, use or disposal of hazardous materials. Communities can be at risk if a chemical is used unsafely or released in harmful

[5] National Archives and Records Administration, "Code of Federal Regulations Title 49: Transportation" (July 1 2012), http://ecfr/gpoaccess.gov/cgi/t/text/text-idx?c=ecfr;sid=54f867044f1c9e1af52443eb305e1360;rgn=div5;view=text;node=49%3A2.1.1.3.7;idno=49;cc=ecfr

amounts into the environment. Hazardous materials can cause death, serious injury, long-lasting health effects, and damage to buildings, the environment, homes, and other property.[6]

Application mode: Hazardous waste/materials spills may be accidental or intentional, and may occur at fixed facilities or on vehicles.

Accidental Hazardous Waste/Materials Spill

Hazardous materials accidents can range from a chemical spill on a highway to groundwater contamination by naturally occurring methane gas to a household hazardous materials accident.[7] Potential hazards can occur during any stage of use from production and storage to transportation, use or disposal. Production and storage occurs in chemical plants, gas stations, hospitals, and many other sites. There are many reasons an unintentional hazardous waste/materials spill may occur. Some of these include:

- Malfunction of equipment
- Natural disaster
- Accidents caused by humans[8]

Intentional Fixed Facility Hazardous Waste/Materials Spill

Hazardous material spills at fixed facilities may be internal or external to the facility. External releases may involve industrial storage, firesor malicious acts. External releases may create airborne plumes of chemical, biologicalor radiological elements that can affect a wide area and last for hours or days. Internal releases occur inside buildings and can be caused by a chemical spill or release of a biological or radiological agent. Internal releases can affect all occupants of a building, particularly if the material is distributed throughout the building through the heating/ventilation system.[9]

Intentional hazardous material releases at fixed facilities might include:

- Deliberate release of a hazardous substance by an employee of a facility that stores or uses hazardous materials or produces hazardous waste;
- Deliberate release of a hazardous substance into the water supply
- Detonation of a "dirty bomb" – an explosive device containing radiological or biological substances that are released into the air upon explosion;

[6] City of Palo Alto EOP; Santa Clara County 2011 LHMP
[7] University of Idaho Cooperative Extension System, http://www.uiweb.uidaho.edu/disaster/haz/hazmat.html
[8] Innovateus, "What is a Chemical Spill?", http://www.innovateus.net/earth-matters/what-chemical-spill
[9] US Air Force, "Protective Actions for a Hazardous Material Release", (22 October 2001), Http://emc.ornl.gov/CSEPPweb/data/Reports/Misc.%20Reports/HAZMAT.pdf

- Redirection of toxic waste into water supply or ventilation system; and
- Delivery or placement of a hazardous material inside a building.

Intentional Mobile Hazardous Waste/Materials Spill

Intentional mobile releases may include:

- Release of a chemical, biological or radiological agent from a moving vehicle or train;
- Use of a vehicle as a dirty bomb, i.e. crashing a vehicle filled with hazardous materials into a structure or building or exploding the vehicle;
- Targeting commercial/industrial chemical containers transported in bulk by both road and rail;
- Release of hazardous materials from airplanes over densely populated areas; and
- Release of hazardous materials into water from a boat.

Duration: Accidental hazardous waste/materials spills can be reported immediately following the spill, thus reducing the amount of time the spill is left uncontained. Most hazardous waste/materials spills occur with little or no warning, and can be difficult to detect until symptoms present themselves to those affected.[10] External releases may create airborne plumes of chemical, biologicalor radiological elements that can affect a wide area and last for hours or days. Internal releases will most likely require evacuation of a facility for hours to days. Both external and internal releases require extensive clean-up efforts, lasting from days to months depending on the type and magnitude of the spill.

Dynamic/static characteristics: Both mobile and external hazardous materials releases can spread and affect a wide area, through the release of plumes of chemical, biological or radiological elements or leaks or spills. Conversely, internal releases are more likely to be confined to the structure the material is stored in.

Chemicals may be corrosive or otherwise damaging over time. A hazardous materials release could also result in fire or explosion. Contamination may be carried out of the incident area by people, vehicles, wind, and water.[11]

Hazardous material releases are dynamic and may vary depending on the following factors:

- Type and amount of agent released;
- Environmental conditions – The micro-meteorological effects of the buildings and terrain can influence the travel of agents[12];

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[10] US Air Force, "Protective Actions for a Hazardous Material Release", (22 October 2001), Http://emc.ornl.gov/CSEPPweb/data/Reports/Misc.%20Reports/HAZMAT.pdf
[11] FEMA, "Primer to Design Safe School Projects in Case of Terrorist Attacks," FEMA 428, http://www.fema.gov/pdf/plan/prevent/rms/428/fema428_ch1.pdf

- Location of release (urban vs. rural, water vs. air); and

- Remediation time, dependent on a locality's or facility's hazardous material release preparedness programs.

Mitigating conditions: Facilities that store hazardous materials are reported to local and federal governments. Security measures at these facilities can be heightened. Many facilities have their own hazardous materials guides and response plans, including transportation companies who transport hazardous materials.

The City's EOP includes an annex identifying the actions and agencies involved in responding to a hazardous materials incident. The City of Palo Alto Fire Department administers the County's hazardous materials emergency planning and community right-to-know program. They also maintain Hazardous Materials Business Plans for every business in the City that handles a hazardous material in quantities above the State's reporting threshold. The City inspects and issues annual permits to approximately 500 businesses with annual hazardous materials permits that necessitate monitoring and inspection.

In addition, the City of Palo Alto provides safe hazardous waste disposal for residents and small businesses at a specified Household Hazardous Waste (HHW) Station. Their HHW Program educates the public about the safe use, storage, disposal, and alternatives to hazardous products.

5.6 Urban Fire Profile

The entire City of Palo Alto is at risk to major fires impacting a section of the City or a large complex. The City has over 25,000 housing units and a significant business base. The proximity of structures to each other within the City creates additional exposure to widespread urban fire. Localized, single-structure fires sometimes occur in Palo Alto. As of November 2013, the City had experienced three urban fires during the previous three months. Major uncontrolled fires are a possibility, but rarely occur.[13]

Application mode: Urban fires can be accidentally caused through human error including cooking accidents, smoking or unsafe use of woodstoves or space heaters. Malfunctioning electrical equipment is also a major cause of fire in urban areas.[14] Fires originating in the Wildland-Urban Interface (WUI) also pose a threat as they can spread toward more developed areas and cause significant damage to structures, residents, and natural resources. Arson or the deliberate burning of property, is also a possibility within City limits. Arson attacks may be imposed upon structures, motor vehicles, wildland areas or other "nonstructural" properties.

Duration: The duration of an urban fire is dependent on weather conditions, the magnitude of the fire, and fire suppression resources. Structural fires could burn for several hours before being fully contained.

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[12] FEMA, "Primer to Design Safe School Projects in Case of Terrorist Attacks," FEMA 428, http://www.fema.gov/pdf/plan/prevent/rms/428/fema428_ch1.pdf
[13] City of Palo Alto EOP (2007)
[14] National Fire Protection Association, (29 January 2013), Urban Fire Safety, http://www.nfpa.org/safety-information/for-consumers/populations/urban-fire-safety

Dynamic/static characteristics: Weather conditions (wind and warm, dry temperatures) and the presence of fire fuel can cause fires to spread away from their source.

Mitigating conditions: In the event of a major urban fire, auto-aid and mutual-aid agreements (with CAL FIRE) will be utilized, as outlined in the Palo Alto Emergency Operations Plan. The City strives to minimize exposure to wildland and urban fire hazards through rapid emergency response, a sufficient water supply, proactive fire code enforcement, public education programs, and adequate emergency management preparation.

To ensure a sufficient water supply, an emergency water supply and storage project, initiated in 2007, was primarily completed by the City in late 2013/early 2014. This project provides Palo Alto with a self-sustaining emergency water supply through rehabilitating five City wells, constructing three new wells, constructing a new 2.5 million gallon reservoir and associated pump station and well, and upgrading an existing pump station (Mayfield Reservoir Pump Station).

As part of the City's emergency management preparation for wildland and urban fires, they designed and implemented the Palo Alto Foothills Fire Management Plan. This plan pertains to the Palo Alto Foothills area west of the Foothills Expressway and Junipero Serra Boulevard, which represents a Wildland Urban Interface (WUI) area. The plan addresses a broad range of integrated activities and planning documents to identify and mitigate the impacts of fire hazards in the Palo Alto Foothills Area. Fire mitigation project areas include the boundaries of Foothills Park and Pearson-Arastradero Preserve.

In urban areas, arsonists may target abandoned buildings. Limiting the number of abandoned buildings or providing security near these buildings may deter arsonists. Both structure and wildland arson data can be analyzed to depict trends in copy cat arsonists as well as in weather and fuel conditions. Documenting these trends in a reporting system may assist in mitigating future cases.

Exacerbating conditions: Increasing development in the wildland-urban interface can exacerbate the spread of a wildfire into developed areas, making these areas vulnerable. While planning and mitigation to reduce the risk of fire in Palo Alto's WUI area is controlled through the Palo Alto Foothills Fire Management Plan, there is still potential a fire in this area could impact the City's public safety, cultural and economic activities, and environmental and natural resource management.

5.7 Major Crimes

Major criminal incidents include shooting, homicide, and kidnapping crimes that may include multiple suspects or multiple victims and are considered an ongoing threat to the community. These types of crime have an ability to impact the community in such a way that can undermine the quality of life within the Palo Alto community.

Application mode: For reporting purposes, criminal offenses are divided into two major groups: Part I offenses and Part II offenses per the DOJ and FBI. Part I crimes comprise two categories: violent and property crimes. Aggravated assault, forcible rape, murder, and robbery are classified as violent, while arson, burglary, larceny-theft, and motor vehicle theft are classified as property crimes. Part I crimes are collectively known as Index crimes, this name is used because the crimes are considered quite serious, tend to be reported more reliably than others, and are reported directly to the police. In Part II, the following categories are tracked: simple assault, curfew offenses and loitering, embezzlement, forgery and counterfeiting, disorderly conduct, driving under the influence, drug offenses, fraud, gambling, liquor offenses, offenses against the family, prostitution, public drunkenness, runaways, sex offenses, stolen property, vandalism, vagrancy, and weapons offenses.

This categorization is informative as it links to Palo Alto Police Department's Fiscal Year 2013 Annual Report. "Crime in Palo Alto has seen an overall decrease in the past five years. Violent crimes have continued to decrease, while property crimes have increased. The most notable is the increase in Residential and Auto Burglaries. Fiscal Year 2013 saw a sharp increase in residential burglaries. The Police Department responded with a directed enforcement campaign, and an increased presence in high risk areas. A total of 79 suspects were arrested for burglary, attempted burglary and other associated charges."

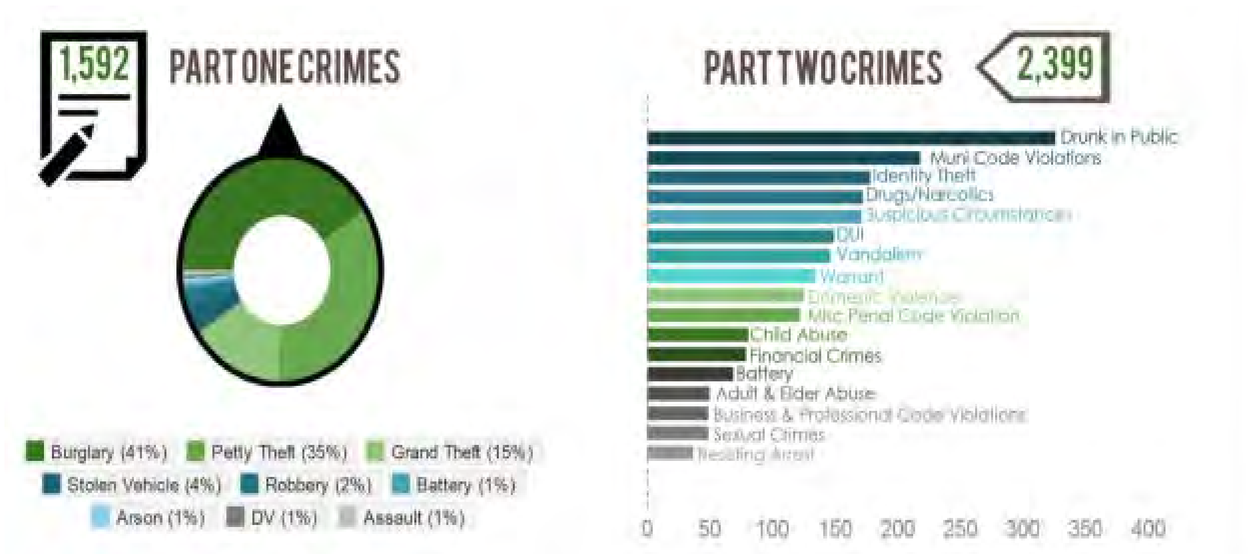


Figure 5-1 Statistics of Part I and Part II Crimes in Palo Alto from the Palo Alto Fiscal Year 2013 Annual Report

Duration: A major crime may occur in a short amount of time, from seconds to hours, and it usually occurs without immediate notice.

Dynamic/static characteristics: Major crimes can occur anywhere in the community.

Mitigating conditions: The Palo Alto Police Department and Stanford Department of Public Safety participate in mutual aid and regional organizations to share information, capabilities, and other resources to prevent major crimes from occurring. Additionally, increased 2013 staffing and effective training of Palo Alto Police Department personnel will likely have deterrent effects.

Exacerbating conditions: Palo Alto businesses and residences are perceived as a soft target resulting in increased property crimes by criminals who live outside Palo Alto. The increase of such events increases the probability of a robbery going wrong resulting in a shooting or homicide event.

5.8 Cyber Attack Profile

A cyber terrorist can infiltrate many institutions including banking, medical, education, government, military, and communication and infrastructure systems. The majority of effective malicious cyber-activity has become web-based. Recent trends indicate that hackers are targeting users to steal personal information and moving away from targeting computers by causing system failure.[15]

Application mode: Common types of cyber attacks are summarized in Table 5-1 Common Types of Cyber Attacks[16]

Table 5-1 Common Types of Cyber Attacks

Type of Attack	Description
Denial of service	A method of attack from a single source that denies system access to legitimate users by overwhelming the target computer with messages and blocking legitimate traffic. It can prevent a system from being able to exchange data with other systems or use the internet.
Botnet	A collection of compromised machines (bots) under (unified) control of an attacker (botmaster).
Distributed denial of service	A variant of the denial-of-service attack that uses a coordinated attack from a distributed system of computers rather than from a single source. It often makes use of worms to spread to multiple computers that can then attack the target.
Exploit tools	Publicly available and sophisticated tools that intruders of various skill levels can use to determine vulnerabilities and gain entry into targeted systems.
Logic bombs	A form of sabotage in which a programmer inserts code that causes the program to perform a destructive action when some triggering event occurs, such as terminating the

[15] Symantec, "Internet Security Threat Report" Volume 17 (2011), www.symantec.com/threatreport

[16] United States Government Accountability Office, "Critical Infrastructure Protection: Department of Homeland Security Faces Challenges in Fulfilling Cybersecurity Responsibilities", Report #GAO-05-434 (May 2005), www.gao.gov/new.items/d05434.pdf

Type of Attack	Description
	programmer's employment.
Phishing	The creation and use of e-mails and Web sites—designed to look like those of well-known legitimate businesses, financial institutions, and government agencies—in order to deceive Internet users into disclosing their personal data, such as bank and financial account information and passwords. The phishers then take that information and use it for criminal purposes, such as identity theft and fraud.
Sniffer	Synonymous with packet sniffer. A program that intercepts routed data and examines each packet in search of specified information, such as passwords transmitted in clear text.
Trojan horse	A computer program that conceals harmful code. A Trojan horse usually masquerades as a useful program that a user would wish to execute.
Virus	A program that infects computer files, usually executable programs, by inserting a copy of itself into the file. These copies are usually executed when the infected file is loaded into memory, allowing the virus to infect other files. Unlike the computer worm, a virus requires human involvement (usually unwitting) to propagate.
War dialing	Simple programs that dial consecutive telephone numbers looking for modems.
War driving	A method of gaining entry into wireless computer networks using a laptop, antennas, and a wireless network adaptor that involves patrolling locations to gain unauthorized access.
Worm	An independent computer program that reproduces by copying itself from one system to another across a network. Unlike computer viruses, worms do not require human involvement to propagate.

One of the difficulties of malicious cyber activity is that its origin could be virtually anyone, virtually anywhere. Table 5-2 Common Sources of Cybersecurity Threats summarizes common sources of cybersecurity threats.[17]

Table 5-2 Common Sources of Cybersecurity Threats

Threat	Description
Bot-network operators	Bot-network operators are hackers; however, instead of breaking into systems for the challenge or bragging rights, they take over multiple systems in order to coordinate attacks and to distribute phishing schemes, spam, and malware attacks. The services of these networks are sometimes made available on underground markets (e.g., purchasing a denial-of-service attack, servers to relay spam or phishing attacks, etc.).
Criminal groups	Criminal groups seek to attack systems for monetary gain. Specifically organized crime groups are using spam, phishing, and spyware/malware to commit identity theft and online fraud. International corporate spies and organized crime organizations also pose a threat to the United States through their ability to conduct industrial espionage and large-scale monetary theft and to hire or develop hacker talent.
Foreign intelligence services	Foreign intelligence services use cyber tools as part of their information-gathering and espionage activities. In addition, several nations are aggressively working to develop information warfare doctrine, programs, and capabilities. Such capabilities enable a single entity to have a significant and serious impact by disrupting the supply, communications, and economic infrastructures that support military power—impacts that could affect the daily lives of U.S. citizens across the country.

[17] United States Government Accountability Office, "Critical Infrastructure Protection: Department of Homeland Security Faces Challenges in Fulfilling Cybersecurity Responsibilities", Report #GAO-05-434 (May 2005), www.gao.gov/new.items/d05434.pdf

Threat	Description
Hackers	Hackers break into networks for the thrill of the challenge or for bragging rights in the hacker community. While remote cracking once required a fair amount of skill or computer knowledge, hackers can now download attack scripts and protocols from the Internet and launch them against victim sites. Thus, while attack tools have become more sophisticated, they have also become easier to use. According to the Central Intelligence Agency, the large majority of hackers do not have the requisite expertise to threaten difficult targets such as critical U.S. networks. Nevertheless, the worldwide population of hackers poses a relatively high threat of an isolated or brief disruption causing serious damage.
Insiders	The disgruntled organization insider is a principal source of computer crime. Insiders may not need a great deal of knowledge about computer intrusions because their knowledge of a target system often allows them to gain unrestricted access to cause damage to the system or to steal system data. The insider threat also includes outsourcing vendors as well as employees who accidentally introduce malware into systems.
Phishers	Individuals or small groups, that execute phishing schemes in an attempt to steal identities or information for monetary gain. Phishers may also use spam and spyware/malware to accomplish their objectives.
Spammers	Individuals or organizations that distribute unsolicited e-mail with hidden or false information in order to sell products, conduct phishing schemes, distribute spyware/malware or attack organizations (i.e., denial of service).
Spyware/malware authors	Individuals or organizations with malicious intent carry out attacks against users by producing and distributing spyware and malware. Several destructive computer viruses and worms have harmed files and hard drives, including the Melissa Macro Virus, the Explore.Zip worm, the CIH (Chernobyl) Virus, Nimda, Code Red, Slammer, and Blaster.
Cyber-Terrorists	Cyber-Terrorists seek to destroy, incapacitateor exploit critical infrastructures in order to threaten national security, cause mass casualties, weaken economies or target businesses, and damage public morale and confidence.

Threat	Description
	Cyber-Terrorists may use phishing schemes or spyware/malware in order to generate funds or gather sensitive information.

Given its location in Silicon Valley, Palo Alto is home to many large companies that could be subject to a cyber attack.

Duration: The duration of a cyber attack is dependent on the complexity of the attack, how widespread it is, how quickly the attack is detected, and the resources available to aid in restoring the system.

Dynamic/static characteristics: A cyber attack could be geared toward one organization, one type of infrastructure and/or a specific geographical area. The affected area could range from small to large scale.

Cyber attacks generated toward large corporations can negatively affect the economy. The Congressional Research Service study (2008) found the economic impact of cyber attacks on businesses has grown to over $226 billion annually.[18]

Attacks geared toward critical infrastructure and hospitals can result in the loss of life and the loss of basic needs, such as power and water, to the general public. Cyber attacks can also lead to the loss of operational capacity.

Mitigating conditions: Palo Alto has three levels of security to prevent cyber attacks:

1. A Symantech anti-virus protection for desktops and laptops;
2. Malware Protection Systems for Web and email systems; and
3. A Barracuda Firewall for the IT Network.

In addition, the City is in the process of deploying a vulnerability management system to better protect the IT network.

Access control to buildings, such as ID cards and badges, can help regulate the people who have access to an agency's or corporations' cyber network. Palo Alto information technology network locations include access control measures to prevent unauthorized access to these controlled areas.

The City has an Energy Assurance Plan that focuses on minimizing energy interruptions during emergencies. This plan could be updated to include a contingency plan for keeping energy lifelines online given a cyber attack. Currently, the North American Electric Reliability Corporation (NERC) is responsible for ensuring energy industry compliance with Critical Infrastructure Protection (CIP) standards. These rules require organizations that deliver bulk electricity to the North American power grid to identify and protect critical cyber assets. In

[18] *Defense Tech*. http://defensetech.org/2008/10/20/the-cyber-attack-danger/

addition, bulk power suppliers must define methods, processes, and procedures for securing critical cyber assets. “Cyber assets” are loosely defined as all “programmable electronic devices and communication networks including hardware, software, and data.[19]

Exacerbating conditions: Humans are the weakest link in a chain of cyber security. It remains difficult to continuously monitor and manage human/operator vulnerability. However, to address this weakness the City has deployed an online security training program which all employees are required to complete annually.

5.9 Hostage/Assassin Profile

A hostage situation includes a person or group of people seized or held as security for the fulfillment of a condition. An assassin is a person who murders an important person in a surprise attack for political, religious or monetary reasons.

Application mode: A hostage crisis can develop when one or more individuals or an organized group of people seize people against their will and try to hold off authorities by force, often threatening to kill hostages if provoked or attacked. Typically hostage takers will issue demands, many times politically or religiously driven. Monetary demands are also possible. In cases where the hostage situation was improvised as an attempt to avoid capture for another crime, the demand usually revolves around exchanging the lives of the hostage(s) for transport to safety. Hostage takers are usually armed with explosives, handguns, and/or other weapons.

Similar to a hostage situation, an assassination may be prompted by religious, political or monetary motives. Assassinations can also be militarily driven or done to avenge a grievance or to gain fame or notoriety. Car bombs and other explosives, poison, snipers, and handguns are most commonly used in assassination attempts. In most cases, the assassin will have detailed advanced knowledge of the intended victim’s itinerary in order to plan out the assassination. Most modern assassinations have been committed either during a public performance or transport, both because of weaker security and security lapses.

Duration: A hostage crisis can range from a couple of hours to years. Assassinations occur without warning and, although they may take years to plan out, can transpire in a matter of seconds.

Dynamic/static characteristics: For the most part, both hostage situations and assassinations are static in that they are confined to one location. However, both scenarios could escalate into a chase for the suspects, thus having the capacity to shut down an entire city or multiple locations simultaneously. In addition, if bombs or other explosive devices are used, impacts may be distributed throughout a larger area.

Mitigating conditions: Many high profile dignitaries travel with security, making the ability to execute a hostage situation or assassination more difficult. Increased security in public places where these incidents are more likely to occur has the potential to discourage these types of events from taking place. The City’s police force includes a SWAT (Special Weapons and Tactics) Team and Crisis Negotiation Team, both of which are trained to contain these

[19] *NextLabs*. http://www.nextlabs.com/html/?q=nerc-and-ferc-cyber-security-standards

situations. Additionally, multi-jurisdiction intelligence sharing forums improve the awareness of when such high profile visits take place; and enhanced coordination between these jurisdictions closes the common operational gaps should a response be necessary. The City of Palo Alto's Office of Emergency Services hosts a monthly multi-jurisdictional intelligence sharing meeting that reinforces this concept. The Palo Alto Police Department also is integrated into the Northern California Regional Intelligence Center (NCRIC) through their Terrorism Liaison Officer (TLO) program that provides a direct conduit for intelligence sharing with this agency.

Exacerbating conditions: The level of threat depends on the presence of dignitaries or notable figures in the City. The risk of a hostage/assassin situation is exacerbated when high level dignitaries visit, which occurs frequently. In addition, wealthy Silicon Valley executives live in the City and could be potential targets.

5.10 Sabotage/Theft Profile

Sabotage is a deliberate action aimed at weakening another entity (business, government, etc.) through subversion, obstruction or destruction. The result of sabotage could be the destruction of a vital facility or the disruption of operations. The principal identifying characteristic of sabotage is that the attack is usually not intended to harm large numbers of people, but rather to cause economic harm or embarrassment to the target.

Application mode: One who engages in sabotage is a saboteur. A saboteur could be one individual working alone or an organized crime group. They typically try to conceal their identities because of the consequences of their actions. Many single-issue terrorists, including ecological extremists and anti-abortion radicals, have used sabotage widely. Disgruntled employees and activists may also use sabotage. Many times, a saboteur is an insider.

Sabotage can be conducted as a response to an environmental action, in which groups turn to the destruction of property to stop actions they consider detrimental to the environment. Another modern form of sabotage is the distribution of software intended to damage specific industrial systems. Some criminals have engaged in sabotage for reasons of extortion, in which destruction of property or the threat of destruction is used to obtain money, property or services. Political sabotage is sometimes used to harass or damage the reputation of a political opponent or group. Sabotage of lifeline infrastructure, energy systems or of hazardous materials sites is also possible.

Duration: While planning sabotage may take an extended period of time, actually executing the plan can happen instantaneously. An act of sabotage may take a matter of seconds to a few hours, but the effects can be longer term. For example, if a train is targeted as an act of sabotage, it may take days to months to rebuild the train infrastructure that was destroyed.

Dynamic/static characteristics: A sabotage incident may be concentrated to one general area or personor could be more widespread, all depending on the tactic used. For example, a disgruntled employee at a meat packing plant could sabotage the company by adding poison to their product before distribution. Once the meat is distributed, the incident becomes a more widespread problem.

Mitigating conditions: Some cases of sabotage can be categorized as terrorism. The City of Palo Alto maintains a Terrorism Response Plan to prepare various City departments and agencies to perform safely and effectively during a terrorist incident. The City's EOP also provides insight on how to deal with certain types of emergency incidents, such as hazardous materials spills, which could be the result of a case of sabotage. Many employers undergo training on how to identify and mitigate sabotage in the workplace. In addition, as discussed in further detail in the "mitigating conditions" section of the Hostage/Assassin profile above, the City's Police Department and Office of Emergency Services are prepared to mitigate acts of terrorism through training, intelligence sharing forums, and partnerships with the NCRIC.

Exacerbating conditions: Sabotage is difficult to detect and to trace to its origin. Sabotage may cause lifeline infrastructure, for example water lines, to be disabled, and thus have secondary impacts, such as causing or worsening flood/drought events, fire, hazardous material spills, and other effects that could limit a city's capacity to function as normal. Social media, such as Twitter and Facebook, have become very popular in recent times and could be used as a readily available means to sabotage companies, fellow employees or employers, and/or officials.

5.11 Workplace Violence Profile

Workplace violence is violence or the threat of violence against workers. It includes any act or threat of physical violence, harassment, intimidation or other threatening disruptive behavior that occurs at the worksite. It can occur at or outside the workplace and can range from threats and verbal abuse to physical assaults and homicide. It can affect and involve employees, clients, customers, and visitors. Workplace violence includes locations such as churches, malls, etc. and may be the result of a person acting alone.[20]

Application mode: Workplace violence can range from threats and verbal abuse to physical assaults and homicide. These incidents can be caused by fellow employees, by employers or by external clients.

Duration: Acts of workplace violence could be a onetime incident or could occur repetitively over time, lasting weeks to years.

Dynamic/static characteristics: Workplace violence can occur at or outside the workplace.

Mitigating conditions: Many companies have established workplace violence prevention programs and offer trainings on workplace violence including how to identify it and mitigate it. Providing a secure workplace that has video surveillance, extra lighting, and alarm systems may minimize access to outsiders.

Exacerbating conditions: Some workers are at increased risk to workplace violence. Among them are workers who exchange money with the public, deliver passengers, goods or services; or work alone or in small groups, during late night or early morning hours, in high-crime areas or in community settings and homes where they have extensive contact with the public. As with

[20] US Department of Labor, Occupational Safety and Health Act, www.OSHA.gov

sabotage, social media such as Twitter and Facebook may be a means of exacerbating workplace bullying and violence.

6 Conclusion

The City of Palo Alto and its local partners should be commended for the tremendous capabilities currently available to prevent, protect against, mitigate, respond to, and recover from hazards and threats. One invaluable strength of the City's emergency management program is the ongoing coordination with local partners. Emergency planning, training, and exercises are conducted in partnership with Stanford University, Stanford Hospital, neighboring jurisdictions, community members, and other pertinent organizations such as the American Red Cross.

Communications technology within the City is fairly robust. Mass notification systems are in place. Responders and emergency managers will use the highest level of communication technology available during/immediately following an incident. Communications and notification systems are both for public safety agencies and the general public. There are a wide range of communications options. Stanford University employs an Outdoor Warning System (PA and sirens) for emergency alerts/notifications, but such a system does not exist in Palo Alto. Stanford University and the City of Palo Alto have interoperable dispatch systems. A Mobile Emergency Operations Center (MEOC) is available to enable communication coordination should the primary EOC be compromised. Social media will be an asset for receiving information from the public regarding attacks and impacts. KZSU, the Stanford radio station, is an available resource that can be taken over from Palo Alto City Hall to provide supplemental information, beyond and more-local than what might be available on other broadcast stations via the Emergency Alert System (EAS). Certain businesses have two-way radio communications within their neighborhood and to the City EOC. WebEOC enables efficient dissemination of incident management information across local government agencies throughout the Operational Area. Finally, the growth of social media tools is a resource to Palo Alto and Stanford.

Opportunities for residents and members of the public to contribute to the City's resiliency are bountiful. The Emergency Services Volunteer program provides supplemental resources to the professional first responders and facilitates means for neighbors to help neighbors (including businesses and other entities). This organization includes several City-sponsored emergency preparedness volunteer programs:

- Neighborhood and Block Preparedness Coordinator program (BPC/NPC)
- Palo Alto CERT Program
- Palo Alto Auxiliary Communications Services: ARES/RACES
- Palo Alto Medical Reserve Corps

In addition to these formal opportunities for community members to receive training and assist through specific roles, "see something, say something" campaigns are helpful in maintaining vigilance throughout the City. Public education occurs via the Office of Emergency Services presence on the web (www.cityofpaloalto.org/publicsafety), providing emergency preparedness presentations to the "whole community", and through the use of semi-annual utility bill inserts. Policies and organizational processes are in place for the City government to achieve long term resiliency. Examples include the zoning ordinance and building code enforcing safe development. Critical Infrastructure and Key Resources (CIKR) sites are tagged in the new Computer Aided Dispatch (CAD) system for Palo Alto, Stanford University Campus, Los Altos, and Mountain View. Current planning efforts include an update to the Comprehensive Plan, a recent Hazard Mitigation Plan, and this THIRA report. The established THIRA Executive Committee may prove to be helpful in ongoing planning efforts beyond regular updates of this report.

6.1 Recommendations for Action

Throughout the THIRA process, the Stakeholder Group and Executive Committee identified many actions to improve capabilities for prevention, protection, mitigation, response, and recovery. These recommendations are captured in Table 8-1. The list below has been modified to summarize clear actionable items the City may prioritize and incorporate into ongoing planning and budgeting processes.

Planning

- Update the City of Palo Alto Emergency Operations Plan and incorporate the identified hazards as evaluated in this THIRA.
- Develop a detailed inventory of Critical Infrastructure and Key Resources (CIKR) among Palo Alto and Stanford University that will foster improved planning for critical infrastructure protection. Implement a plan to document risks to specified CIKR and develop a strategy to mitigate these risks. This plan could include a template for CIKR managers to conduct and document risk assessments for submission to the City of Palo Alto.
- Explore sustainable solutions for energy assurance, including alternate energy for critical facilities.
- Promote Utilities Infrastructure improvements that mitigate/improve resiliency (power, water, wastewater, gas).
- Continue to collaborate with regional planning efforts to mitigate impacts of sea level rise/ climate change.
- Implement an Infrastructure Management System – identified by IBRC.
- Conduct an updated assessment on the vulnerabilities of public safety communication technologies and capabilities.
    - Develop alternate communications capabilities to reduce reliance on commercial carriers.

    - Incorporate a city-wide public safety communications infrastructure assessment and survey (including Stanford University and Stanford Hospital) to provide a baseline capability to connect key facilities and nodes.

- Develop a Continuity of Operations/Continuity of Government Plan.

- Develop an emergency information technology plan, including business continuity and disaster recovery (BCDR).

- Develop a supporting plan in conjunction with the Operational Area plan for mortuary affairs, mass casualty, mass sheltering, points of distribution and points of dispensing (mass prophylaxis) and other such regional activities.

- Encourage owners of CIKR to develop all hazard response plans and coordinate, where applicable, support requirements with appropriate service providers.

- Develop a City of Palo Alto recovery plan including:

    - Pre-identified locations for FEMA trailers and field hospital/medical treatment areas.

    - Plans for restoring basic health and social services functions following a catastrophic event pre-identified alternative housing solutions for use following a catastrophic event.

    - An evaluation of options for expediting building permits following a catastrophic event.

    - Resources available from the City of Palo Alto airport.

- Convene THIRA executive committee annually to review and update the THIRA.

Organization

- Maintain an OES staff that is trained to develop, manage, and coordinate the implementation of the Palo Alto family of emergency plans (EOP, COOP, HMP, THIRA, etc.).

- Use the *Threat and Hazard Identification and Risk Assessment* (THIRA) report to help guide decisions related to prevention, protection, mitigation, response and recovery related to threats that could affect the City.

- Implement a Joint Information System with North County stakeholders that will improve public messaging during times of crises. Maintain trained staff to serve as local alerting authorities consistent with the Integrated Public Alert and Warning system (IPAWS).

- Maintain Palo Alto Emergency Services Volunteer, Stanford University volunteer programs, corporate Emergency Response Teams, and similar programs throughout the community.

- Maintain participation in regional efforts to address remaining flood concerns, e.g., SFC JPA, SCVWD, South San Francisco Bay Shoreline Study, and Salt Pond Restoration Project.

- Implement a Multi-Agency Coordination (MAC) structure for storms/floods, public works mutual aid, etc. Evaluate and improve coordination protocols within the Operational Area, and with appropriate state and federal agencies.

- Bolster participation in the Northern California Regional Intelligence Center (NCRIC), the Terrorism Liaison Officer (TLO) program, the Urban Area Security Initiative (UASI), and other means to share information among agencies, businesses, and partner organizations.

- Establish an emergency resource directory and put in place advanced contracts for key commodities or services identified during the planning, training, exercise process .

Equipment/Facilities

- Construct new Palo Alto Public Safety Building.

- Develop an Emergency Operations Staging Area (EOSA) to serve as a North County staging area resource and to shelter the Palo Alto Mobile Emergency Operations Center and other critical supplies.

- Improve video monitoring throughout the City of Palo Alto through collaboration and coordination with privately owned video systems and city owned video systems.

- Increase access controls /physical security at critical city owned and operated facilities.

- Maintain at a high level of readiness emergency response vehicles and specialized equipment required to respond to the threats and hazards listed in this report.

- Acquire alternative energy and energy efficient equipment that will reduce fuel requirements and ease overall logistical burdens.

- Upgrade creek storm water monitoring systems to provide improved situational awareness during storm events.

- Evaluate and implement a thermal sensors/camera network to cover the Wildland Urban Interface (WUI).

- Coordinate with appropriate organizations to install battery backup systems on traffic signals that increase public safety following a power outage scenario.

- Improve connectivity to partner EOCs and 911 PSAPs such as fiber, microwave, etc.

- Explore Video Teleconferencing (VTC) capabilities to link government and nongovernment partners.

- Upgrade command and control software systems that improve communications, collaboration, and situational awareness.

- Acquire base camp supplies and materials to sustain small response operations (30-50 responders) for events that occur in or around Palo Alto.

- Continue to participate in UASI CBRNE and HAZMAT equipment evaluation and selection.

- Continue to evaluate feasibility of Regional Command Center at Moffett Field.

Training and Exercise

- Collaborate and regularly exercise with agencies/organizations referenced in the City's Emergency Operations Plan: Federal, State, agencies with a regional presence; Mutual Aid Jurisdictions, Schools and Universities, Private Sector businesses, Not for Profit organizations (Faith Based, Community Service); Hospitals & Health Care Facilities.
    - Conduct training with other government agencies such as the FBI, State Dept., Secret Service, etc. to ensure collaborative processes and work through specific scenario variables.
    - Conduct collaborative planning, training and exercises with Caltrain and other rail carriers operating in the area.
    - Train and exercise road block/traffic diversion procedures such as in the vicinity of Stanford Hospital and Stanford University.

- Conduct training and exercises with private sector entities such as Stanford Industrial Park, Stanford Shopping Center, etc.

- Regularly conduct ICS and EOC staff training per the Palo Alto EOC Staff Development Program prioritizing high threat hazards

- Conduct employee information technology security and awareness training and exercise a cyber-security response effort with the information technology department as the operations lead.

- Routinely conduct mass care and shelter training in coordination with American Red Cross and City of Palo Alto partners.

Community Readiness

- Cultivate a culture of preparedness and community connection through efforts such as outreach to public and private schools, Citizen Corps Council, City Staff and Volunteer Disaster Service Worker training, and other "whole community" stakeholders.
    - Continue to engage the business sector to improve their mitigation and preparedness efforts; educate small businesses on the importance of resiliency planning.
    - Establish a goal for each family and business within the community to have an adequate supply of water, food, etc.
    - Pre-identify/establish public messaging campaigns that remind the community of appropriate actions to a variety of potential hazard events (e.g. shelter in place, evacuate, earthquake, flooding, etc.)
    - Continue and improve promotion of family and business readiness to mitigate service needs such as sheltering and mass care.
- Evaluate the potential for establishing a coordinating group for private airplane pilots (a model exists in southern Santa Clara County) that could improve small-scale disaster logistics operations.

6.2 THIRA Maintenance

The Palo Alto Office of Emergency Services (OES) will be responsible for reviewing this THIRA report quarterly to make note of progress and/or items to update. Annually, the THIRA Executive Committee will convene to discuss the progress and/or circumstances requiring changes to the stated priorities.

The annual Executive Committee meeting will culminate in a summary memo prepared by OES and submitted to the City Council for consent as a matter of public record.

Every two years the THIRA report will be updated and re-issued as a new version. On an ongoing basis the THIRA report shall inform updates to the City's Emergency Operations Plan.

The THIRA report is For Official Use Only and is not available in its entirety to the public. Questions regarding this report may be directed to OES at 650-617-3197.

7 Appendices

Appendix A: Planning Team

Table 7-1 lists the Executive Committee and broader stakeholder group members who participated in and contributed to the development of this THIRA.

Table 7-1 Planning Team

Name	Agency	Executive Committee Member
Aaron Aknin	Acting Director, City of Palo Alto Planning, Community & Environment (now employed by Redwood City)	X
Andy Swanson	City of Palo Alto, Airport Manager	
Annette Glanckopf	City of Palo Alto Emergency Services Volunteer Program	
Arrietta Chakos	Dewberry Team	
Bern Beecham	City of Palo Alto Emergency Services Volunteer Program (and former City Councilmember)	
Brad Wardle	City of Mountain View, Fire Chief	
Brandon Bond	Stanford University Medical Center, Administrative Director of Office of Emergency Management	X
Brian Marquez	Stanford Shopping Center, Security Manager	
Cathleen Atchison	Dewberry	
Chris Cohendet	Stanford University Department of Public Safety, Sergeant	X
Claudia Keith	Chief Communications Officer; City Manager's Office	
Corinne Bartshire	Dewberry	
David MacKenzie	City of Palo Alto Chamber of Commerce, CEO	
Dean Batchelor	City of Palo Alto Utilities, Assistant Director	
Dennis Burns	City of Palo Alto Police Chief	X
Donna Grider	City of Palo Alto, City Clerk	
Elizabeth Lam	City of East Palo Alto Police Department, CSO	
Eric Nickel	City of Palo Alto Fire Chief	X
Frank Grgurina	City of Sunnyvale Department of Public Safety, Chief	
Greg Betts	City of Palo Alto, Director of Community Services	
Hillary Gitelman	City of Palo Alto Planning, Community & Environment, Director	X
Houman Boussina	City of Palo Alto, Interim Auditor	
James Keene	City of Palo Alto, City Manager	X
Jim Dunnegan	Varian Oncology Systems, EH&S Manager	
Jim Schweikhard	Palo Alto Medical Foundation, Safety Manager	
John StClair III	City of Palo Alto Emergency Services Volunteer Program, CERT	
Jonathan Reichental	City of Palo Alto, Chief Information Technology Officer	X
Karen Bouvier	Palo Alto Research Center	
Karl Matzke	American Red Cross	
Kathryn Shen	City of Palo Alto, Director of People Strategy	

Name	Agency	Executive Committee Member
	& Operations	
Kay Iida	Stanford University Department of Public Safety, Lieutenant	
Keith Perry	Stanford University EH&S	X
Ken Dueker	City of Palo Alto, Director of Emergency Services	X
Lalo Perez	City of Palo Alto, Director of Administrative Services/Chief Financial Officer	
Laura Wilson	Stanford University Department of Public Safety, Chief	X
Linda Barcomb	Merck Sharp & Dohme Corp.	
Linda Hibbs	Lytton Gardens	
Lydia Kou	City of Palo Alto Emergency Services Volunteer Program	
Lynn Brown	City of Mountain View, Emergency Services Coordinator	
Matt Sorgenfrei	City of Palo Alto Emergency Services Volunteer Program, CERT	
Mike Sartor	City of Palo Alto, Director of Public Works	X
Molly Stump	City of Palo Alto, City Attorney	
Monique leConge	City of Palo Alto, Library Director	
Nathan Rainey	City of Palo Alto Office of Emergency Services	
Paul Lufkin	City of Palo Alto Emergency Services Volunteer Program, ARES/RACES	
Peter Prinejad	City of Palo Alto, Development Center Director	
Ryan Zollicoffer	Menlo Park Fire Protection District, Emergency Manager	
Samantha Brichacek	Stanford Industrial Park (SIP), EH&S Manager	
Scott Vermeer	City of Mountain View, Chief of Police	
Simon Williams	City of Palo Alto Office of Emergency Services	
Steve Drewniany	City of Sunnyvale Department of Public Safety, Deputy Chief	
Tom Fehrenbach	City of Palo Alto Economic Development Manager	X
Tuck Younis	City of Los Altos, Police Chief	
Val Fong	City of Palo Alto, Director of Utilities	X
Victor Talavera	Palo Alto Research Center	
Vinny Mata	City of Sunnyvale, Emergency Services Coordinator	
Walter Rossman	City of Palo Alto, Director of Office of Management and Budget	
Zachary Perron	City of Palo Alto Police Department, Lieutenant	

City of Palo Alto (ID # 5293)

Policy and Services Committee Staff Report

Report Type: Agenda Items **Meeting Date: 12/9/2014**

Summary Title: Hazardous Buildings and Seismic Safety Study Session

Title: Discussion of Updating the Seismic Safety Chapter of the Municipal Code for Hazardous Buildings

From: City Manager

Lead Department: Planning and Community Environment

Recommendation

Staff recommends that the Committee review the information included here regarding the City's existing inventory of structurally deficient buildings and the City's existing ordinance addressing these buildings, and recommend that the full Council authorize an immediate Request for Proposals to prepare an updated inventory and to customize an approach for seismically upgrading the City's most vulnerable buildings.

Executive Summary

In 1986, the City adopted an ordinance categorizing seismically vulnerable buildings. (See Palo Alto Municipal Code Section 16.42.) The ordinance required property owners to prepare an engineering analysis of their buildings and provided incentives for owners to address identified deficiencies. Twenty-three (23) of the buildings on the inventory remain vulnerable. In addition, there are building typologies that were not included in the original inventory which are now recognized as vulnerable, requiring additional analysis and an update to the City's inventory and ordinance.

This report sets the framework for the Policy and Services Committee (Committee) discussion related to seismically vulnerable buildings. It explores the City's existing ordinance, reviews best practices from other communities and concludes with recommended discussion items/next steps.

Background

On September 15, 2014, the City Council directed the Policy and Services Committee to address the following:

- identification and prioritization of buildings that pose a potential hazard in an earthquake, including soft-story buildings and other types of construction

- review "best practices" from other cities regarding prioritization of various seismically vulnerable buildings, including retrofit incentives and requirements
- review current or pending State legislation related to soft-story buildings and other structurally deficient buildings

Two events precipitated this recent direction. First, the 6.0 magnitude earthquake on August 24, 2014 in Napa Valley and, second, the City Council's review of the Office of Emergency Service's Threats and Hazard Identification and Risk Assessment report on September 15, 2014, which identified over 150 seismically vulnerable buildings: http://www.cityofpaloalto.org/civicax/filebank/documents/43866. Each of these study topics are addressed below, followed by a recommended approach for the Committee to consider.

Building Identification and Prioritization
In 1986, the City Council adopted the Seismic Hazards and Identification Program codified at Section 16.42 of the Municipal Code (Attachment A). This ordinance established a mandatory evaluation and reporting program and created incentives for property owners to voluntarily upgrade their structurally deficient buildings. Three categories of buildings were identified, including:

- **Category I Buildings**: Buildings constructed of unreinforced masonry (except for those smaller than 1,900 square feet with six (6) or fewer occupants).
- **Category II Buildings**: Buildings constructed prior to January 1, 1935 containing one hundred (100) or more occupants.
- **Category III Buildings**: Buildings constructed prior to August 1, 1976 containing three hundred (300) or more occupants.

An unreinforced masonry building (or UMB, URM building) is a type of building where load bearing walls, non-load bearing walls or other structures, such as chimneys are made of brick, cinderblock, tiles, adobe or other masonry material, that is not braced by reinforcing beams.

The categories above were developed by a citizen's committee, reviewed by staff and the Policy and Services Committee, and adopted by the City Council. These categories were created to record known URM buildings and potentially and other structurally deficient buildings with high occupancy volumes.

This program identified 89 buildings and was successful in two significant ways. One hundred percent (100%) of the property owners complied with the ordinance and submitted engineering reports detailing structural deficiencies and recommendations to strengthen structures to alleviate the threat of collapse.[1] Further, approximately seventy-five percent (75%), or sixty-six buildings were strengthened, demolished, or proposed to be demolished. See Attachment B for current status of all inventoried properties.

[1] Based on a December 13, 2004 City Council Report from PCE

Part of this success may be attributed to incentives that allowed upfront engineering report costs be applied toward permit fees and the ability for property owners in the Downtown Commercial (CD) district to add up to 2,500 square feet of new floor area, or twenty-five percent (25%) of the existing building area, whichever is greater, to the site without having to provide additional parking.[2] This floor area bonus could be used onsite or transferred to another owner or property in the CD district. Approximately twenty-one (21) property owners took advantage of this incentive.

Despite its successes, however, twenty-three (23) buildings identified from that original inventory remain vulnerable. Further, there are other building typologies that were not surveyed prior to adoption of the 1986 ordinance. For example, problems with soft-story construction were documented following the 1994 Northridge earthquake, which resulted in changes to construction industry standards a few years later.

A soft story building is a multi-story building in which one or more floors have windows, wide doors, large unobstructed commercial spaces, or other openings in places where a shear wall would normally be required for stability as a matter of earthquake engineering design. A typical soft story building is an apartment building of two or more story's located over a ground level with large openings, such as a parking garage or series of retail businesses with large windows.

In 2003, the Collaborative for Disaster Mitigation at San Jose State University completed an "Inventory of Soft-First Story Multi-Family Dwellings in Santa Clara County." According to the report, the City of Palo Alto had 130 soft-story multi-family buildings including 1,263 residential units housing 3,158 occupants. (Attachment C)

There are other construction types that were not surveyed in 1986, including non-ductile concrete buildings, steel moment frame buildings, and concrete tilt-up buildings, in addition to soft-story construction. It is unclear how many of these buildings exist in the city.

The city's existing ordinance requires annual reporting to the City Council on the status of the program. This reporting appears to have ended in 2004 for unknown reasons. More recently, the City Council adopted an interim ordinance modifying the seismic incentive such that parking must now be provided if an owner seeks to add 2,500 square feet or 25% of the total building area in the CD District. It is unclear how this policy change will affect continued participation in the program.

Best Practices and Incentives

The Association of Bay Area Governments has a Resilience Program and developed a website that has an inventory of ordinances from certain jurisdictions within its boundaries. It is

[2] This incentive was also made available to properties in Historic Categories 1 and 2 not seeking seismic upgrades

intended to serve as a toolkit for best practices. The website address is http://resilience.abag.ca.gov/recovery/ordinances/.

In addition, staff contacted the Planning Advisory Service, which is a fee-based service and research arm of the American Planning Association. This service helps augment staff's research capabilities.

Based on a review of several city ordinances, it appears that there is some degree of variation how local jurisdictions seek to mitigate structurally deficient buildings. Most go beyond identifying and reporting to mandating retrofitting within specified periods of time. In some instances, the more seismically vulnerable buildings are prioritized over other buildings in terms of timelines for compliance to current retrofitting standards.

This is the typical process in most communities:

1. City develops an inventory and notifies owner
    a. Inventory typically includes evaluation of URM; soft-story construction; concrete tilt-up structures
    b. Inventory is prepared by qualified city staff or consultants
    c. Property owners have some right of appeal to challenge their placement on the inventory
2. Owner submits a report to the city within a specified time period detailing:
    a. Structure's compliance with minimum earthquake safety standards
    b. Structural deficiencies and proposed retrofit plan
    c. Demolition plan
3. Owners are given a timeline for compliance (often one or more years)

Many communities exempt detached residential structures and apartment buildings with fewer than 5 units, as well as warehouses.

Penalties for non-compliance range from misdemeanor charges subject to fines or imprisonment to orders that the building be vacated or demolished.

Some cities offer incentives. Berkeley for instance refunds one-third (1/3) of its 1.5% real estate transfer tax for qualifying projects. Other cities reduce or eliminate building permit and inspection fees associated with retrofitting. San Mateo at one point offered grants and loans for certain projects.

Incentives, when offered, typically include:

- Financial (waiving permit fees, grants or loans, reductions in property or real estate taxes)
- Process (streamlined permitting and inspection services)

- Development (increased floor area, reduced parking requirements, or other meaningful deviations from standard zoning code requirements)

Application of best practices is balanced with each local jurisdiction's desire to reduce the threat of unsafe buildings with the potentially significant financial costs to upgrade and retrofit buildings. Voluntary retrofitting has achieved some success, but many buildings in the state remain vulnerable to collapse.

More information is presented below summarizing the specific programs in two cities.

City of Berkeley	
URM Buildings	• Mandatory program • Applies to 1956 or later construction, or high buildings in highly traveled pedestrian corridors • Given 2 years to complete seismic reports • 1-4 years (depending on risk category) to complete upgrades • Certain events triggered acceleration of compliance, including remodels, change of ownership, or change of use. • INCENTIVE: Waives permit application and inspection fees • INCENTIVE: Refunds 1/3 of 1.5% Real Estate Transfer Tax
Soft Story Construction	• Mandatory reporting / Voluntary Retrofitting • Inventory list prepared • Building Official sends notice to property owners • Property owners with rights to appeal placement on list • Property owner to notice tenants w/in 30 days and post 'earthquake warning' sign(s) in conspicuous place • Given 2 years to submit engineering reports • Opportunities for extensions under certain circumstances

City of San Francisco	
URM Buildings	• Mandatory program • City notifies owners of URM buildings • Given 2 years to submit Inventory form • Given 1-9 years to apply for a building permit (depending on 'compliance tier') • Given 6-12 months to obtain building permit (depending on 'compliance tier') • Given 1-2 years to complete the upgrades (depending on 'compliance tier') • INCENTIVE: Loans (2.5%) were made available via voter approved bond

	measure
Soft Story Construction	• Mandatory program • Applies to wood-framed residential construction with 3 or more units • Given 1 year to submit Screening and (optional) Evaluation forms. These are used to determine building eligibility under the program and 'compliance tier', or priority • Given 1-4 years (depending on compliance tier) to obtain a building permit • Given 2 years to complete the work • Appeal opportunities exist, but do not extend timelines unless approved by hearing authority • Noncompliance subject to penalties set forth in municipal code and site posting warning those that would enter the building that the building does not comply with city codes regarding earthquake safety. • INCENTIVE: Public financing available through city's Property Assessed Clean Energy (PACE) program to compensate owner for construction expenses. Loan is paid back to the City through the owner's property tax (deadline for applying passed in April 2014)

Pending State/Federal Legislation

The California Health and Safety Code (Sections 19160 – 19168) enables local jurisdictions the ability to apply building retrofit standards to any hazardous building. Unreinforced masonry buildings and certain wood-framed multi-family buildings are identified.

Assembly Bill 2181, authored by Richard Bloom representing the 50th District, would also provide that local jurisdictions require owners to evaluate the earthquake hazard of soft story residential buildings and older concrete residential buildings as well as other seismically hazardous buildings brought to the attention of local officials (excerpted in part from the Legislative Counsel's Digest: http://leginfo.legislature.ca.gov/faces/billVotesClient.xhtml). This Bill is still in committee.

The Federal Emergency Management Administration also publishes a variety of documents to help local jurisdictions plan and prepare for a seismic event, including risk assessment and evaluation criteria of structurally deficient buildings. Many of these resources could be used to help develop a local inventory and assist jurisdictions with prioritizing which buildings require more immediate retrofitting.

Discussion

The 1986 ordinance was fairly typical of the types of ordinances introduced at that time to address seismically vulnerable buildings. However, much has been learned from earthquakes following its implementation and the construction industry has made significant strides in improving the performance of buildings during seismic events. Accordingly, there is a need to update the City's existing ordinance to expand the list of potentially vulnerable buildings and creating an additional mechanisms to encourage retrofitting buildings not previously identified.

At a minimum, it is recommended that the City update the inventory of structurally deficient buildings in the multi-family, commercial and industrial areas of the city, categorizing building typologies including:

a. URM
b. Soft-Story
c. Tilt-Up Construction
d. Non-ductile Concrete
e. Steel Moment

This task would require use of a consultant to:

f. Prepare the inventory update
g. Review existing engineering reports on file with the city as a result of the 1986 ordinance
h. Assist the city in prioritizing buildings to be retrofitted
i. Provide guidance for a new or revised ordinance

Depending on the breadth of the program, consultant costs could extend up to $100,000 based on feedback received from other communities doing similar work.

In addition, the City may want to explore whether the program should be updated to require mandatory retrofitting following a voluntary compliance period. The use of incentives could continue play an important role and can help defray some costs associated with potentially financially burdensome compliance requirements.

Staff would like the Committee's input on these issues prior to contracting for an updated inventory and preparing a revised ordinance.

Timeline

Preparation of an updated inventory will take approximately 4-6 months once a contractor is on board. Depending on the number and type (including the current occupancy) of properties identified, it could take considerably more time to conduct outreach to proprety owners and the community, as well as prepare a draft ordinance for Committee review. Any amendments that require changes to Title 18 – Zoning, would require review by the Planning and Transportation Commission before the matter is brought to the Council.

The ordinance would set forth other timelines related to notice to owners, requirements for owner prepared engineering reports and expected completion dates to retrofit buildings determined to be structurall deficient.

Resource Impact

It is anticipated that staff would prepare the ordinance amendments, however, preparation of an updated inventory will require consultant assistance preliminarily estimated to be $100,000. At the time a contract is awarded, staff would request that City Council approve a Budget Amendment Ordinance (BAO) to increase the department's Fiscal Year 2015 Adopted Operating Budget appropriation to include this expense.

Environmental Review

The recommended action in this report is not a project and, therefore, not subject to environmental review. However, adoption of an ordinance to amend the muncipal code is subject to enviromental review. It is anticipated that a future amendment would be exempt from the provisions of the California Environmental Quality Act unless the ordinance would have the potentail to result in significant displacement of existing uses/residents.

Attachments:

- Attachment A: Palo Alto Municipal Code Section 16.42 (PDF)
- Attachment B: Seismic Inventory Status Update (DOC)
- Attachment C: Preliminary Soft-Story Construction List (DOCX)

Attachment A

Print

Palo Alto Municipal Code

Chapter 16.42
SEISMIC HAZARDS IDENTIFICATION PROGRAM

Sections:

16.42.010 Purpose.

It is found and declared that in the event of a strong or moderate local earthquake, loss of life or serious injury may result from damage to or collapse of buildings in Palo Alto. It is generally acknowledged that Palo Alto will experience earthquakes in the future due to its proximity to both the San Andreas and Hayward faults. The purpose of this chapter is to promote public safety by identifying those buildings in Palo Alto which exhibit structural deficiencies and by accurately determining the severity and extent of those deficiencies in relation to their potential for causing loss of life or injury. The city council finds it desirable to identify the hazards that these deficiencies may pose to occupants of buildings and pedestrians in the event of an earthquake. Such a seismic hazards identification program is consistent with California Health and Safety Code Sections 19160 - 19169 and is necessary to implement the Palo Alto Comprehensive Plan's Environmental Resources Policy 14, Program 47.

(Ord. 3666 § 1 (part), 1986)

16.42.020 Definitions.

(a) "Bearing wall" means any wall supporting a floor or roof where the total superimposed load exceeds one hundred pounds per linear foot, or any unreinforced masonry wall supporting its own weight when over six feet in height.

(b) "Building," for the purpose of determining occupant load, means any contiguous or interconnected structure; for purposes of engineering evaluation, means the entire structure or a portion thereof which will respond to seismic forces as a unit.

(c) "Capacity for transfer" means the maximum allowable capacity of a structural system or connection to resist in a ductile manner the lateral forces it would encounter due to earthquake forces.

(d) "Civil engineer or structural engineer" means a licensed civil or structural engineer registered by the state of California pursuant to the rules and regulations of Title 16, Chapter 5 of the California Administrative Code.

(e) "External hazard" means an object attached to or forming the exterior facade of a building which may fall onto pedestrians or occupants of adjacent buildings. Examples of this type of hazard include, but are not limited to, the following:

(1) Nonstructural exterior wall panels, such as masonry infill or decorative precast concrete;

(2) Parapets;

(3) Marquees, awnings or other roof-like projections from a building;

(4) Masonry or stone wall veneer and wall ornamentation, including cornices or other decorative appendages;

(5) Masonry chimneys;

(6) Tile roofing;

(7) Wall signs and exterior lighting fixtures hung from a building exterior;

(8) Fire escapes or balconies.

(f) "Geometry" means a building's shape or configuration, including setbacks of wall/column lines, reentrant corners, discontinuities in vertical and horizontal lateral force diaphragms, open storefront and building stiffness variations due to the distribution of resisting elements or the use of materials of differing properties within the same structural element, or other irregularities in plan or elevation.

(g) "Occupants" means the total occupant load of a building determinedm pursuant to the Uniform Building Code, or the actual maximum number of occupants in that building if that number is less than seventy-five percent of the number determined pursuant to the code. The number of actual occupants may be documented by counting actual seating capacity if permanent seating is provided in the occupancy, or by employee and client counts which can be substantiated as a practical maximum use of the space in the building. The chief building official will establish the procedure for documenting occupant loads.

(h) "Solution" means any justifiable method that will provide for the transfer of lateral forces through a system or connection to a degree which will substantially eliminate a potential collapse failure. A general description of the methods and materials to be used shall be included in sufficient detail to allow for a cost estimate of the solution to be made (i.e., adding shear walls, overlaying horizontal diaphragms, strengthening critical connections, etc.).

(i) "Unreinforced masonry" ("URM") building means any building containing walls constructed wholly or partially with any of the following materials:

(1) Unreinforced brick masonry;

(2) Unreinforced concrete masonry;

(3) Hollow clay tile;

(4) Adobe or unburned clay masonry.

(Ord. 4642 § 28, 2000: Ord. 3666 § 1 (part), 1986)

16.42.030 Scope of program.

(a) Applicability. The following buildings in Palo Alto shall be required to have an engineering report submitted to the city's building inspection division, pursuant to Section 16.42.050, to determine: (i) the existence, nature and extent of structural deficiencies which could result in collapse or partial collapse of the building; and (ii) the existence, nature and extent of deficiencies in the anchoring of external hazards:

(1) Buildings constructed of unreinforced masonry (URM), except those of less than one thousand nine hundred square feet containing six or fewer occupants;

(2) Buildings constructed prior to January 1, 1935 containing one hundred or more occupants;

(3) Buildings constructed prior to August 1, 1976 containing three hundred or more occupants.

(b) Exemptions. The following buildings need not comply with this chapter:

(1) Buildings which have been structurally upgraded in substantial accordance with either the Los Angeles Division 88 Standard for URM buildings or the 1973, or later, edition of the Uniform Building Code;

(2) Buildings whose uses are subject to amortization under this code; provided that, upon the termination of the nonconforming use, such a building shall be required to be rehabilitated to the then current lateral force requirements in the Uniform Building Code prior to occupancy by a conforming use.

(Ord. 3666 § 1 (part), 1986)

16.42.040 Building categories and implementation schedule.

(a) Building Categories. The categories of buildings within the scope of this chapter are set forth in Table A, below.

(b) Owner Notification. The owners of buildings in categories I through III, except those designated as historic buildings, shall be notified within six months of enactment of the ordinance codified in this chapter by the building inspection division of the city of Palo Alto that their buildings are required to have an engineering report submitted to the city. Owners of designated historic buildings, as defined in Chapter 16.49, shall be notified within eighteen months of enactment of the ordinance codified in this chapter.

(c) Implementation Schedule. The owners of buildings in categories I through III must submit engineering reports within the time frame set out in Table A, below, from the date of mailed notice by the city.

Table A

Category	**Description**	**Engineering Report Submitted Within Date of Mailed Notice (in Years)**
I	All URM buildings.	1-1/2
II	All pre-1935 buildings other than URM with 100 occupants or more.	2
III	All buildings with 300 occupants or more constructed between January 1, 1935 and August 1976.	2-1/2

(Ord. 3666 § 1 (part), 1986)

16.42.050 Engineering reports.

(a) Preparation of Reports. Building owners shall employ a civil or structural engineer to prepare the investigation and engineering report outlined below.

(b) Purpose. To investigate, in a thorough and unambiguous fashion, a building's structural systems that resist the forces imposed by earthquakes and to determine if any individual portion or combination of these systems is inadequate to prevent a structural failure (collapse or partial collapse).

(c) General. Each building shall be treated as an individual case without prejudice or comparison to similar type or age buildings which may have greater or lesser earthquake resistance. Generalities or stereotypes are to be avoided in the evaluation process by focusing on the specifics of the structural system of the building in question and the local geology of the land on which the building is constructed.

(d) Level of Investigation. Some buildings will require extensive testing and field investigation to uncover potential structural deficiencies, while others will allow the same level of overall evaluation by a less complicated process due to simplicity of design or the availability of original or subsequent alteration design and construction documents.

It is the responsibility of the engineer performing the evaluation to choose the appropriate level of investigation which will produce a report that is complete and can serve as a sound basis for a conclusion on the collapse hazard the building may present.

(e) Format for the Report. The following is a basic outline of the format each engineering report should follow. This outline is not to be construed to be a constraint on the professional preparing the report, but rather to provide a skeleton framework within which individual approaches to assembling the information required by the ordinance may be accomplished. It also will serve as a means for the city to evaluate the completeness of each report.

(1) General Information. A description of the building including: (i) the street address; (ii) the type of occupancy use within the building, with separate uses that generate different occupant loads indicated on a plan showing the square footage of each different use; (iii) plans and elevations showing the location, type and extent of lateral force resisting elements in the building (both horizontal and vertical elements); (iv) a description of the construction materials used in the structural elements and information regarding their present condition; (v) the date of original construction, if known and the date, if known, of any subsequent additions or substantial structural alterations of the building; and (vi) the name and address of the original designer and contractor, if known, and the name and address of the designer and contractor, if known, for any subsequent additions or substantial structural alterations.

(2) Investigation and Evaluation of Structural Systems. All items to be investigated and the methods of investigation for each type of building under consideration are contained in Appendices A and B, attached to the ordinance codified in this chapter, available from the city's building inspection division.

(3) Test Reports. All field and laboratory test results shall be included in the report. Evaluation of the significance of these test results shall be made with regard to each structural system or typical connection being evaluated. This evaluation may be limited to a statement of the adequacy or inadequacy of the system or connection based on the lateral load demand it would be required to resist by calculation. If tests reveal inadequacy, a conceptual solution must be included in the report.

(4) Conclusions. Based on the demand/capacity ratio and the specific evaluation items contained in Appendices A or B attached to the ordinance codified in this chapter, a statement shall be provided explaining the overall significance of the deficiencies found to exist in the building's lateral force-resisting system regarding potential collapse or partial collapse failure.

(5) Recommendations. An appropriate solution, which could be used to strengthen the structure to alleviate any collapse or partial collapse threat, shall be specified.

(f) Exceptions and Alternatives. Exceptions to the specific items required to be included in an engineering report may be granted by the chief building official upon review of a written request from the engineer preparing the report. Such a request shall provide evidence that adequate information concerning the required item(s) can be determined by alternate means or that a conclusion can be made about the item without following the solution called for in the appropriate appendix. The purpose of granting such exceptions shall be to reduce the costs or disruption that would result from taking required actions, when it can be shown that they are unnecessary to provide information available by other equivalent means. In no case will an exception be granted which would result in an item not being completely evaluated. The decision of the chief building official in granting exceptions is final.

(Ord. 3666 § 1 (part), 1986)

16.42.060 Review of reports.

(a) The city shall utilize the services of civil or structural engineers to assist the building inspection division in determining if the submitted engineering reports conform to the requirements of this chapter.

(b) The cost of this review shall be recovered by a fee assessed from the building owner based on the time required for the review. This fee amount shall be deducted from the plan checking fee collected for any future construction work that deals directly with correcting any of the structural inadequacies specified in the engineering report.

(c) Copies of the engineering reports shall be available to interested individuals for a standard copying fee or may be reviewed at the building inspection division offices.

(Ord. 3666 § 1 (part), 1986)

16.42.070 Responsibilities of the building owners.

(a) Notification of Building Tenants. A building owner shall notify all tenants, in writing, that a structural investigation has been performed and that the report is available at the building inspection division offices. This notice must be sent within thirty days of the date the report is submitted to the city.

(b) Letter of Intent. A building owner shall submit a letter to the building inspection division within one year of the date the engineering report was submitted, indicating the owner's intentions for dealing with the potential collapse hazards found to exist in the building.

(Ord. 3666 § 1 (part), 1986)

16.42.080 Program status reports to the city council.

The chief building official shall submit a semiannual report to the city council on the status of the seismic hazards identification program. The reports shall include information regarding the number of buildings analyzed, the severity of the structural inadequacies discovered and any actions taken by individual building owners to correct these inadequacies.

(Ord. 3666 § 1 (part), 1986)

16.42.090 Remedies.

It shall be unlawful for the owner of a building identified as being included in the scope of this chapter to fail to submit a report on either building collapse hazards or external hazards within the time period specified in Section 16.42.040(c), Table A, or to fail to submit a letter of intent within the time period specified in Section 16.42.070(b). The following remedies are available to the city:

(a) The city may seek injunctive relief on behalf of the public to enjoin a building owner's violation of this chapter.

(b) Any building owner violating this chapter shall be guilty of a misdemeanor and upon conviction thereof shall be punishable as provided in Section 1.08.010 of this code. Such building owner is guilty of a separate offense for each and every day during any portion of which such violation of this chapter is committed, continued or permitted by such building owner.

(c) These remedies are not exclusive.

(Ord. 3881 § 9, 1989: Ord. 3666 § 1 (part), 1986)

Attachment

Current Status of Existing Seismic Hazards Buildings per Category (September 2014)

Category I Buildings	Category II Buildings	Category III Buildings
Category I Buildings: Buildings constructed of unreinforced masonry (except for those smaller than 1,900 square feet with six (6) or fewer occupants).	**Category II Buildings**: Buildings constructed prior to January 1, 1935 containing one hundred (100) or more occupants.	**Category III Buildings**: Buildings constructed prior to August 1, 1976 containing three hundred (300) or more occupants.
Strengthened/Retrofitted: **21**	Strengthened: **13**	Strengthened: **5**
Demolished/New Building: **14**	Demolished/New Building: **2**	Demolished/New Building: **5**
URM Wall Removed: **1**		Proposed to be demolished: **4**
Exempt: **1**		
No Change: **10**	No change: **4**	No Change: **9**
Total Number: **47**	Total Number: **19**	Total Number: **23**

Category I Seismic

(Unreinforced Masonry including In-fill)

Updated September 2014

Address	Occupant	Status	
525 Alma	Patagonia	Strengthened UCBC	Historic
529 Alma	Pampas	Strengthened UCBC	Historic
539 Alma	Premier Properties	URM Wall Removed	Historic
657 Alma	Phil's Coffee	Demolished / New Building	
705 Alma	Ellison's Garage	Demolished / New Building	#995138-1997 UBC
841 Alma	Palo Alto Family Housing	Demolished / New Building	
901 Alma		No Change	
425-31 Cali	Fine arts	No Change	
437-41 Emerson	Classic Gelato	Strengthened UCBC	
530-32 Emerson	Jungle Printing	Strengthened UCBC	
544 Emerson	Gravity	Retrofitted 08rev-00239	
611-19 Emerson	Vivre/Fitness	Strengthened #2000973 – w/ 25 % increase	
626-40 Emerson	Gordon Biersh	Strengthened Permit # 871446 (Concrete beams w/ infill)	
744 Emerson	Whole Foods	Strengthened Permit 871186	
847 Emerson		No Change – Exempt from Ordinance	
949-51 Emerson	SOS Grocery	No Change	

150-56 Hamilton	House of Foam	No Change
411 High	Criteo Corp.	Strengthened Permit 981074 UBC
542 High	Palantir	No Change
160 Forest	Costanoa	Strengthened Permit # 902932
151 Homer	Pete's Coffee	Demolished / New Building
230 Homer		Strengthened Permit # 952276
232 Homer		Strengthened Permit # 952276
265 Homer		No Change
401 Florence	Russo & Hale	Strengthened Permit # 91104 w/ 25% increase
431-39 Florence	First Am. Title	Demolished / New Building
522 Ramona	Coupa Cafe	Strengthened UCBC
634-636 Ramona		No Change
820 Ramona	Maple Investments	Demolished / New Building
140 University	Palo Alto grill	Strengthened UCBC
150 University	Palantir	Demolished / New Building
171-77 University	Palo Alto Bicycle	Demolished / New Building
172-74 University	Frendz Studio	No Change
180-82 University	Cot Plus	Strengthened Permit # 933333 UBC

201-07 University	Sushi	Strengthened Permit # 941359
227 University	Stanford theater Addition	Demolished #040514
233-35 University	Mills Florist	No Change
270 University	Jos. A. Bank	Demolished / New Building
274-78 University	Keen Shoes	Demolished / New Building
275-83 University	Restoration Hardware	Strengthened Permit # 95939 UBC
380-82 University	Slamon Consulting	Demolished / New Building
384 University	Chico's	Strengthened UBC
403-05 University	O Sushi	Strengthened Permit # 950778
400 University	Union Bank	No Change
424 University	LuLuLemon	Demolished / New Building
499 University	Sprint	Demolished / New Building
700 Welch	Stanford Barn	Strengthened Permit # 871528

Category I – Seismic Summary: September 2014

Total Number	47
Strengthened or Retrofitted	21
Demolished / New Building	14
URM Wall Removed	1
Vacated	0
Exempt	1
No Change	10

Category II Seismic

(Buildings constructed prior to 1935 with more than 100 occupants)

Updated September 2014

Address	Occupant	Status
450 Bryant	City of Palo Alto/Senior Center (Avenidas)	Strengthened Permit # 95109
518-26 Bryant	Three Seasons	Strengthened
661 Bryant	Tencent	Mandatory Seismic upgrade 10-00592 Strengthened Permit # 902764
205-25 Hamilton	Institute for the Future	Strengthened Permit # 851796
231-47 Hamilton	Cardinal Hotel	No Change
255-67 Hamilton	University Art Center	Strengthening -seismic upgrade included in permit to be submitted with historic restoration late 2014
475 Homer	Women's Club	No Change
1305 Middlefield	City of Palo Alto/Stern Center	Strengthened Permit # 91689
211 Quarry	Hoover Pavilion	Strengthened 10-03433

668 Ramona	Pacific Art League	Strengthened 12-02860
223 University	Stanford Theater	Strengthened Permit #
251-55 University	Fidelity Investments	Strengthened Permit # 91455
300-14 University	Walgreen's	Demolished / New Building
340-46 University	Apple Store	Demolished / New Building
456 University	Border's Books	Strengthened Permit # 951243 25% Inc.
480 University	President Apartments	No Change
25 University	McArthur Park	No Change
745 Waverly	St. Thomas Aquinas Church	Strengthened Permit # 871141
2300 Wellesley	City of Palo Alto/Library	Strengthened

Category II – Seismic Summary: September 2014

Total Number	19
Strengthened	13
Demolished / New Building	2
No change	4
Historic	14

Category III Seismic

(Buildings constructed prior to 1976 with more than 300 Occupants)

Updated September 2014

Address	Occupant	Status
200 Arboretum	Nordstrom's	No Change
601 California	Wilson Sonsini Goodrich	Demolished / New Building
975 California	Merk	No Change
1451 California	Stanford Planned community development	To be demolished spring 2015 Strengthened Under Permit # 932441
1501 California	Stanford Planned community development	To be demolished spring 2015 Strengthened
1601 California	Stanford Planned community development Current home of Theranos Inc.	To be demolished spring 2015 Strengthened Under Permit # 891372
3333 Coyote Hill	PARC/Xerox	No Change
1069 East Meadow	Sofia University	Strengthened Under Permit # 89669
180 El Camino Real	Macy's	No change
180 El Ca Camino Real	Bloomingdales	New building under construction with demo of old building to follow.
3000 El Camino Real	Palo Alto Square	No Change
4249 El Camino Real	Elks Club	Demolished / New Building
4290 El	Arbor real planned	Demolished / New Building

Camino Real	community development	
3825 Fabian	Space Systems Loral	Strengthened Under Permit # 92859
3939 Fabian	Altair planned community Development	Demolished / New Building
285 Hamilton	Palo Alto Development Center	No Change
4001 Mirada	Miranda Park	Demolished / New Building
1651 Page Mill	Stanford Clinics	Strengthened
1801 Page Mill	Multiple Tenants	Strengthened Under Permit # 991605
3172 Porter	Stanford	Strengthened
500 Quarry	Sakes Fifth Avenue	No Change
865 Stanford	LDS Church	No Change
525 University	Tower	No Change

Category II – Seismic Summary: September 2014

Total Number	23
Strengthened	5
Demolished / New Building	5
No Change	9
New Construction purposed in 2015	4

Attachment C

Inventory of Soft-First Story Multi-Family Dwellings - City of Palo Alto
Santa Clara County Hazard Mitigation Plan
Updated September 2014

In 2003, the Collaborative for Disaster Mitigation at San Jose State University completed an "*Inventory of Soft-First Story Multi-Family Dwellings in Santa Clara County*". According to the report the City of Palo Alto had 130 soft-first story multi-family buildings including 1,263 residential units housing 3,158 occupants.

The following list of addresses updates the San Jose State University report with updated information from the City of Palo Fire Department, complied in July 2010.

Address	Occupant	Status
1851 Alma		
3043 Alma		
3053 Alma		
3065 Alma		
3079 Alma		
3087-3095 Alma One (1) Building		
3297 Alma		
3353 Alma		Voluntary Seismic Upgrade 06-03192
3357 Alma		
4157 Byron		Voluntary Seismic Upgrade 06-03088
4160 Byron		
4170 Byron		Voluntary Seismic Upgrade 06-03089
4171 Byron		
4180 Byron		
4185 Byron		
4190 Byron		
720 California		
750 California		
780 California		
122-128 Channing		Possibly Demo – Need to Confirm
460 Channing		Voluntary Seismic Upgrade Foundation Only
634 College		
657 College		
664 College		

811 College		
819 College		
827 College		
725 Cowper		
825 Cowper		
936-940 Cowper One (1) Building		
220 Curtner Bldg 1 & 2 Two (2) Buildings		
241 Curtner Bldg 1 & 2 One (1) Building		
242 Curtner		
250 Curtner Bldg 1 & 2 Two (2) Buildings		
301 Curtner		
320 Curtner		
322 Curtner		
330 Curtner		
350 Curtner		
380 Curtner Bldg 1 & 2 One (1) Building		Voluntary Seismic Upgrade 06-02139
385 Curtner		
391 Curtner		
3943 El Camino Real		
518 Everett		
528 Everett		
601-619 Forest One (1) Building		
628 Forest		
640 Forest		
660-666 Forest One (1) Building		
668-674 Forest One (1) Building		
446-454 Grant One (1) Building		
456-464 Grant One (1) Building		
630-640 Hamilton One (1) Building		
403-407 James 409-419 James		

One (1) Building		
420 James		
562 Kendall		
630 Los Robles Bldg 1 & 2 Three (3) Buildings		
559 Matadero		
4211 McKellar One (1) Building		
4217 McKellar		
575 Middlefield		
759 Middlefield		
801 Middlefield		
3901 - 3909 Middlefield One (1) Building		
570 Oxford		
3833 Park		
3860 Park		
3875 Park		
1072 Tanland		
1080 Tanland		
1090 Tanland		
1091 Tanland		
1093 Tanland		
1094 Tanland		
696 Towle		
800 University		
812 University Bldg 1 & 2 One (1) Building		
831 University		
836 University Bldg 1 & 2 One (1) Building		
220 Ventura		
290 Ventura		
310 Ventura		
330 Ventura Bldg 1 & 2 One (1) Building		
382/384/386/388 Ventura One (1) Building		
392/394/396/398 Ventura One (1) Building		
438 Ventura		
443 Ventura		
577 Vista Bldg 1 & 2		

One (1) Building		
925 Waverly		
355 Webster Bldg 1 & 2 One (1) Building		
440 Webster		
899 Webster		
2051 Wellesley Bldg 1 & 2 One (1) Building		
4290 Wilkie		
4292 Wilkie		
4294 Wilkie		
4296 Wilkie		
4298 Wilkie		
2134 Williams		
2145 Williams		
2175 Williams		
2251 Williams		
2261 Williams		

September 2014

	SJSU Report	City of PA Fire Department
Total Number	130	108
Voluntary Seismic Upgrade	6	6
No Change	124	102

Print

Palo Alto Municipal Code

Chapter 18.18
DOWNTOWN COMMERCIAL (CD) DISTRICT

Sections:

18.18.010 Purposes

(a) Downtown Commercial District [CD]

The CD downtown commercial district is intended to be a comprehensive zoning district for the downtown business area, accommodating a wide range of commercial uses serving city-wide and regional business and service needs, as well as providing for residential uses and neighborhood service needs. The CD commercial downtown district is specifically created to promote the following objectives in the downtown area of Palo Alto:

(1) control the rate and size of commercial development;

(2) preserve and promote ground-floor retail uses;

(3) enhance pedestrian activity;

(4) create harmonious transitions from the commercial areas to adjacent residential areas; and

(5) where applied in conjunction with Chapter 16.49 of the Palo Alto Municipal Code, preserve historic buildings.

(Ord. 4923 § 4 (part), 2006)

18.18.020 Applicable Regulations

(a) Applicable Chapters

The specific regulations of this chapter and the additional regulations and procedures established by other relevant chapters of the Zoning Code shall apply to the CD commercial downtown district, including subdistricts designated as CD-C (community), CD-S (service) and CD-N (neighborhood) and site development areas within the CD district, as shown on the City's Zoning Map. The term "abutting residential zones," where used in this chapter, includes the R-1, R-2, RMD, RM-15, RM-30, RM-40, or residential Planned Community (PC) districts, unless otherwise specifically noted.

(b) Applicable Combining Districts

The combining districts applicable to the CD district shall include, but shall not be limited to, the following districts:

(1) The pedestrian shopping (P) combining district regulations, as specified in Chapter 18.30(B), shall apply to the area of the CD district designated "P" combining district as shown on the City's Zoning Map.

(2) The ground floor (GF) combining district regulations, as specified in Chapter 18.30(C), shall apply to the area of the CD district designated "GF" combining district as shown on the City's Zoning Map.

(Ord. 4923 § 4 (part), 2006)

18.18.030 Definitions

(a) For the purposes of calculating floor area ratio for nonresidential uses under this chapter, "gross floor area" includes not only the area defined in Chapter 18.04, but also all covered at-grade or above-grade parking for nonresidential uses, no matter how slightly above grade such parking is.

(b) As used in this chapter, "historic rehabilitation" means returning a property to a state of utility, through repair or alteration, which makes possible an efficient contemporary use while preserving those portions and features of the property which are significant to its historic, architectural, and cultural values. "Historic rehabilitation" shall remedy all the known rehabilitation needs of the building, and shall not be confined to routine repair and maintenance as determined by the director of planning and community environment.

(c) As used in this chapter, "certification" means certification, by the director of planning and community environment, of floor area eligible for transfer to another site as described in Section 18.18.070.

(d) As used in this chapter, "receiver site" means a site which receives floor area pursuant to the provisions of Section 18.18.080.

(e) As used in this chapter, "sender site" means a site which has received a certification by the director of planning and community environment of floor area eligible for transfer to another site pursuant to the provisions of this chapter.

(f) "Transferable development right" or "TDR" means the floor area eligible for transfer to a receiver site as described in Section 18.18.080 of this code.

(Ord. 4923 § 4 (part), 2006)

18.18.040 Repeal of Regulations

The department of planning and community environment shall monitor the number of square feet approved for nonresidential development in the CD district and the number of square feet approved for nonresidential development pursuant to a planned community (PC) zone if the site of the PC zone was within the CD district on the effective date of this chapter. When 350,000 square feet of nonresidential development have received final design review approval pursuant to Chapter 18.76 or have received building permits, if no design approval is required, this chapter shall be repealed and a moratorium shall be imposed. This moratorium shall prohibit the city's acceptance or processing of any application for planning approval or a building permit for new nonresidential square footage in the CD district. This moratorium shall remain in effect for one year while the city undertakes a study of what regulations would be appropriate in the CD district. The moratorium may be extended by the council until such study is completed and appropriate regulations are implemented.

(Ord. 4923 § 4 (part), 2006)

18.18.050 Land Uses

The uses of land allowed by this chapter in each commercial zoning district are identified in the following table. Land uses that are not listed on the tables are not allowed, except where otherwise noted. Where the last column on the following tables ("Subject to Regulations in") includes a section number, specific regulations in the referenced section also apply to the use; however, provisions in other sections may apply as well.

Permited and conditionally permitted land uses for the CD district are shown in Table 1:

Table 1				
CD Permitted and Conditionally Permitted Uses				
P Permitted Use • CUP Conditional Use Permit Required				
	CD-C	**CD-S**	**CD-N**	**Subject to regulations in Chapter:**

ACCESSORY USES				
Accessory facilities and activities associated with or essential to permitted uses, and operated incidental to the principal use	P	P	P	
Drive-in or Take-out Services associated with permitted uses (2)	CUP	CUP	CUP	
Tire, battery, and automotive service facilities, when operated incidental to a permitted retail service or shopping center having a gross floor area of more than 30,000 square feet	CUP			
EDUCATIONAL, RELIGIOUS, AND ASSEMBLY USES				
Business and Trade Schools	P	P		
Churches and Religious Institutions	P	P	P	
Private Educational Facilities	P	P	CUP	
Private Clubs, Lodges, or Fraternal Organizations	P	P	CUP	
MANUFACTURING AND PROCESSING USES				
Recycling Centers	CUP	CUP	CUP	
Warehousing and Distribution		CUP		
OFFICE USES				
Administrative Office Services		P		18.18.060(f)
Medical, Professional, and General Business Offices	P	P	P	18.18.060(f)
PUBLIC/QUASI-PUBLIC FACILITY USES				
Utility Facilities essential to provision of utility services but excluding construction or storage yards, maintenance facilities, or corporation yards	CUP	CUP		
RECREATION USES				
Commercial Recreation	CUP	CUP	CUP	
Outdoor Recreation Services	CUP	CUP	CUP	
RESIDENTIAL USES				
Multiple-Family	P (1)	P (1)	P (1)	18.18.060(b)
Home Occupations	P	P	P	

Residential Care Homes	P	P	P	
RETAIL USES				
Eating and Drinking Services, except drive-in or take-out services	P	P	P	18.18.060(g)
Retail Services, excluding liquor stores	P	P	P	18.18.060(g)
Shopping Centers	P			18.18.060(g)
Liquor Stores	P	P	CUP	
SERVICE USES				
Animal Care, excluding boarding and kennels	P	P	P	
Ambulance Services	CUP	CUP	CUP	18.30(G)
Automobile Service Stations	CUP	CUP	CUP	
Automobile Services		CUP		
Convalescent Facilities	P	P	CUP	
Day Care Centers	P	P	P	
Small Family Day Care Homes	P	P	P	
Large Family Day Care Homes	P	P	P	
Small Adult Day Care Homes	P	P	P	
Large Adult Day Care Homes				
Financial Services, except drive-up services	P	P	CUP	
General Business Services	CUP	P	P	
Hotels	P	P	P	18.18.060(d)
Mortuaries	P	P	CUP	
Personal Services	P	P	P	18.18.060(g)
Reverse Vending Machines	P	P	P	
TRANSPORTATION USES				
Parking as a principal use	CUP	CUP		
Passenger Transportation Terminals		CUP		
TEMPORARY USES				
Indoor Farmers' Markets	CUP	CUP	CUP	
Temporary Parking Facilities, provided that such facilities shall remain no more than five years	CUP	CUP	CUP	

P Permitted Use CUP Conditional Use Permit Required

(1) Residential is only permitted as part of a mixed use development, pursuant to the provisions of Section 18.18.060(b), or on sites designated as Housing Opportunity Sites in the Housing Element of the Comprehensive Plan, pursuant to the provisions of Section 18.18.060(c).

(2) Drive-up facilities, excluding car washes, provide full access to pedestrians and bicyclists. A maximum of two such services shall be permitted within 1,000 feet and each use shall not be less than 150 ft from one another.

(Ord. 5065 § 4, 2009: Ord. 4923 § 4 (part), 2006)

18.18.060 Development Standards

(a) Exclusively Non-Residential Use

Table 2 specifies the development standards for new exclusively non-residential uses and alterations to non-residential uses or structures in the CD district, including the CD-C, CD-S, and CD-N subdistricts. These developments shall be designed and constructed in compliance with the following requirements and the context-based design criteria outlined in Section 18.18.110, provided that more restrictive regulations may be recommended by the architectural review board and approved by the director of planning and community environment, pursuant to Section 18.76.020:

Table 2				
Exclusively Non-Residential Development Standards				
	CD-C	**CD-S**	**CD-N**	**Subject to regulations in Section:**
Minimum Setbacks				
Front Yard (ft)	None required		10 (1)	
Rear Yard (ft)	None required			
Interior Side Yard (ft)	None required			
Street Side Yard (ft)	None required		20 (1)	Setback lines imposed by a special setback map pursuant to Chapter 20.08 of this code may apply
Minimum street setback for sites sharing a common block face with any abutting residential zone district	- (4)	- (4)	- (4)	
Minimum yard (ft) for lot lines abutting or opposite residential zone districts	10' (1)	10' (1)	10' (1)	
Maximum Site Coverage	None required		50%	
Maximum Height (ft)				
Standard	50	50	25	
Within 150 ft. of an abutting residential zone district	_ (3)	_ (3)	_ (3)	
	1.0:1 (5)	0.4:1 (5)	0.4:1 (5)	18.18.060(e)

Maximum Floor Area Ratio (FAR)				18.18.070
Maximum Floor Area Ratio (FAR) for Hotels	2.0:1	2.0:1	N/A	18.18.060(d)
Maximum Size of New Non-Residential Construction or Expansion Projects	25,000 square feet of gross floor area or 15,00 square feet above the existing floor area, whichever is greater, provided the floor area limits set forth elsewhere in this chapter are not exceeded			
Daylight Plane for lot lines abutting one or more residential zone districts				
Initial Height at side or rear lot line	_(2)	10	10	
Slope	_(2)	1:2	1:2	
(1) The yard shall be planted and maintained as a landscaped screen, excluding area required for site access.				
(2) The initial height and slope shall be identical to those of the residential zone abutting the site line in question.				
(3) The maximum height within 150 feet of any abutting residential zone district shall not exceed the height limit of the abutting residential district.				
(4) The minimum street setback shall be equal to the residentially zoned setback for 150 feet from the abutting single-family or multiple family development.				
(5) FAR may be increased with transfers of development and/or bonuses for seismic and historic rehabilitation upgrades, not to exceed a total site FAR of 3.0:1 in the CD-C subdistrict or 2.0:1 in the CD-S or CD-N subdistricts.				

(b) Mixed Use

Table 3 specifies the development standards for new residential mixed use developments. These developments shall be designed and constructed in compliance with the following requirements and the context-based design criteria outlines in Section 18.18.110, provided that more restrictive regulations may be recommended by the architectural review board and approved by the director of planning and community environment, pursuant to Section 18.76.020:

TABLE 3
MIXED USE DEVELOPMENT STANDARDS

	CD-C	CD-S	CD-N	Subject to regulations in Section:
Minimum Setbacks				Setback lines imposed by a special setback map pursuant to Chapter 20.08 of

				this code may apply
Front Yard (ft)	None required		10'	
Rear Yard (ft)	10' for residential portion; no requirement for commercial portion			
Interior Side Yard (ft)	No requirement	10' if abutting residential zone	10' if abutting residential zone	
Street Side Yard (ft)	No requirement	5'	5'	
Permitted Setback Encroachments	Balconies, awnings, porches, stairways, and similar elements may extend up to 6' into the setback. Cornices, eaves, fireplaces, and similar architectural features (excluding flat or continuous walls or enclosures of interior space) may extend up to 4' into the front and rear setbacks and up to 3' into interior side setbacks			
Maximum Site Coverage	No requirement	50%	50%	
Landscape Open Space Coverage	20%	30%	35%	
Usable Open Space	200 sq ft per unit for 5 or fewer units(1); 150 sq ft per unit for 6 units or more(1)			
	CD-C	CD-S	CD-N	Subject to regulations in Section:
Maximum Height (ft)				
Standard	50'	50'	35'	
Within 150 ft. of an abutting residential zone	40'(4)	40'(4)	35'(4)	
Daylight Plane for lot lines abutting one or more residential zoning districts or a residential PC district	Daylight plane height and slope identical to those of the most restrictive residential zone abutting the lot line			
Residential Density (net)(2)	40	30	30	
Maximum Residential Floor Area Ratio (FAR)	1.0:1(3)	0.6:1(3)	0.5:1(3)	
	1.0:1(3)	0.4:1	0.4:1	

Maximum Nonresidential Floor Area Ratio (FAR)				
Total Floor Area Ratio (FAR)(3)	2.0:1(3)	1.0:1(3)	0.9:1(3)	18.18.070
Parking Requirement	See Chapters 18.52 and 18.54			Chs. 18.52, 18.54

(1) Required usable open space: (1) may be any combination of private and common open spaces; (2) does not need to be located on the ground (but rooftop gardens are not included as open space); (3) minimum private open space dimension 6'; and (4) minimum common open space dimension 12'.

(2) Residential density shall be computed based upon the total site area, irrespective of the percent of the site devoted to commercial use. There shall be no deduction for that portion of the site area in nonresidential use.

(3) FAR may be increased with transfers of development and/or bonuses for seismic and historic rehabilitation upgrades, not to exceed a total site FAR of 3.0:1 in the CD-C subdistrict or 2.0:1 in the CD-S or CD-N subdistrict.

(4) For sites abutting an RM-40 zoned residential district or a residential Planned Community (PC) district, maximum height may be increased to 50 feet.

(1) Residential and nonresidential mixed use projects shall be subject to site and design review in accord with Chapter 18.30(G), except that mixed use projects with nine or fewer units shall only require review and approval by the architectural review board.

(2) Nonresidential uses that involve the use or storage of hazardous materials in excess of the exempt quantities prescribed in Title 15 of the Municipal Code, including but not limited to dry cleaning plants and auto repair, are prohibited in a mixed use development with residential uses.

(c) Exclusively Residential Uses

Exclusively residential uses are generally prohibited in the CD district and subdistricts. Such uses are allowed, however, where a site is designated as a Housing Opportunity Site in the Housing Element of the Comprehensive Plan. Such sites shall be developed pursuant to the regulations for the multi-family zone designation (RM-15, RM-30, or RM-40) identified for the site in the Housing Element.

(d) Hotel Regulations

(1) The purpose of these regulations is to allow floor area for development of hotels in excess of floor area limitations for other commercial uses, in order to provide a visitor-serving use that results in an enhanced business climate, increased transient occupancy tax and sales tax revenue, and other community and economic benefits to the city.

(2) Hotels, where they are a permitted use, may develop to a maximum FAR of 2.0:1, subject to the following limitations:

(A) The hotel use must generate transient occupancy tax (TOT) as provided in Chapter 2.33 of the Palo Alto Municipal Code; and

(B) No room stays in excess of thirty days are permitted, except where the city council approves longer stays through an enforceable agreement with the applicant to provide for compensating revenues.

(3) Hotels may include residential condominium use, subject to:

(A) No more than twenty-five percent of the floor area shall be devoted to condominium use; and

(B) No more than twenty-five percent of the total number of lodging units shall be devoted to condominium use; and

(C) A minimum FAR of 1.0 shall be provided for the hotel/condominium building(s); and

(D) Where residential condominium use is proposed, room stays for other hotel rooms shall not exceed thirty days.

(4) Violation of this chapter is subject to enforcement action for stays in excess of thirty days not permitted under the provisions of this chapter, in which case each day of room stay in excess of thirty days shall constitute a separate violation and administrative penalties shall be assessed pursuant to Chapters 1.12 and 1.16.

(e) Exempt Floor Area

When an existing building is being expanded, square footage which, in the judgement of the chief building official, does not increase the usable floor area, and is either necessary to conform the building to Title 24 of the California Code of Regulations, regarding disability related access, or is necessary to implement the historic rehabilitation of the building, shall not be counted as floor area. For the purposes of this section disability related upgrades are limited to the incremental square footage necessary to accommodate disability access and shall be subject to the Director's approval not to exceed 500 square feet per site. Disability related upgrades shall only apply to remodels of existing buildings and shall not qualify for grandfathered floor area in the event the building is later replaced or otherwise redeveloped.

(f) Restrictions on Office Uses

(1) New construction and alterations in the CD-C zoning district shall be required to design ground floor space to accommodate retail use and shall comply with the provisions of the Pedestrian (P) combining district.

(2) In the CD-S and CD-N subdistricts, the following requirements shall apply to office uses:

(A) No new gross square footage of a medical, professional, general business, or administrative office use shall be allowed, once the gross square footage of such office uses, or any combination of such uses, on a site has reached 5,000 square feet.

(B) No conversion of gross square footage from any other use to a medical, professional, general business, or administrative office use shall be allowed once the gross square footage of such office uses, or any combination of such uses, on a site has reached 5,000 square feet.

(g) Restrictions on Size of Commercial Establishments in CD-N Subdistrict

In the CD-N subdistrict, permitted commercial uses shall not exceed the floor area per individual use or business establishment shown in Table 4. Such uses may be allowed to exceed the maximum establishment size, subject to the issuance of a conditional use permit in accordance with Chapter 18.76. The maximum establishment size for any conditional use shall be established by the director and specified in the conditional use permit for such use.

TABLE 4
MAXIMUM SIZE OF ESTABLISHMENT

Type of Establishment	**Maximum Size (ft^2)**
Personal Services	2,500
Retail services, except grocery stores	15,000
Grocery stores	20,000
Eating and drinking services	5,000

(h) Outdoor Sales and Storage.

The following regulations shall apply to outdoor sales and storage in the CD district:

(1) CD-C Subdistrict

In the CD-C subdistrict, the following regulations apply:

(A) Except in shopping centers, all permitted office and commercial activities shall be conducted within a building, except for:

(i) Incidental sales and display of plant materials and garden supplies occupying no more than 2,000 square feet of exterior sales and display area,

(ii) Outdoor eating areas operated incidental to permitted eating and drinking services,

(iii) Farmers' markets which have obtained a conditional use permit, and

(iv) Recycling centers that have obtained a conditional use permit.

(B) Any permitted outdoor activity in excess of 2,000 square feet shall be subject to a conditional use permit.

(C) Exterior storage shall be prohibited, except recycling centers which have obtained a conditional use permit.

(2) CD-S Subdistrict

In the CD-S subdistrict, outdoor sales and display of merchandise, and outdoor eating areas operated incidental to permitted eating and drinking services shall be permitted subject to the following regulations:

(A) Outdoor sales and display shall not occupy a total site area exceeding the gross building floor area on the site, except as authorized by a conditional use permit.

(B) Areas used for outdoor sales and display of motor vehicles, boats, campers, camp trailers, trailers, trailer coaches, house cars, or similar conveyances shall meet the minimum design standards applicable to off-street parking facilities with respect to paving, grading, drainage, access to public streets and alleys, safety and protective features, lighting, landscaping, and screening.

(C) Exterior storage shall be prohibited, unless screened by a solid wall or fence of between 5 and 8 feet in height.

(3) CD-N Subdistrict

In the CD-N subdistrict, all permitted office and commercial activities shall be conducted within a building, except for:

(A) Incidental sales and display of plant materials and garden supplies occupying not more than 500 square feet of exterior sales and display area, and

(B) Farmers' markets that have obtained conditional use permits.

(i) Employee Showers

Employee shower facilities shall be provided for any new building constructed or for any addition to or enlargement of any existing building as specified in Table 5.

TABLE 5
EMPLOYEE SHOWERS REQUIRED

Uses	**Gross Floor Area of New Construction (ft^2)**	**Showers Required**
Medical, Professional, and General Business Offices, Financial Services, Business and Trade Schools, General Business Services	0-9,999	No requirement
	10,000-19,999	1
	20,000-49,999	2
	50,000 and up	4
Retail Services, Personal Services, and Eating and Drinking Services	0-24,999	No requirement
	25,000-49,999	1
	50,000-99,999	2
	100,000 and up	4

(j) Nuisances Prohibited

All uses, whether permitted or conditional, shall be conducted in such a manner as to preclude nuisance, hazard, or commonly recognized offensive conditions or characteristics, including creation or emission of dust, gas, smoke, noise, fumes, odors, vibrations, particulate matter, chemical compounds, electrical disturbance, humidity, heat, cold, glare, or night illuminations. Prior to issuance of a building permit, or occupancy permit, or at any other time, the building inspector may require evidence that adequate controls, measures, or devices have been provided to ensure and protect the public interest, health, comfort, convenience, safety, and general welfare from such nuisance, hazard, or offensive condition.

(k) Recycling Storage

All new development, including approved modifications that add thirty percent or more floor area to existing uses, shall provide adequate and accessible interior areas or exterior enclosures for the storage of recyclable materials in appropriate containers. The design, construction and accessibility of recycling areas and enclosures shall be subject to approval by the architectural review board, in accordance with design guidelines adopted by that board and approved by the city council pursuant to Section 16.48.070.

(Ord. 5373 § 15 (part), 2016; Ord. 5065 § 4, 2009: Ord. 5035 § 3, 2009: Ord. 4923 § 4 (part), 2006)

18.18.070 Floor Area Bonuses

(a) Available Floor Area Bonuses

(1) Minor Bonus for Buildings Not Eligible for Historic or Seismic Bonus

A building that is neither in Historic Category 1 or 2 nor in Seismic Category I, II, or III shall be allowed to increase its floor area by 200 square feet without having this increase count toward the FAR, subject to the restrictions in subsection (b). Such increase in floor area shall not be permitted for buildings that exceed a FAR of 3.0:1 in the CD-C subdistrict or a FAR of 2.0:1 in the CD-N or CD- S subdistricts. This bonus is not subject to transfer and must be fully parked. In addition to any applicable parking provisions, this bonus may be parked by the payment of in lieu parking fees under Section 18.18.090.

(2) Seismic Rehabilitation Bonus

A building that is in Seismic Category I, II, or III, and is undergoing seismic rehabilitation, but is not in Historic Category 1 or 2, shall be allowed to increase its floor area by 2,500 square feet or 25% of the existing building, whichever is greater, without having this increase count toward the FAR, subject to the restrictions in subsection (b). Such increase in floor area shall not be permitted for buildings that exceed a FAR of 3.0:1 in the CD-C subdistrict or a FAR of 2.0:1 in the CD-N or CD-S subdistricts. This bonus area must be fully parked. In addition to any applicable parking provisions, this bonus may be parked by the payment of in lieu parking fees under Section 18.18.090.

(3) Historic Rehabilitation Bonus

A building that is in Historic Category 1 or 2, and is undergoing historic rehabilitation, but is not in Seismic Category I, II, or III, shall be allowed to increase its floor area by 2,500 square feet or 25% of the existing building, whichever is greater, without having this increase count toward the FAR, subject to the restrictions in subsection (b). Such increase in floor area shall not be permitted for buildings that exceed a FAR of 3.0:1 in the CD-C subdistrict or a FAR of 2.0:1 in the CD-N or CD-S subdistricts, except as provided in subsection (5). This bonus area must be fully parked, In addition to any applicable parking provisions, this bonus may be parked by the payment of in lieu parking fees under Section 18.18.090.

(4) Combined Historic and Seismic Rehabilitation Bonus

A building that is in Historic Category 1 or 2, and is undergoing historic rehabilitation, and is also in Seismic Category I, II, or III, and is undergoing seismic rehabilitation, shall be allowed to increase its floor area by 5,000 square feet or 50% of the existing building, whichever is greater, without having this increase count toward the FAR, subject to the restrictions in subsection (b). Such increase in floor area shall not be permitted for buildings that exceed a FAR of 3.0:1 in the CD-C subdistrict or a FAR of 2.0:1 in the CD-N or CD-S subdistricts, except as provided in subsection (5). This bonus area must be fully parked. In addition to any applicable parking provisions, this bonus may be parked by the payment of in lieu parking fees under Section 18.18.090.

(5) Historic Bonus for Over-Sized Buildings

A building in Historic Category 1 or 2 that is undergoing historic rehabilitation and that currently exceeds a FAR of 3.0:1 if located in the CD-C subdistrict or 2.0:1 if located in the CD-S or CD-N subdistricts shall nevertheless be allowed to obtain a floor area bonus of 50% of the maximum allowable floor area for the site of the building, based upon a FAR of 3.0:1 if in the CD-C subdistrict and a FAR of 2.0:1 in the CD-S and CD-N subdistricts, subject to the restrictions in subsection (b) and the following limitation:

(A) The floor area bonus shall not be used on the site of the Historic Category 1 or 2 building, but instead may be transferred to another property or properties under the provisions of Section 18.18.080.

(b) Restrictions on Floor Area Bonuses

The floor area bonuses in subsection (a) shall be subject to the following restrictions:

(1) All bonus square footage shall be counted as square footage for the purposes of the 350,000 square foot limit on development specified in Section 18.18.040.

(2) All bonus square footage shall be counted as square footage for the purposes of the project size limit specified in Section 18.18.060 (a).

(3) In no event shall a building expand beyond a FAR of 3.0:1 in the CD-C subdistrict or a FAR of 2.0:1 in the CD-S or CD-N subdistrict.

(4) The bonus shall be allowed on a site only once.

(5) For sites in Seismic Category I, II, or III, seismic rehabilitation shall conform to the analysis standards referenced in Chapter 16.42 of this code.

(6) For sites in Historic Category 1 or 2, historic rehabilitation shall conform to the Secretary of the Interior's *Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings* (36 CFR §67,7).

(7) For sites in both Seismic Category I, II, or III and Historic Category 1 or 2, no bonus shall be granted unless the project includes both seismic and historic rehabilitation conforming to the standards in subsections (5) and (6).

(8) For sites in both Seismic Category I, II, or III and Historic Category 1 or 2, a bonus granted under this section that will be used on-site is subject to the following requirements:

(A) The city council must approve on-site use of such a FAR bonus. Such approval is discretionary, and may be granted only upon making both of the following findings:

(i) The exterior modifications for the entire project comply with the U.S. Secretary of the Interior's *Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings* (36 CFR §67,7); and

(ii) The on-site use of the FAR bonus would not otherwise be inconsistent with the historic character of the interior and exterior of the building and site.

(B) The applicant for on-site use of a cumulative floor area bonus shall have the burden of demonstrating the facts necessary to support the findings required for council approval.

(c) Transfer of Floor Area Bonuses

The floor area bonuses described in subsection (a), except the floor area bonus in subsection (a)(1), may be transferred to a non-historic receiver site as described in Section 18.18.080. Such transfer shall not be subject to the discretionary council approval set forth in subsection (b)(8).

(d) Procedure for Granting of Floor Area Bonuses

The floor area bonuses described in subsection (a), except the bonus described in subsection (a)(1), shall be granted in accordance with the following requirements:

(1) An application for such floor area bonus(es) must be filed with the director of planning and community environment in the form prescribed by the director, stating the amount of such bonus(es) applied for, the basis therefor under this section, and the extent to which such bonus (es) are proposed to be used on-site and/or for transfer. An application for floor area bonus for rehabilitation of a Category 1 or 2 historic building shall include a historic structure report, prepared by a qualified expert, retained by the city, at the applicant's expense, in accordance with the standards and guidelines of the California State Office of Historic Preservation. It shall also include a plan for rehabilitation; if any part of the existing building is proposed to be removed or replaced, the historic rehabilitation project plans submitted for review shall clearly show and identify any and all material proposed for removal or replacement.

(2) The city may retain an expert in historic rehabilitation or preservation, at the applicant's expense, to provide the city with an independent evaluation of the project's conformity with the Secretary of the Interior's "Standards for Rehabilitation and Guidelines for Rehabilitation Historic Buildings."

(3) The historic resources board shall review the historic structure report, the historic rehabilitation project plans, and, if required, the expert independent evaluation of the project, and make a recommendation to the director of planning and community environment on the project's conformity with the Secretary of the Interior's "Standards for Rehabilitation and Guidelines for Rehabilitation Historic Buildings."

(4) Upon completion of such an application, written determination of the sender site's eligibility for bonus(es) shall be issued by the director of planning and community environment or the director's designee, based upon the following:

(A) In the case of a floor area bonus for seismic rehabilitation, the chief building official has made a determination that the project complies with or exceeds the analysis standards referenced in Chapter 16.42 of this code;

(B) In the case of the floor area bonus for historic rehabilitation of a building in Historic Category 1 or 2, the director, taking into consideration the recommendations of the historic resources board, has found that the project complies with the Secretary of the Interior's *Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings* (36 CFR §67,7); and

(C) In the case of a bonus for both seismic and historic rehabilitation that is proposed to be use on-site, the city council has made the findings set forth in subsection (b)(8) of this section.

(e) **Certification of FAR Bonuses**

The floor area bonuses described in subsection (a), except the bonus described in subsection (a)(1), may be used on the site of the proposed seismic and/or historic rehabilitation project and a building permit issued therefor only upon satisfaction of all the requirements in subsection (d) above. Upon determining that the project has been completed as approved, or in the case of city-owned buildings upon completion of all of the requirements of Chapter 18.28, the director or director's designee shall issue a written certification which shall state the total floor area bonus utilized at the site (in the case of buildings in the CD-Commercial Downtown District), and the amount (if any) of remaining floor area bonus which is eligible for transfer to another site pursuant to the provisions of this chapter. The certification shall be recorded in the office of the county recorder and a copy shall be provided to the applicant.

As a condition precedent to being credited with a historic rehabilitation floor area bonus whether for use on-site or for transfer, the owner of the site shall enter into an unsubordinated protective covenant running with the land in favor of the city (or, if the city is the owner, in favor of a qualified and disinterested third party if the property is to be rehabilitated after the sale of the transfer of development rights), in a form satisfactory to the city attorney, to assure that the property will be rehabilitated and maintained in accordance with the Secretary of Interior's *Standards for Rehabilitation of Historic Buildings*, together with the accompanying interpretive *Guidelines for Rehabilitation of Historic Buildings*, as they may be amended from time to time. For city owned buildings subject to a long term lease of ten or more years where the rehabilitation work is to be performed by the lessee, this protective covenant shall be in favor of the city.

(Ord. 5356 § 2, 2015: Ord. 5214 § 2, 2013: Ord. 5038 § 1, 2009: Ord. 4964 § 15, 2007: Ord. 4923 § 4 (part), 2006)

18.18.080 Transfer of Development Rights

(a) Purpose

The purpose of this section is to implement the Comprehensive Plan by encouraging seismic rehabilitation of buildings in Seismic Categories I, II, and III, and encouraging historic rehabilitation of buildings or sites in Historic Category 1 and 2, and by establishing standards and procedures for the transfer of specified development rights from such sites to other eligible sites. Except as provided in subsection (e)(1) and for city-owned properties as provided in Chapter 18.28, this section is applicable only to properties located in the CD district, and is the exclusive procedure for transfer of development rights for properties so zoned.

(b) Establishment of Forms

The city may from time to time establish application forms, submittal requirements, fees and such other requirements and guidelines as will aid in the efficient implementation of this chapter.

(c) Eligibility for Transfer of Development Rights

Transferable development rights may be transferred to an eligible receiver site upon:

(1) Certification by the city pursuant to Section 18.18.070 of the floor area from the sender site which is eligible for transfer; and

(2) Compliance with the transfer procedures set forth in subsection (h).

(d) Availability of Receiver Sites

The city does not guarantee that at all times in the future there will be sufficient eligible receiver sites to receive such transferable development rights.

(e) Eligible Receiver Sites

A site is eligible to be a receiver site only if it meets all of the following criteria:

(1) It is located in the CD commercial downtown district, or is located in a planned community (PC) district if the property was formerly located in the CD commercial downtown district and the ordinance rezoning the property to planned community (PC) approves the use of transferable development rights on the site.

(2) It is neither an historic site, nor a site containing a historic structure, as those terms are defined in Section 16.49.020(e) of Chapter 16.49 of this code; and

(3) The site is either:

(A) Located at least 150 feet from any property zoned for residential use, not including property in planned community zones or in commercial zones within the downtown boundaries where mixed use projects are.

(B) Separated from residentially zoned property by a city street with a width of at least 50 feet, and separated from residentially zoned property by an intervening property zoned CD-C, CD-S, or CD-N, which intervening property has a width of not less than 50 feet.

(f) Limitations On Usage of Transferable Development Rights

No otherwise eligible receiver site shall be allowed to utilize transferable development rights under this chapter to the extent such transfer would:

(1) Be outside the boundaries of the downtown parking assessment district, result in a maximum floor area ratio of 0.5 to 1 above what exists or would otherwise be permitted for that site under Section 18.18.060, whichever is greater, or result in total additional floor area of more than 10,000 square feet.

(2) Be within the boundaries of the downtown parking assessment district, result in a maximum floor area ratio of 1.0 to 1 above what exists, or would otherwise be permitted for that site under Section 18.18.060, whichever is greater, or result in total additional floor area of more than 10,000 square feet.

(3) Cause the development limitation or project size limitation set forth in Section 18.18.040 to be exceeded.

(4) Cause the site to exceed 3.0 to 1 FAR in the CD-C subdistrict or 2.0 to 1 FAR in the CD-S or CD-N subdistricts.

(g) Parking Requirements

Any square footage allowed to be transferred to a receiver site pursuant to this chapter shall be subject to the parking regulations applicable to the district in which the receiver site is located.

(h) Transfer Procedure

Transferable development rights may be transferred from a sender site (or sites) to a receiver site only in accordance with all of the following requirements:

(1) An application pursuant to Chapter 18.76 of this code for major ARB review of the project proposed for the receiver site must be filed. The application shall include:

(A) A statement that the applicant intends to use transferable development rights for the project;

(B) Identification of the sender site(s) and the amount of TDRs proposed to be transferred; and

(C) Evidence that the applicant owns the transferable development rights or a signed statement from any other owner(s) of the TDRs that the specified amount of floor area is available for the proposed project and will be assigned for its use.

(2) The application shall not be deemed complete unless and until the city determines that the TDRs proposed to be used for the project are available for that purpose.

(3) In reviewing a project proposed for a receiver site pursuant to this section, the architectural review board shall review the project in accordance with Chapters 18.76 and 18.77 of this code; however, the project may not be required to be modified for the sole purpose of reducing square footage unless necessary in order to satisfy the findings for approval under Chapter 18.76 or any specific requirement of the municipal code.

(4) Following ARB approval of the project on the receiver site, and prior to issuance of building permits, the director of planning and community environment or the director's designee shall issue written confirmation of the transfer, which identifies both the sender and receiver sites and the amount of TDRs which have been transferred. This confirmation shall be recorded in the office of the county recorder prior to the issuance of building permits and shall include the written consent or assignment by the owner(s) of the TDRs where such owner(s) are other than the applicant.

(i) Purchase or Conveyance of TDRs - Documentation

(1) Transferable development rights may be sold or otherwise conveyed by their owner(s) to another party. However, no such sale or conveyance shall be effective unless evidenced by a recorded document, signed by the transferor and transferee and in a form designed to run with the land and satisfactory to the city attorney. The document shall clearly identify the sender site

and the amount of floor area transferred and shall also be filed with the department of planning and community environment.

(2) Where transfer of TDRs is made directly to a receiver site, the recorded confirmation of transfer described in subsection (h)(4) shall satisfy the requirements of this section.

(Ord. 5373 § 15 (part), 2016; Ord. 5356 § 2, 2015: Ord. 5214 § 3, 2013: Ord. 4923 § 4 (part), 2006)

18.18.090 Parking and Loading

The provisions of Chapters 18.52 and 18.54 shall apply within the CD district, except the provisions of Chapters 18.52 and 18.54 regarding on-site and off-site parking for non-residential uses within an assessment district wherein properties are assessed under a Bond Plan G financing pursuant to Title 13. With respect to such uses, the following requirements shall apply in the CD district in lieu of the requirements in Chapters 18.52 and 18.54:

(a) On-Site Parking Requirement

Any new development, any addition or enlargement of existing development, or any use of any floor area that has never been assessed under any Bond Plan G financing pursuant to Title 13, shall provide one parking space for each two hundred fifty gross square feet of floor area, except as may be exempt from such requirement by the provisions of subsection (b) of this section. The purpose of this subsection is to regulate the number of parking spaces required. Requirements for the size and other design criteria for parking spaces shall continue to be governed by the provisions of Chapters 18.52 and 18.54.

(b) Exceptions to On-Site Parking Requirement

The requirement for on-site parking provided in subsection (a) of this section shall not apply in the following circumstances:

(1) The following square footage shall be exempt from the on-site parking requirement of subsection (a):

(A) Square footage for handicapped access which does not increase the usable floor area, as determined by Section 18.18.060(e);

(B) Square footage for at or above grade parking, though such square footage is included in the FAR calculations in Section 18.18.060(a).

(2) A conversion to commercial use of a historic building in Categories 1 and 2 shall be exempt from the on-site parking requirement in subsection (a), provided that the building is fifty feet or less in height and has most recently been in residential use. Such conversion, in order to be exempt, shall be done in conjunction with exterior historic rehabilitation approved by the director of planning and community environment upon the recommendation of the architectural review board in consultation with the historic resources board. Such conversion must not eliminate any existing on-site parking.

(3) Vacant parcels shall be exempt from the requirements of subsection (a) of this section at the time when development occurs as provided herein. Such development shall be exempt to the extent of parking spaces for every one thousand square feet of site area, provided that such

parcels were at some time assessed for parking under a Bond Plan E financing pursuant to Chapter 13.16 or were subject to other ad valorem assessments for parking.

(4) No new parking spaces will be required for a site in conjunction with the development or replacement of the amount of floor area used for nonresidential use equal to the amount of adjusted square footage for the site shown on the engineer's report for fiscal year 1986-87 for the latest Bond Plan G financing for parking acquisition or improvements in that certain area of the city delineated on the map of the University Avenue parking assessment district entitled, "Proposed Boundaries of University Avenue Off-Street Parking Project #75-63 Assessment District, City of Palo Alto, County of Santa Clara, State of California," dated October 30, 1978, and on file with the city clerk. No exemption from parking requirements shall be available where a residential use changes to a nonresidential use, except pursuant to subsection (2).

(c) Off-Site Parking

Parking required by this chapter may be provided by off-site parking, provided that such off-site parking is within a reasonable distance of the site using it or, if the site is within an assessment district, within a reasonable distance of the assessment district boundary and approved in writing by the director of planning and community environment. The director shall assure that sufficient covenants and guarantees are provided to ensure use and maintenance of such parking facilities, including an enforceable agreement that any development occurring on the site where parking is provided shall not result in a net reduction of parking spaces provided, considering both the parking previously provided and the parking required by the proposed use.

(d) In-lieu Parking Provisions

In connection with any expansion of the supply of public parking spaces within the CD commercial downtown district, the city shall allocate a number of spaces for use as "in-lieu parking" spaces to allow development to occur on sites which would otherwise be precluded from development due to parking constraints imposed by monetary contribution to the city to defray the cost of providing such parking. Contributions for each required parking space shall equal the incremental cost of providing a net new parking space in an assessment district project plus cost for the administration of the program, all as determined pursuant to Chapter 16.57 of Title 16 of this code, by the director of planning and community environment, whose decision shall be final. Only sites satisfying one or more of the following criteria, as determined by the director of planning and community environment, shall be eligible to participate in the in-lieu parking program:

(1) Construction of on-site parking would necessitate destruction or substantial demolition of a designated historic structure;

(2) The site area is less than 10,000 square feet, but of such an unusual configuration that it would not be physically feasible to provide the required on-site parking;

(3) The site is greater than 10,000 square feet, but of such an unusual configuration that it would not be physically feasible to provide the required on-site parking;

(4) The site is located in an area where city policy precludes curb cuts or otherwise prevents use of the site for on-site parking; or

(5) The site has other physical constraints, such as a high groundwater table, which preclude provision of on-site parking without extraordinary expense.

(e) Underground Parking

Underground parking deeper than two levels below grade shall be prohibited unless a soils report or engineering analysis demonstrates that regular pumping of subsurface water will not be required.

(Ord. 5356 § 4, 2015: Ord. 5214 § 4, 2013: Ord. 4923 § 4 (part), 2006)

18.18.100 Performance Standards

In addition to the standards for development prescribed above, all development shall comply with the performance criteria outlined in Chapter 18.23 of the Zoning Ordinance. All mixed use development shall also comply with the provisions of Chapter 18.23 of the Zoning Ordinance.

(Ord. 4923 § 4 (part), 2006)

18.18.110 Context-Based Design Criteria

(a) Contextual and Compatibility Criteria

Development in a commercial district shall be responsible to its context and compatible with adjacent development, and shall promote the establishment of pedestrian oriented design.

(1) Context

(A) Context as used in this section is intended to indicate relationships between the site's development to adjacent street types, surrounding land uses, and on-site or nearby natural features, such as creeks or trees. Effective transitions to these adjacent uses and features are strongly reinforced by Comprehensive Plan policies.

(B) The word "context" should not be construed as a desire to replicate existing surroundings, but rather to provide appropriate transitions to those surroundings. "Context" is also not specific to architectural style or design, though in some instances relationships may be reinforced by an architectural response.

(2) Compatibility

(A) Compatibility is achieved when the apparent scale and mass of new buildings is consistent with the pattern of achieving a pedestrian oriented design, and when new construction shares general characteristics and establishes design linkages with the overall pattern of buildings so that the visual unity of the street is maintained.

(B) Compatibility goals may be accomplished through various means, including but not limited to:

(i) the siting, scale, massing, and materials;

(ii) the rhythmic pattern of the street established by the general width of the buildings and the spacing between them;

(iii) the pattern of roof lines and projections;

(iv) the sizes, proportions, and orientations of windows, bays and doorways;

(v) the location and treatment of entryways;

(vi) the shadow patterns from massing and decorative features;

(vii) the siting and treatment of parking; and

(viii) the treatment of landscaping.

(b) Context-Based Design Considerations and Findings

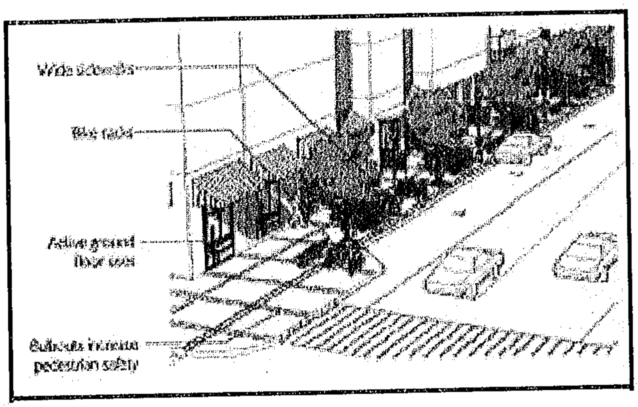
In addition to the findings for Architectural Review contained in Section 18.76.020(d) of the Zoning Ordinance, the following additional findings are applicable in the CD district and subdistricts, as further illustrated on the accompanying diagrams:

(1) Pedestrian and Bicycle Environment

The design of new projects shall promote pedestrian walkability, a bicycle friendly environment, and connectivity through design elements such as:

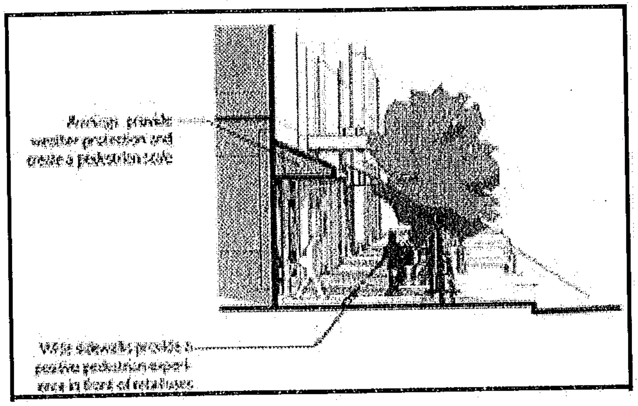
A. Ground floor uses that are appealing to pedestrians through well-designed visibility and access (Figure 1-1);

Figure 1-1



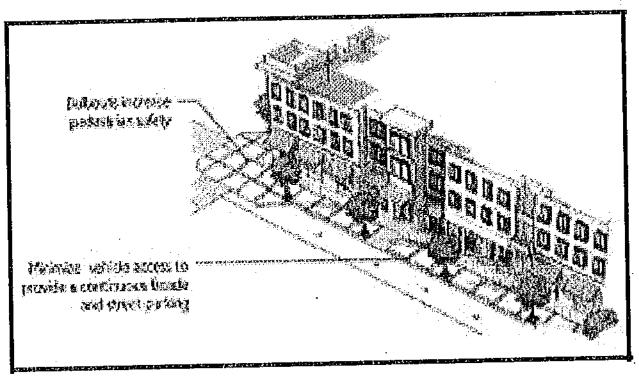
B. On primary pedestrian routes, climate and weather protection where possible, such as covered waiting areas, building projections and colonnades, and awnings (Figure 1-2);

Figure 1-2



C. Streetscape or pedestrian amenities that contribute to the area's streetscape environment such as street trees, bulbouts, benches, landscape elements, and public art (Figure 1-3);

Figure 1-3



D. Bicycle amenities that contribute to the area's bicycle environment and safety needs, such as bike racks, storage or parking, or dedicated bike lanes or paths (Figure 1-1); and

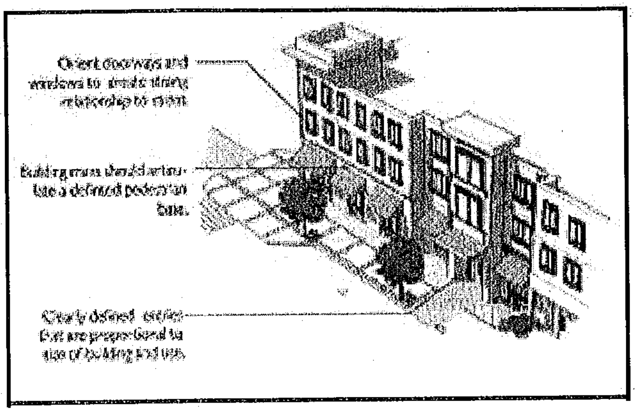
E. Vehicle access from alleys or sidestreets where they exist, with pedestrian access from the public street.

(2) Street Building Facades

Street facades shall be designed to provide a strong relationship with the sidewalk and the street(s), to create an environment that supports and encourages pedestrian activity through design elements such as:

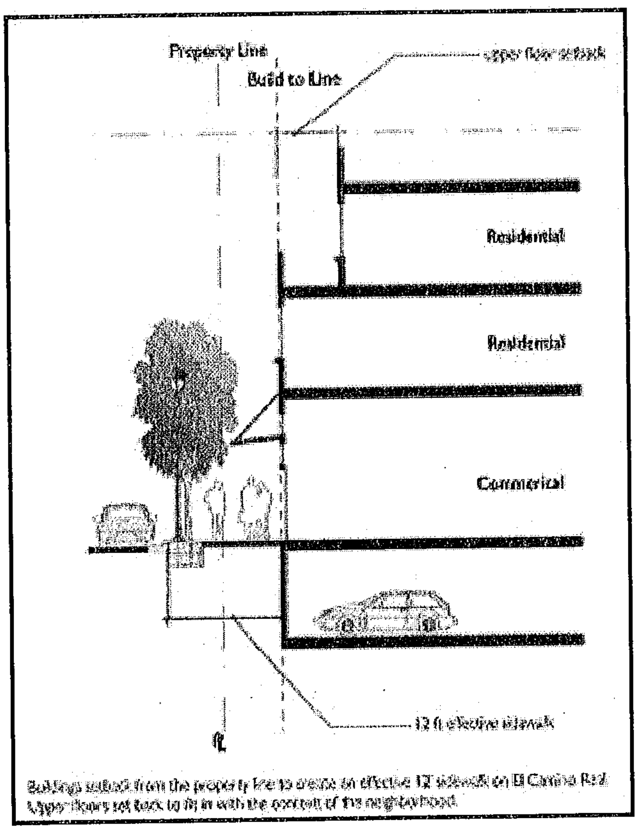
A. Placement and orientation of doorways, windows, and landscape elements to create strong, direct relationships with the street (Figure 2-1);

Figure 2-1



B. Facades that include projecting eaves and overhangs, porches, and other architectural elements that provide human scale and help break up building mass (Figure 2-2);

Figure 2-2



C. Entries that are clearly defined features of front facades, and that have a scale that is in proportion to the size and type of the building and number of units being accessed; larger buildings should have a more prominent building entrance, while maintaining a pedestrian scale;

D. Residential units and storefronts that have a presence on the street and are not walled-off or oriented exclusively inward;

E. Elements that signal habitation such as entrances, stairs, porches, bays and balconies that are visible to people on the street;

F. All exposed sides of a building designed with the same level of care and integrity;

G. Reinforcing the definition and importance of the street with building mass; and

H. Upper floors set back to fit in with the context of the neighborhood.

(3) Massing and Setbacks

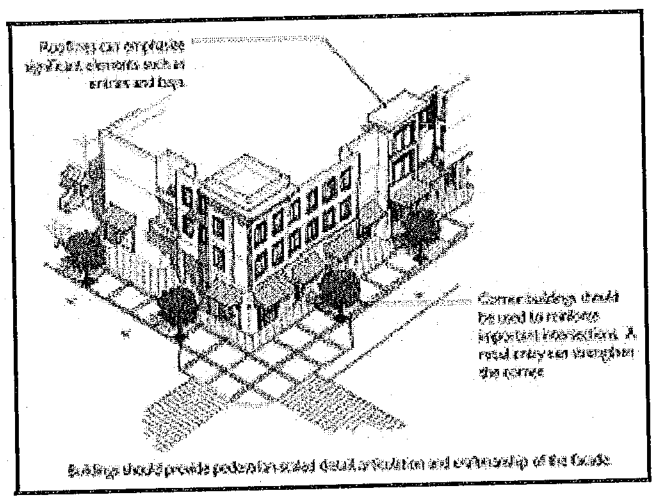
Buildings shall be designed to minimize massing and conform to proper setbacks through elements such as:

A. Rooflines that emphasize and accentuate significant elements of the building such as entries, bays, and balconies (Figure 3-1);

B. Design with articulation, setbacks, and materials that minimize massing, break down the scale of buildings, and provide visual interest (Figure 3-1);

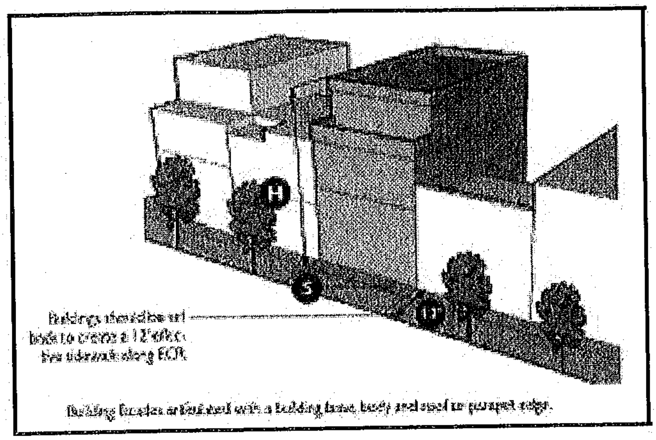
C. Corner buildings that incorporate special features to reinforce important intersections and create buildings of unique architectural merit and varied styles (Figure 3-1);

Figure 3-1



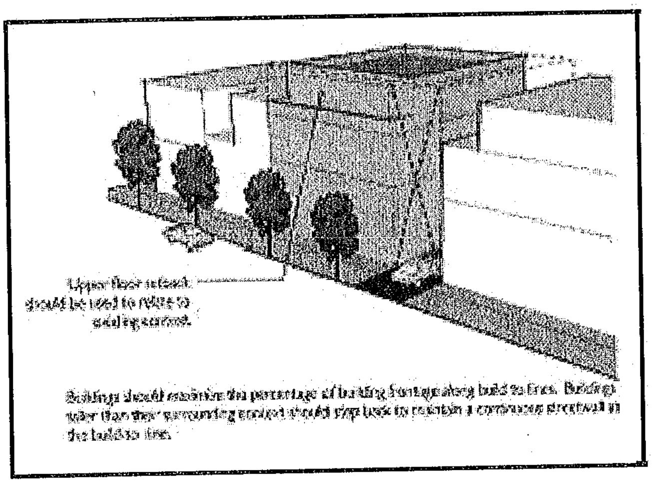
D. Building facades articulated with a building base, body and roof or parapet edge (Figure 3-2);

Figure 3-2



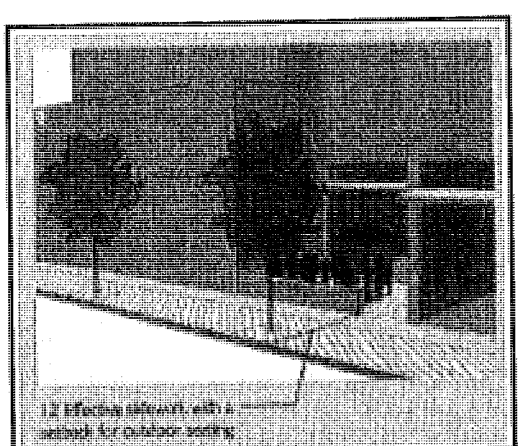
E. Buildings set back from the property line to create an effective 12' sidewalk on El Camino Real, 8' elsewhere (Figure 3-4);

Figure 3-3



F. A majority of the building frontage located at the setback line (Figure 3-3); and

Figure 3-4



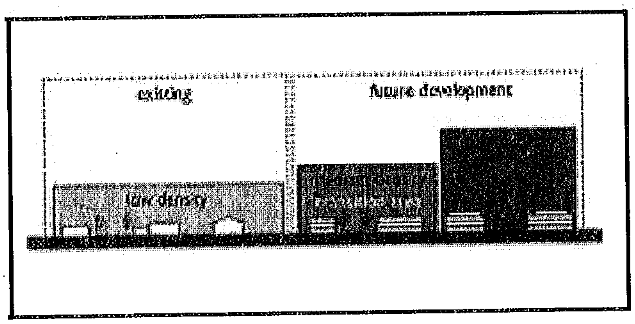
G. No side setback for midblock properties, allowing for a continuous street facade, except when abutting low density residential (Figure 3-3).

(4) Low-Density Residential Transitions

Where new projects are built abutting existing lower-scale residential development, care shall be taken to respect the scale and privacy of neighboring properties through:

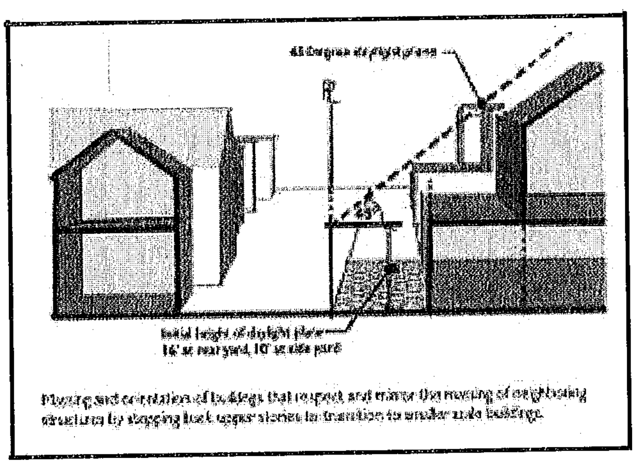
A. Transitions of development intensity from higher density development building types to building types that are compatible with the lower intensity surrounding uses (Figure 4-1);

Figure 4-1



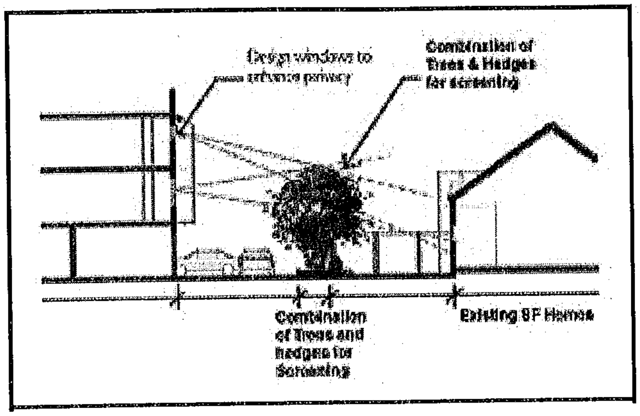
B. Massing and orientation of buildings that respect and mirror the massing of neighboring structures by stepping back upper stories to transition to smaller scale buildings, including setbacks and daylight planes that match abutting R-1 and R-2 zone requirements (Figure 4-2);

Figure 4-2



C. Respecting privacy of neighboring structures, with windows and upper floor balconies positioned so they minimize views into neighboring properties (Figure 4-3);

Figure 4-3



D. Minimizing sight lines into and from neighboring properties (Figure 4-3);

E. Limiting sun and shade impacts on abutting properties; and

F. Providing pedestrian paseos and mews to create separation between uses.

(5) Project Open Space

Private and public open space shall be provided so that it is usable for the residents, visitors, and/or employees of a site.

A. The type and design of the usable private open space shall be appropriate to the character of the building(s), and shall consider dimensions, solar access, wind protection, views, and privacy;

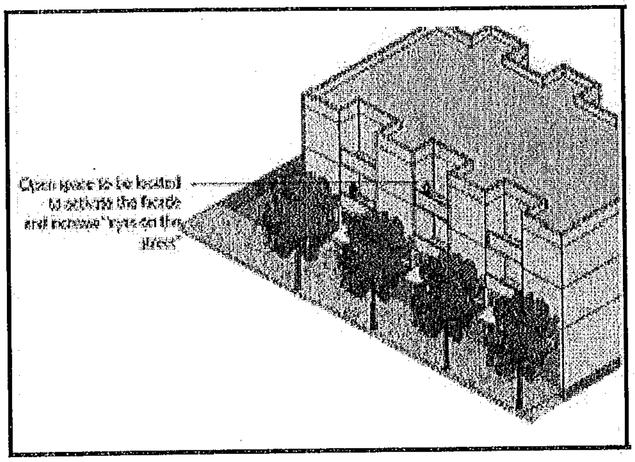
B. Open space should be sited and designed to accommodate different activities, groups, active and passive uses, and should be located convenient to the users (e.g., residents, employees, or public)

C. Common open spaces should connect to the pedestrian pathways and existing natural amenities of the site and its surroundings;

D. Usable open space may be any combination of private and common spaces;

E. Usable open space does not need to be located on the ground and may be located in porches, decks, balconies and/or podiums (but not on rooftops) (Figure 5-1);

Figure 5-1



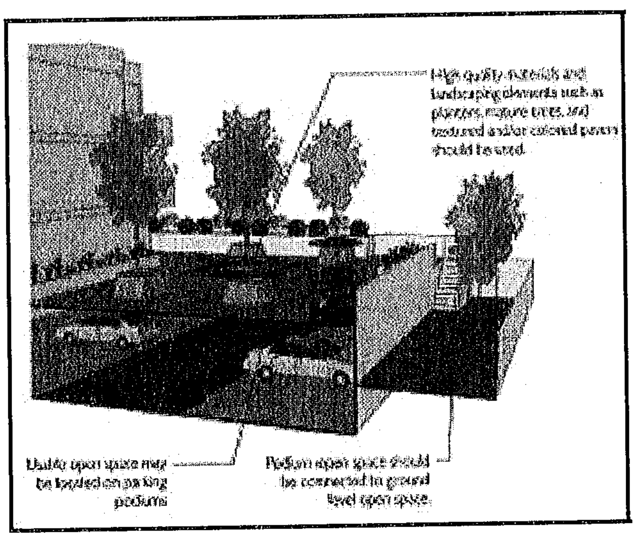
F. Open space should be located to activate the street façade and increase "eyes on the street" when possible (Figure 5-1);

G. Both private and common open space areas should be buffered from noise where feasible through landscaping and building placement;

H. Open space situated over a structural slab/podium or on a rooftop shall have a combination of landscaping and high quality paving materials, including elements such as planters, mature trees, and use of textured and/or colored paved surfaces (Figure 5-2); and

I. Parking may not be counted as open space.

Figure 5-2



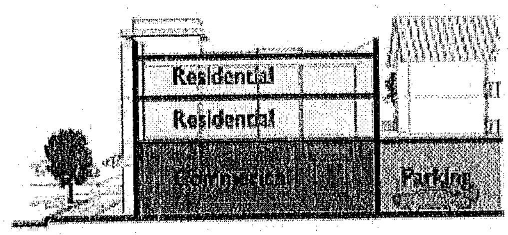
(6) Parking Design

Parking needs shall be accommodated but shall not be allowed to overwhelm the character of the project or detract from the pedestrian environment, such that:

A. Parking is located behind buildings, below grade or, where those options are not feasible, screened by landscaping, low walls, etc.;

B. Structured parking is fronted or wrapped with habitable uses when possible (Figure 6-1);

Figure 6-1

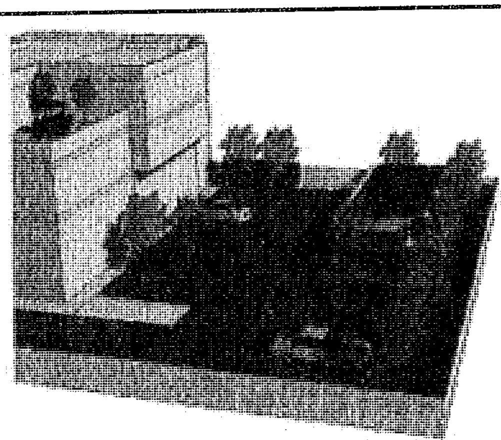


Parking podiums shall be fronted or wrapped with habitable or active uses when possible.

C. Parking that is semi-depressed is screened with architectural elements that enhance the streetscape such as stoops, balcony overhangs, and/or art;

D. Landscaping such as trees, shrubs, vines, or groundcover is incorporated into surface parking lots (Figure 6-2);

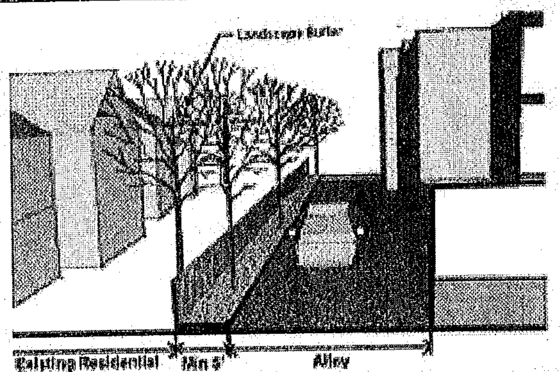
Figure 6-2



Landscaping such as trees, shrubs, vines or ground cover is incorporated into surface parking lots.

E. For properties with parking access from the rear of the site (such as a rear alley or driveway) landscaping shall provide a visual buffer between vehicle circulation areas and abutting properties (Figure 6-3);

Figure 6-3



Landscaping shall provide a visual buffer between vehicle areas and adjacent properties.

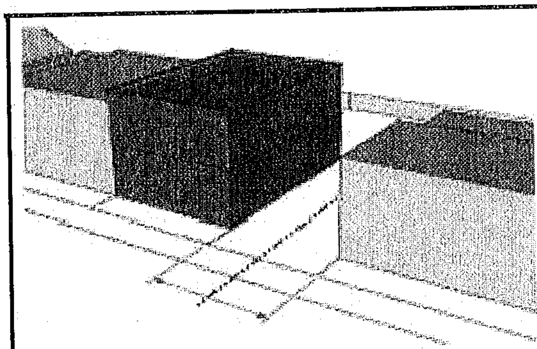
F. Street parking is utilized for visitor or customer parking and is designed in a manner to enhance traffic calming;

G. For properties with parking accessed from the front, minimize the amount of frontage used for parking access, no more than 25% of the site frontage facing a street should be devoted to garage openings, carports, or open/surface parking (on sites with less than 100 feet of frontage, no more than 25 feet);

H. Where two parking lots abut and it is possible for a curb cut and driveway to serve several properties, owners are strongly encouraged to enter in to shared access agreements (Figure 6-4); and

I. Parking is accessed from side streets or alleys when possible.

Figure 6-4



When possible, adjacent properties are strongly encouraged to share driveways to limit curb cuts.

Figure 6-5 -- Mixed-Use with Surface Parking

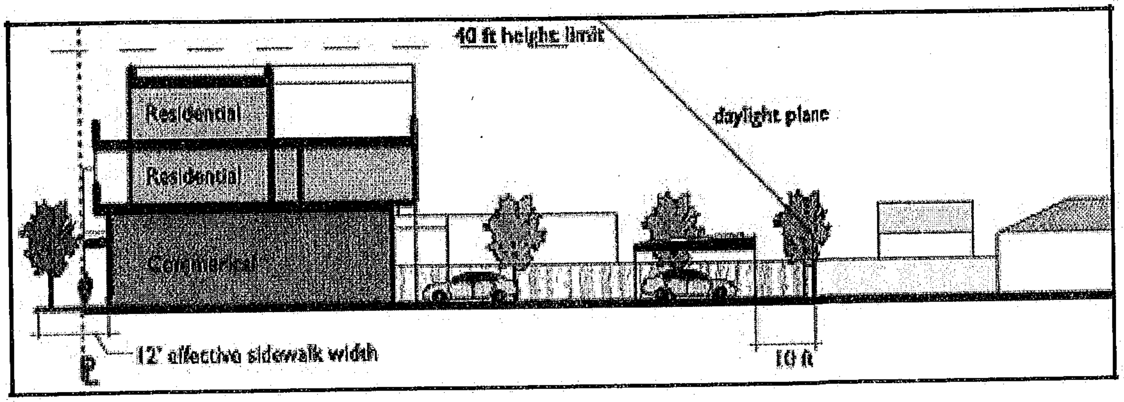


Figure 6-6 -- Mixed-Use with Podium Parking

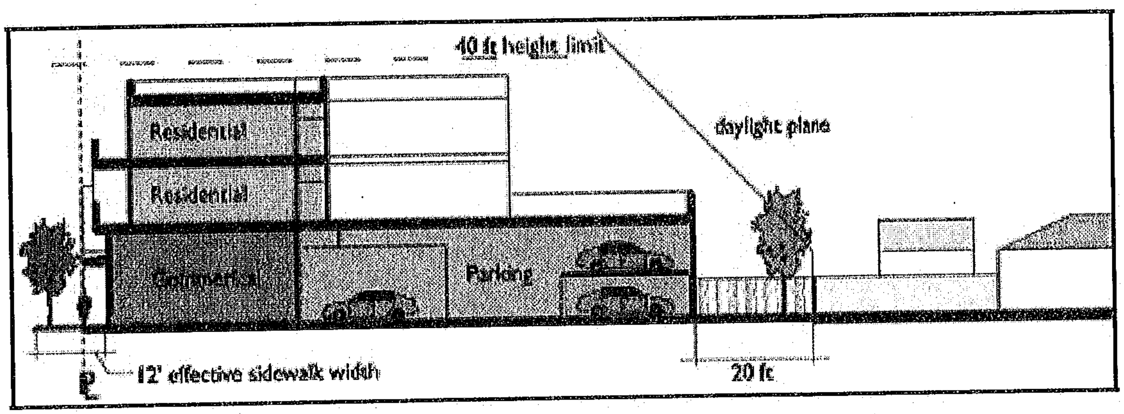


Figure 6-7 -- Mixed-Use with Partial Sub-Grade Parking Podium

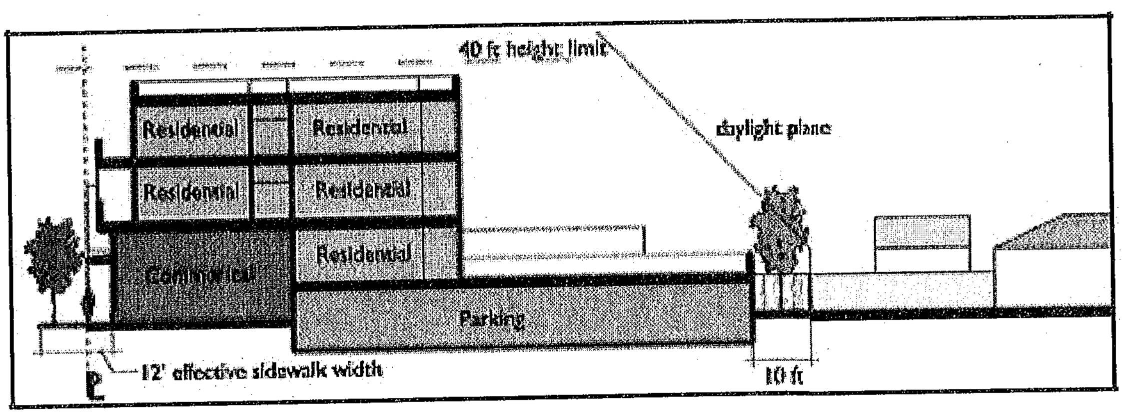
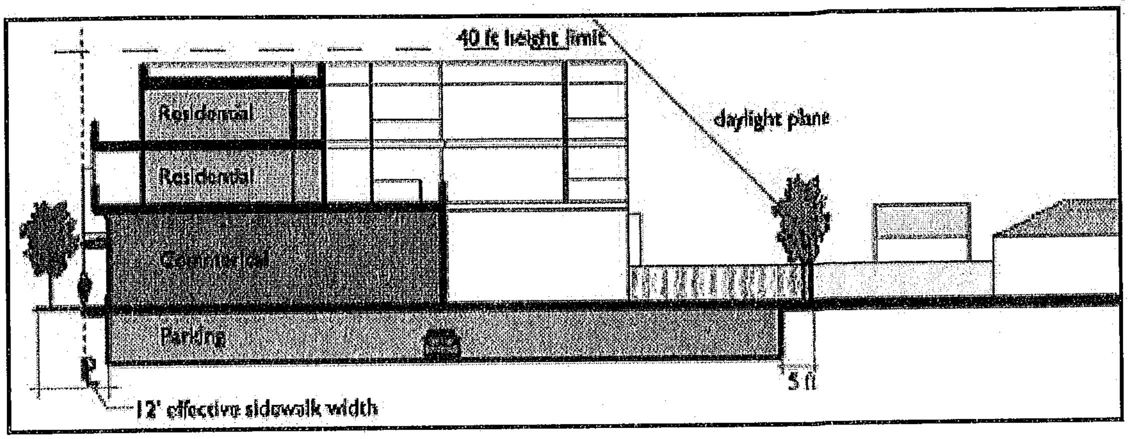


Figure 6-8 -- Mixed-Use with Below-Grade Parking Podium



(7) Large (Multi-Acre) Sites

Large (in excess of one acre) sites shall be designed so that street, block, and building patterns are consistent with those of the surrounding neighborhood, and such that:

A. New development of large sites maintains and enhances connectivity with a hierarchy of public streets, private streets, walks and bike paths (integrated with Palo Alto's Bicycle Master Plan, when applicable);

B. The diversity of building types increases with increased lot size (e.g., <1 acre = minimum 1 building type; 1-2 acres = minimum 2 housing types; greater than 2 acres = minimum 3 housing types) (Figures 7-1 through 7-3); and

C. Where a site includes more than one housing type, each building type should respond to its immediate context in terms of scale, massing, and design (e.g., Village Residential building types facing or abutting existing single-family residences) (Figures 7-2 and 7-3).

Figure 7-1

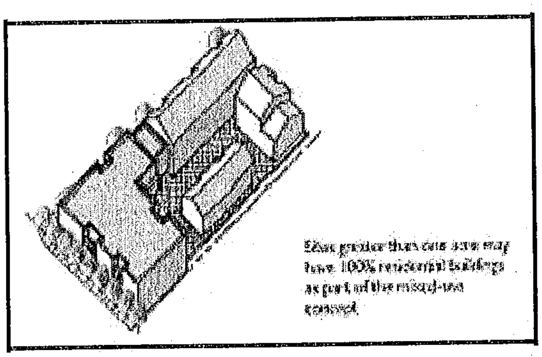


Figure 7-2

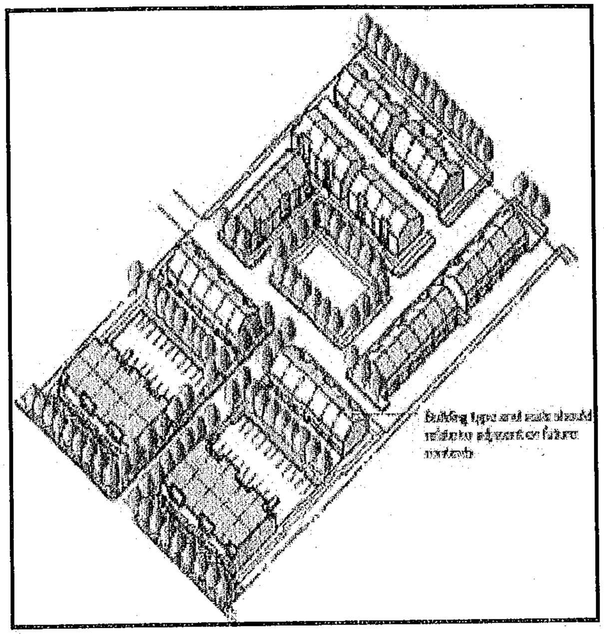
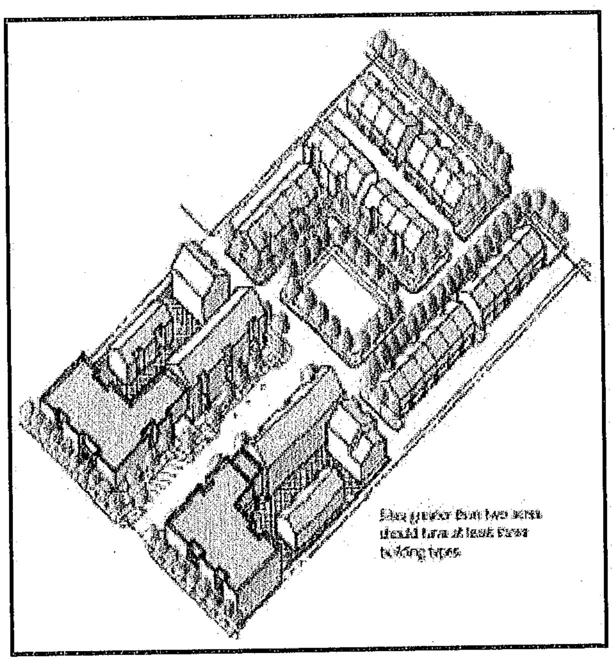


Figure 7-3

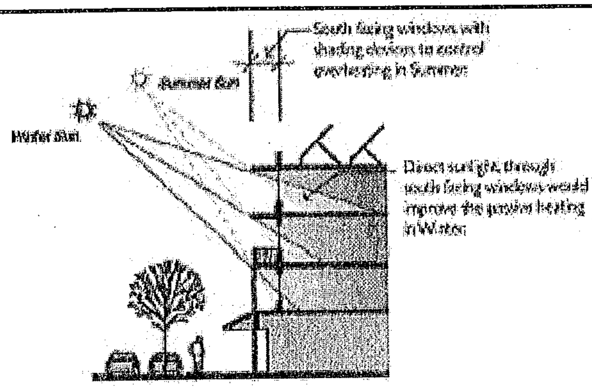


(8) Sustainability and Green Building Design

Project design and materials to achieve sustainability and green building design should be incorporated into the project. Green building design considers the environment during design and construction. Green building design aims for compatibility with the local environment: to protect, respect and benefit from it. In general, sustainable buildings are energy efficient, water conserving, durable and nontoxic, with high-quality spaces and high recycled content materials. The following considerations should be included in site and building design:

A. Optimize building orientation for heat gain, shading, daylighting, and natural ventilation (Figure 8-1).

Figure 8-1



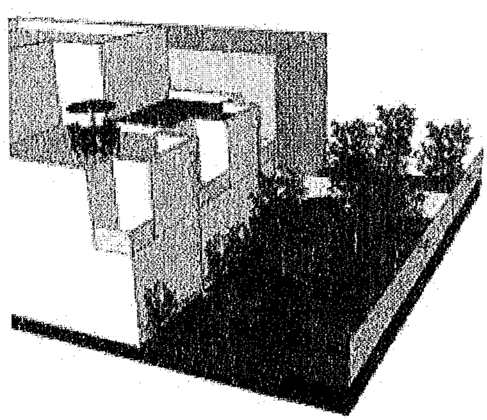
Use of Shading Devices to Control Solar loads in Summer and gain Passive heat in Winter

B. Design landscaping to create comfortable micro-climates and reduce heat island effects.

C. Design for easy pedestrian, bicycle, and transit access.

D. Maximize onsite stormwater management through landscaping and permeable pavement (Figure 8-2).

Figure 8-2



Minimize stormwater runoff to impermeable areas with landscaping, green roofs, and swales when possible.

E. Use sustainable building materials.

F. Design lighting, plumbing, and equipment for efficient energy and water use.

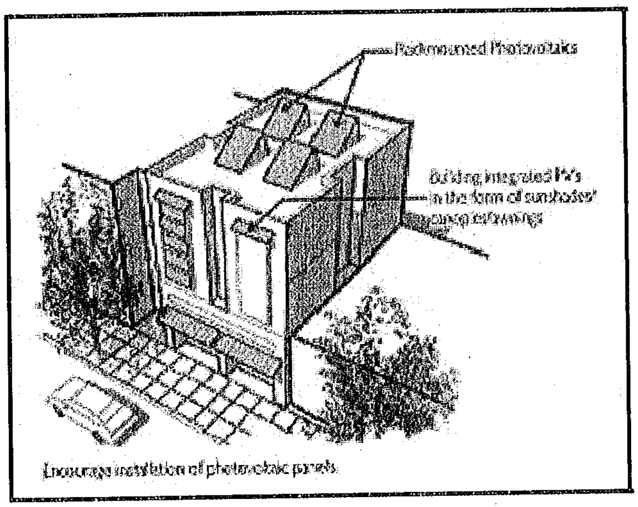
G. Create healthy indoor environments.

H. Use creativity and innovation to build more sustainable environments. One example is establishing gardens with edible fruits, vegetables or other plants to satisfy a portion of project open space requirements.

I. Provide protection for creeks and riparian vegetation and integrate stormwater management measures and open space to minimize water quality and erosion impacts to the creek environment.

J. Encourage installation of photovoltaic panels (Figure 8-3).

Figure 8-3



(Ord. 4923 § 3 (part), 2006)

18.18.120 Grandfathered Uses and Facilities

(a) Grandfathered Uses

(1) The following uses and facilities may remain as grandfathered uses, and shall not require a conditional use permit or be subject to the provisions of Chapter 18.70:

(A) Any use which was being conducted on August 28, 1986; or

(B) A use not being conducted on August 28, 1986, if the use was temporarily discontinued due to a vacancy of 6 months or less before August 28, 1986; or

(C) Any office use existing on April 16, 1990 on a property zoned CD and GF combining, which also existed as a lawful conforming use prior to August 28, 1986, notwithstanding any intervening conforming use.

(2) The grandfathered uses in subsection (1) shall be permitted to remodel, improve, or replace site improvements on the same site, for continual use and occupancy by the same use, provided such remodeling, improvement, or replacement complies with all of the following:

(A) shall not result in increased floor area;

(B) shall not relocate below grade floor area to above grade portions of the building;

(C) shall not result in an increase of the height, length, building envelope, building footprint or any other increase in the size of the improvement. For purposes of this section, "building envelope" shall mean the three dimensional shape and size occupied by an existing building. It is not the maximum, buildable potential of the site;

(D) shall not increase the degree of noncompliance, except pursuant to the exceptions to floor area ratio regulations set forth in Section 18.18.070; or

(E) in the case of medical, professional, general business or administrative office uses of a size exceeding 5,000 square feet in the CD-S or CD-N district that are deemed grandfathered pursuant to subsection (1), such remodeling, improvement, or replacement shall not result in increased floor area devoted to such office uses.

(F) The Director may approve minor changes to the building's footprint, height, length, and the building envelope through Architectural Review of minor aesthetic architectural improvements and to improve pedestrian-orientation provided there is no increase to the degree of any non-complying feature.

(3) If a grandfathered use deemed existing pursuant to subsection (1) ceases and thereafter remains discontinued for 12 consecutive months, it shall be considered abandoned and may be replaced only by a conforming use.

(4) A use deemed grandfathered pursuant to subsection (1) which is changed to or replaced by a conforming use shall not be reestablished, and any portion of a site or any portion of a building, the use of which changes from a grandfathered use to a conforming use, shall not thereafter be used except to accommodate a conforming use.

(b) Grandfathered Facilities

(1) Any noncomplying facility existing on August 28, 1986 and which, when built, was a complying facility, may remain as a grandfathered facility and shall not be subject to the provisions of Chapter 18.70.

(2) The grandfathered facilities in subsection (1) shall be permitted to remodel, improve, or replace site improvements on the same site for continual use and occupancy, by the same use, provided such remodeling, improvement, or replacement complies with all of the following:

(A) shall not result in increased floor area;

(B) shall not relocate below grade floor area to above grade portions of the building;

(C) shall not result in an increase of the height, length, building envelope, building footprint, or any other increase in the size of the improvement;

(D) shall not increase the degree of noncompliance, except pursuant to the exceptions to floor area ratio regulations set forth in Section 18.18.070;

(E) The Director may approve minor changes to the building's footprint, height, length, and the building envelope through Architectural Review of minor aesthetic architectural improvements and to improve pedestrian-orientation provided there is no increase to the degree of any non-complying feature.

(Ord. 5373 § 15 (part), 2016; Ord. 4923 § 3 (part), 2006)

City of Palo Alto Seismic Risk Management Program Advisory Committee Members

v7_GH_01.15.16

Organization or Company	Contact Name	Title	Stakeholder Category	Commitment Status
ABAG	Dana Brechwald	Resilience Specialist	policy	AG Member
Applied Technology	Christopher Rojahn	Director Emeritus	engineers	AG Member
BCCI Construction Co.	Nelson Vineyard	Field Operations Manager	contractors	AG Member
BOMA (Building Owners and Managers Association)	Sharon Fredlund	Executive	community	AG Member
California Apartment Association Tri-County	Anil Babbar	Executive Director	tenants	AG Member
City of Palo Alto - Economic Development	Thomas Fehrenbach	Economic Development Manager	city staff-economic development	AG Member
Cody Brock	Richard Cody	Principal	contractors	AG Member
Hayes Group	Ken Hayes	Principal	architects	AG Member
Hohbach-Lewin, Inc.	Doug Hohbach	Principal	engineers	AG Member
Hudson Pacific Properties	Shawn Kelly	Director, Portfolio Engineering	community	AG Member
Hudson Pacific Properties	Teresa Marks	Portfolio Manager	community	AG Member

Organization or Company	Contact Name	Title	Stakeholder Category	Commitment Status
Office of the City Administrator City and County of San Francisco	Patrick Otellini	Chief Resilience Officer	policy	AG Member
One Concern	Ahmad Wani	CEO and CoFounder	community	AG Member
Palo Alto Housing Corp.	Georgina Mascarenhas	Vice President of Property Management	community	AG Member
Palo Alto Chamber of Commerce	Judy Kleinberg	CEO/President	business interests	AG Member
PAN (Palo Alto Neighborhoods)	Al Dorsky	Emergency Service Volunteer	community	AG Member
PAN (Palo Alto Neighborhoods)	Annette Glanckopf	Emergency Service Volunteer	community	AG Member
Premier Properties	Jon Goldman	Real Estate Broker/Developer	community	AG Member
Rapp Development	Roxy Rapp	Owner	developers	AG Member
SILVAR (Silicon Valley Assoc. of Realtors)	Jessica Epstein	Government Affairs Director	community	AG Member
Sobrato Organization	Tim Steele	Senior Vice President, Real Estate Development	developers	AG Member
USGS / Bay Area Earthquake Alliance	Tom Holzer	USGS Engineering Geologist	policy	AG Member
City of Palo Alto - Development Services	Peter Pirnejad	Director	city staff-PCE-building	Project Team Member
City of Palo Alto - Development Services - Building Division	Bud Starmer	Building Inspector Supervisor	city staff-PCE-building	Project Team Member

Organization or Company	Contact Name	Title	Stakeholder Category	Commitment Status
City of Palo Alto - Development Services - Building Division	George Hoyt	Chief Building Official	city staff-PCE-building	Project Team Member
City of Palo Alto - Fire	James Henrikson	Deputy Chief/Fire Marshall	city staff-fire	Project Team Member
City of Palo Alto - Office of Emergency Services	Nathaniel Rainey	Coordinator	city staff-OES	Project Team Member
City of Palo Alto - Planning & Community Environment	Jeremy Dennis	Planning Manager	city staff-PCE-planning	Project Team Member
City of Palo Alto - Planning & Community Environment	Elena Lee	Senior Planner	city staff-PCE-planning	Project Team Member
City of Palo Alto - Public Works	Hung Nguyen	Project Engineer	city staff-PCE-public works	Project Team Member
Rutherford + Chekene	Bret Lizundia	Executive Principal	R+C consulting team	Project Team Member
Rutherford + Chekene	Marko Schotanus	Associate	R+C consulting team	Project Team Member
Sharyl Rabinovici Consulting	Sharyl Rabinovici	Disaster Mitigation Researcher and Policy Strategist	R+C consulting team	Project Team Member

PALO ALTO'S 2016 SEISMIC RISK MANAGEMENT PROGRAM ADVISORY GROUP

SUMMARY REPORT ON PROCESS, DISCUSSIONS, AND OUTCOMES

November 21, 2016

OVERVIEW

On December 9, 2014, the Policy and Services Committee of the Palo Alto City Council recommended the City Council authorize a Request for Proposal (RFP) to develop information for use in updating the City's Seismic Hazards Identification Program (Ordinance 3666). The City Council approved the recommendation, an RFP and scope of work was prepared, and a consulting team led by Rutherford + Chekene was selected to develop summarize relevant state and local seismic mitigation legislation, obtain detailed information on Palo Alto's existing building stock, develop conceptual retrofits for vulnerable buildings, make loss estimates of expected damage to the building stock, and work with a City Advisory Group to develop policy recommendations for consideration by the Council.

From an initial meeting in December 2015 through a final meeting in August 2016, the City of Palo Alto (COPA) staff and consultants from Rutherford + Chekene hosted six meetings of a Seismic Risk Management Program Advisory Group. The purpose was to discuss needs and potential directions for COPA leaders to consider going forward in updating the city's seismic mitigation programs. The convening of a stakeholder advisory group was an essential element of a the project to collect and analyze earthquake risks in Palo Alto's existing building stock (primarily multi-family and commercial) and narrow in on promising policy alternatives.

Over the course of twenty hours of face-to-face information exchange, non-staff participation ranged from seven to 20 persons. Attendees included people with a range of relevant expertise and interests from interested citizens, earthquake risk and engineering experts, local developers and owners, and representatives of various community groups. COPA departments represented included Building, Planning, Fire, Office of Emergency Services, and Public Works.

The process was informed by an extensive technical assessment of the earthquake risk landscape in Palo Alto's existing buildings (excluding single-family and two-family residences). Consultants completed a document review, a street survey of a large sample of buildings, and a loss estimation analysis with and without seismic retrofitting, as well as a comprehensive review of other jurisdictional best practices and the state policy context. Advisory Group members received in-depth briefings on the inventory and loss estimation methods and results. That information formed the basis for clarifying and exploring a range of policy options.

This memo summarizes the process, discussions, and outcomes of the City of Palo Alto's Seismic Risk Management Program Advisory Group efforts. The process was not aimed at creating a consensus document or ratification by majority vote. The end goal was a summary—reflected by this document—of the range of issues and opinions expressed by interested parties who participated. All Advisory Group members had the opportunity to review this memo prior to final submittal by the Consultants to COPA staff. The information herein will be provided to the City Council later in the first quarter of 2017 as they consider potential revisions to the City of Palo Alto's current seismic risk management program and seismic hazard identification ordinance.

POLICY OPTION DISCUSSIONS

Scope of the Seismic Risk Problem in Palo Alto

Palo Alto's existing seismic mitigation program, one of the first and most innovative of its kind, focuses on three categories of buildings based on age of construction and structural type and occupancy. Category I is for unreinforced masonry (URM) buildings with more than six occupants and more than 1,900 sf. Category II is for buildings built before 1935 with over 100 occupants. Category III is for buildings built before August 1, 1976 with over 300 occupants. In the 12/9/14 COPA staff report, there were 47 buildings in Category I, 19 in Category II, and 23 in Category III. The program required owners to do a seismic evaluation, but left them the choice of whether to actually perform a retrofit. Owners and developers were offered a Floor Area Ratio (FAR) bonus in exchange for completing basic retrofit work. This tactic was successful for addressing the majority of the Category I, II, and III buildings either by seismic retrofitting or by demolition. Currently, approximately ten Category I, four Category II, and nine Category III buildings remain standing without seismic retrofitting. The modest overall scope of the ordinance left many other vulnerable building types unaddressed.

The current technical assessment covered a much larger set of buildings with a wider array of potentially vulnerable structural systems. The findings showed that the estimated losses to Palo Alto buildings and contents in a major event will be significant, on the order of $2.4 billion. Furthermore, this figure does not include implications such as lives lost, business disruption, or ripple effects in the local economy or real estate market. Much of this loss will not be insured.

Loss Estimates and Cost Benefit Assessments of Local Inventory

Generally, buildings designed to a more recent building code are expected to perform well. Older buildings built before milestone improvements in code provisions can be more seismically vulnerable. Among the building type categories of highest concern in Palo Alto besides the three categories covered by the COPA ordinance are pre-1977 soft-story wood frame (with approximately 294 buildings), pre-1998 tilt-up concrete (99 buildings), pre-1977 concrete soft-story (37 buildings), pre-1998 steel moment frame (35 buildings), and other pre-1977 concrete construction (170 buildings). Participants generally agreed that addressing building types known to be potentially hazardous and with large numbers of buildings will lead to the greatest reduction in losses. It was also nearly unanimous that Palo Alto should seek out ways to resolve the approximately 23 cases of Category I, II, or III buildings that have not yet been addressed.

The technical assessment revealed that the potential reduction in damage costs from retrofitting is significant. Some building categories have greater benefits than others in terms of loss reduction relative to estimated retrofit costs, with a low of approximately 1:1 to a high of approximately 11:1. Two scenarios earthquake events along the San Andreas Fault developed by the United States Geological Survey were used in the loss estimates: a major M7.9 event, and a strong M6.7 event. For a more accurate estimate of costs and benefits, all future earthquakes would need to be considered. It made sense to participants to use the estimated retrofit benefit-cost ratio as one factor (among many) in considering which categories of buildings COPA should address first. Other factors could include loss of life, business disruption, and displaced residents, though these estimates were not within the scope of the loss estimate.

<u>Approaches to Address Seismic Retrofitting Used by Other Jurisdictions</u>

The policy and best practices reviews showed that a wide range of policy options are being used in other jurisdictions to address vulnerabilities similar to those faced by Palo Alto. Potential policy mechanisms include: inventory only, notify only, voluntary retrofit, disclosure approaches, mandatory screening, mandatory evaluation, and mandatory retrofit, with either a fixed timeline or when triggered (for instance, at time of transfer). Mitigation programs often consist of a package of policy mechanisms for different building categories, and use several mechanisms at the same time for different building categories or in phases. Participants were also informed about precedents for a variety of incentives that can be offered for some or all affected owners to ease the process of program compliance.

<u>Bundled Options with Increasing Regulatory Strength</u>

The Advisory Group, together with COPA staff, received detailed briefings on the above findings, asked questions, and discussed potential community responses and concerns. Half way through the process, consultants introduced to participants a range of specific policy options to frame the conversation about the most needed and viable policy approaches. The aims were to identify areas of general agreement, specific approaches that were either favored or not, and issues needing further information or discussion. Six possible options were suggested as follows:

Option 1—Status Quo. Existing program (Palo Alto Municipal Code Chapter 16.42) ordinance with its mandatory evaluation, voluntary retrofit approach would remain in place without changes.

Option 2—Increase Scope but Retrofit Remains Voluntary. Additional categories of structures would be added to the mandatory evaluation requirements beyond those of the current ordinance.

Option 3—Increase Scope with Additional Disclosure Measures. Like Option 2, this option would target a larger set of building categories than the current ordinance <u>and</u> make use of disclosure measures such as prominently posting the building list on the City website, notifying tenants, requiring signage, and/or recording notice on the property title.

Option 4—Increase Scope with Some Categories Voluntary and a Few More Categories Mandatory, with Enforcement by a *Trigger Threshold*. This option would require retrofitting for some building types whenever certain future events take place, such as *when a building is sold or undergoes substantial renovation above a set threshold such as cost*.

Option 5—Increase Scope with Some Categories Voluntary and a Few Categories Mandatory, with Enforcement on a *Fixed Timeline*. This option would be similar to Option 4, but retrofitting is required *according to a fixed timeline*.

Option 6—Increase Scope, Retrofit is Mandatory for More Categories. Retrofitting would be required on a fixed timeline for additional categories.

The possibility of having different requirements or timelines for residential compared to non-residential properties was identified. The group was also open to using location, occupancy type, and/or number of occupants as part of the criteria for selecting a structural type to be included in the updated ordinance, and/or as a basis for setting appropriate timelines, prioritization, tiers, or phasing. In general, mandatory evaluation was seen as a way to make sure building owners and the City are properly informed about existing risks, and as a way to motivate more voluntary retrofit work. Triggered upgrades were also discussed favorably, though some felt this kind of uncertain timeline was not appropriate for risks that city leaders have concluded are unacceptable. There was support for using combinations of the options for different building types, so that some building types would have more stringent requirements than others. Many members of the Advisory Group, though not all, were positive about including mandatory requirements for some building categories (Option 5).

PERSPECTIVES ON DISCLOSURE MEASURES AND INCENTIVES

Along with these options, the group discussed how COPA could utilize a variety of disclosure measures and incentives.

Disclosure Measures

Once introduced to the rationale and precedents for use of disclosure measures, the group supported the idea of making the list of buildings affected by the current and any future ordinance update more prominent and available to the public. The group regarded the City's website and possibly tenant notification as the best ways to do this, while they had less interest in community education efforts. There was some concern that placing notice on the title would not be worth the initial and ongoing efforts necessary to keep such information current. The group discussed extensively but ultimately expressed relatively low support for signage or placarding, unless this tactic was used later in a program as a penalty for failure to comply in a timely manner.

Incentives to Undertake Seismic Retrofitting

The group was eager to discuss possible incentives, from the standpoint of both facilitating prompt action and easing the burden on owners. Incentives were viewed as particularly important to the success of any voluntary program. Most of the group were in favor of the City offering modest financial help in the form of City fee waivers or expedited permitting, but acknowledged that these measures may not significantly help the property owner lessen project costs.

Therefore, there was wide agreement that these should not be the only types of incentives offered. There was interest in having Palo Alto join the small but growing number of jurisdictions that have joined statewide PACE[1] loan financing programs, though it is not clear how many potentially affected property owners would benefit from or actually take advantage of this kind of help.

The group expressed minimal interest in pursuing ways to offer owners deep financial assistance, such as declaration of special district or passage of bond measures. Opinions were split about the effectiveness of using transfer of development rights (TDR)[2], floor area ratio bonuses, and parking exemptions. Some participants felt their constituencies would not benefit, or would be negatively impacted, by these measures. Others felt that such concessions on the part of the City would be a very effective way, as they have been in the past, for motivating earthquake improvements without issuing heavy mandates. Relaxation from parking provisions for example, could be seen as a helpful incentive to commercial property owners, but it would less desirable for tenants and others seeking parking in congested parts of the city such as the downtown area. Allowing conversion of a portion of ground story parking to occupied residential space as an incentive to spur retrofitting of soft-story wood frame buildings was discussed, as this is being considered in other jurisdictions. It was noted that parking is a desirable feature to renters and this may not be strong incentive if rental rates are reduced due to lack of parking. Some policy incentives, especially the complicated TDR, might be administrative challenging to implement and will require deep cooperation with Planning Department and coordination with the City's general plan.

PREFERRED POLICY DIRECTIONS

Discussions with the Advisory Group revealed little to no support for maintaining the status quo. Strong support did exist for:

- ⇒ Implementing retrofit of buildings already in the current program, particularly URM buildings.
- ⇒ Addressing more building types, particularly soft-story wood frame and older concrete tilt-up, that would affect the most people.

<u>Completion of the City's Current Seismic Program</u>

For buildings under the current ordinance, the Advisory Group generally thought a mandatory retrofit requirement would be feasible and fair. Three decades later, market forces alone have not

[1] With a Property Assessed Clean Energy (PACE) loan, first pioneered for solar panels by the City of Berkeley in 2008, owners can apply for 100 percent financing for seismic retrofit work at competitive fixed rates over the useful life of the improvements, to be repaid over up to 20 years with an assessment added to the property's tax bill.
[2] TDR allows owners to transfer unused development rights that are comparable to the value of the retrofit to another property in the community. In other words, in exchange for completing certain seismic rehabilitation work, additional development rights are gained elsewhere. This is a common measure used for historic structures.

been enough to motivate upgrade of these structures. Because the barriers to retrofit work for these properties are not known, case-by-case management by COPA staff may be necessary. There was hesitance, however, about extending or increasing incentives for owners that had not voluntarily taken advantage of the FAR bonus available in the past.

Extending the Seismic Program to Other Potentially Vulnerable Building Types

In the discussion of expanding the scope of the City's seismic program, the goal was to focus on a subset of categories that seemed to have high potential to benefit the owner, occupants, and the broader community. Consultants briefed the group on structural types generally known to be vulnerable that are common or significant to Palo Alto and estimated to have reasonable loss reduction to retrofit cost ratios. Detailed conversations took place about other building category priorities and policy features that could be incorporated into Options 3, 4, and 5.

The group showed high interest in addressing multi-family residential earthquake risks, in particular by starting a soft-story wood frame program as many other California cities have done. One soft-story wood frame program approach discussed was to have two phases, where owners would first be given several years following notification to do a voluntary retrofit, along with more generous incentives. Later, a mandatory timeline would kick in and incentives would be phased out. The group discussed that exemptions such as parking requirements, permission to add other unit(s), or the ability to transfer development rights for additional square footage would likely be attractive and useful incentives for this building type.

Other building categories of concern were reviewed at the last meeting. Regarding pre-1998 tilt-up concrete buildings, there are a modest number in Palo Alto, but group members noted that their uses are changing. Many of what previously might be warehouses are now being repurposed for use as office space, and the higher occupant density increases the safety stakes of any seismic deficiencies. There is currently no policy or code requirement to address earthquake vulnerabilities if other upgrades and build out are being done but there is no significant impact or revision to the structural system. A renovation trigger was discussed, where substantial renovation work would trigger a mandatory seismic upgrade. The trigger could be based on whether a ratio is exceeded of the cost of the renovation work to the replacement value of the building. This has been done in some jurisdictions in the past. The replacement value could be based on a standardized set of costs per square foot for different occupancy types. It should be noted that some individuals in the group expressed concern that a renovation trigger might discourage owners from upgrading or renovating their buildings, depending on the trigger threshold and the cost of the retrofit.

POTENTIAL ISSUES FOR FUTURE STUDY

For some issues, based on Advisory Group discussions, additional information may be beneficial to help in refining a new strategy and to better understand potential impacts on key stakeholders and community concerns. These issues are primarily economic and are outside the scope of the current study. The City Council may wish to direct staff and/or outside consultants to investigate some of these items in more detail as the seismic risk management program effort proceeds. Issues include the following:

- *Occupants and tenants*
  - How much would a typical retrofit add to the monthly rent of a multifamily soft-story wood frame apartment tenant?
  - Would some tenants be unable to afford a rent increase and seek housing elsewhere in Palo Alto or move outside the city (and if so, how many might be displaced)?
  - If soft-story wood frame apartments in Palo Alto are retrofitted in time before the next major earthquake, how much less displacement of residents would occur as a result of the earthquake?
  - What categories of buildings are most important to address in order to help maintain the commercial viability and vitality of the City's core business districts and tax base?
- *Property owners, developers, and business owners*
  - What are the characteristics of property owners that would be affected?
  - How might small businesses be affected compared to larger ones?
  - How many property owners are in need of lower cost capital or other substantial financial assistance to fund retrofitting?
- *City departmental resources and budgets*
  - What would be the loss in revenue to the Building Department if fee waivers were offered?
  - What would be the staffing and budgetary needs over time to administer an expanded program that addresses additional building types?
  - What kinds of interdepartmental cooperation and staff resources in other departments are necessary to ensure effective implementation and coordination with other city planning and public safety efforts?
- *Overall community economic health*
  - What kind of benefits could accrue to Palo Alto in terms of maintaining community function and ability to recover if various building categories are retrofitted in time before the next major earthquake?
- *Other related issues*

- It was brought up that the Building Department needs flexibility and authority to take steps to get tough seismic mitigation projects done. One idea was to grant the Building Official the ability to classify certain projects (with well-specified criteria) as warranting a kind of "seismic safety" or "earthquake resilience" fast tracking, with COPA departments agreeing to coordinate on a specified accelerated project review timeframe.
- Although outside the formal scope of this planning effort, several Advisory Group members commented that it would be desirable for the City to do some kind of assessment of any earthquake mitigation needs in public buildings and facilities serving the City.
- Advisory group members recommended the community be informed of Palo Alto's overall potential seismic risk by providing a summary of potential impacts on the City's website, including the expected performance of vulnerable buildings.
- The group also had a high degree of support for recommending that the City initiate and nest future earthquake mitigation programs within a broader disaster or community resilience initiative, as cities such as Los Angeles, Berkeley, and San Francisco have done. This could be incorporated in the update of the City's Comprehensive Plan Safety Element. There was insufficient time in the project's six advisory group meetings to consider potential initiatives to assess risks for cell phone towers, water supply, facades, private schools, post-earthquake shelter facilities, and/or other assets important to community recovery.

SUMMARY OF RECOMMENDED POLICY DIRECTIONS

There was broad consensus that the City's seismic program should go beyond the status quo by increasing the number of building types that are included and the associated requirements. The following table summarizes the City's current seismic risk management program features, and it provides recommended policy directions for different types of building categories, both for those in the current program and those proposed to be added to the program, including the approximate number of affected buildings, construction type and date, evaluation report and construction completion deadlines, potential preferred disclosure and incentive options, and whether retrofitting remains voluntary, is triggered by a sale or a substantial renovation, or is mandatory. The following summarizes the key issue of whether voluntary, triggered, or mandatory approaches were preferred.

- There was broad consensus that seismic retrofitting for the remaining URM buildings (Category I) should be made mandatory.
- There was general agreement that soft-story wood frame buildings (Category IV) and somewhat general agreement that older tilt-up buildings (Category V) should require

strengthening either by a sale or substantial renovation trigger or on a mandatory fixed timeline.

- There was less of a consensus on whether the older higher occupancy buildings in the current ordinance (Category II and III) should be converted to use a mandatory approach, though a triggered approach may represent a reasonable middle ground.
- There were supporters, but no clear consensus, for voluntary, triggered, or mandatory approaches to addressing older soft-story concrete buildings (Category VI) and older steel moment frame buildings (Category VII).
- Other older nonductile concrete buildings (Category VIII) were discussed, but due to the lack of inexpensive analytical methods for reliably identifying the worst of these buildings, inclusion of this building category in an updated ordinance is not recommended at this time. Such buildings could be included in the future when such analytical methods have been developed in the engineering community.

Summary of Recommended Policy Directions

<table>
<tr><th>Category</th><th>Approx. Number</th><th>Building Type</th><th>Date of Construction</th><th>Occupants</th><th>Evaluation Report</th><th>Voluntary, Triggered, or Mandatory Retrofit[1]</th><th>Deadlines for Evaluation Report and Retrofit Construction (years)[2]</th><th>Disclosure</th><th>Potential Incentives</th></tr>
<tr><td colspan="10">Current Program (Potential Revision in Italics)</td></tr>
<tr><td>I</td><td>10</td><td>Un-reinforced masonry</td><td>NA</td><td>Over 6 (and over 1,900 sf)</td><td>Required</td><td>Mandatory</td><td>Report: Expired
Construction: 2-4</td><td rowspan="3">Website listing and tenant notification</td><td rowspan="3">Fee waiver, expedited permitting, FAR bonus/ transfer of development rights (TDR)</td></tr>
<tr><td>II</td><td>4</td><td>Any</td><td>Before 1/1/35</td><td>Over 100</td><td>Required</td><td>Voluntary or Triggered</td><td rowspan="2">Report: Expired
Construction
• Voluntary: Not required
• Triggered: At sale or renovation</td></tr>
<tr><td>III</td><td>9</td><td>Any</td><td>Before 8/1/76</td><td>Over 300</td><td>Required</td><td>Voluntary or Triggered</td></tr>
<tr><td colspan="10">Expanded Program</td></tr>
<tr><td>IV</td><td>294</td><td>Soft-story wood frame</td><td>Before 1977</td><td>Any</td><td>Required</td><td>Triggered or Mandatory</td><td>Report: 2-4
Construction
• Triggered: At sale or renovation
• Mandatory: 4-6</td><td>Same as above</td><td>Fee waiver, expedited permitting, TDR, parking exemptions, permission to add units</td></tr>
<tr><td>V</td><td>99</td><td>Tilt-up</td><td>Before 1998</td><td>Any</td><td>Required</td><td>Triggered or Mandatory</td><td>Report: 2-4
Construction
• Triggered: At sale or renovation
• Mandatory: 4-6</td><td>Same as above</td><td>Same as Categories I, II and III</td></tr>
<tr><td>VI</td><td>37</td><td>Soft-story concrete</td><td>Before 1977</td><td>Any</td><td>Required</td><td>Voluntary, Triggered or Mandatory</td><td rowspan="2">Report: 2-4
Construction
• Voluntary: Not required
• Triggered: At sale or renovation
• Mandatory: 6-8</td><td rowspan="2">Same as above</td><td rowspan="2">Same as Categories I, II and III</td></tr>
<tr><td>VII</td><td>35</td><td>Steel moment frame</td><td>Before 1998</td><td>Any</td><td>Required</td><td>Voluntary, Triggered or Mandatory</td></tr>
<tr><td>VIII</td><td>TBD</td><td>Other older nonductile concrete</td><td>Before 1977</td><td>Any</td><td>Not rec. at this time</td><td>Not recommended at this time</td><td>Report: NA
Construction: NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="10">[1]Voluntary: Retrofit is voluntary.
Triggered: Retrofit is triggered when the building is sold or undergoes substantial renovation.
Mandatory: Retrofit is required per a fixed timeline.

[2]Deadlines provide a potential range. Timelines would vary depending on tiers or priority groupings of different subcategories.</td></tr>
</table>

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Meeting Agenda

Seismic Risk Management
Program Advisory Committee

From: George Hoyt
Chief Building Official
Development Services
City of Palo Alto
285 Hamilton Avenue
Palo Alto, CA 94301

Project: City of Palo Alto Seismic Risk Management Program **Job #:** 2015-087S
Subject: Agenda for 12/16/15 Advisory Group Kick-off Meeting

Our proposed objectives, agenda topics, and some policy questions to consider for the first Advisory Group session are described below.

MEETING LOCATION, DATE, AND TIME

Downtown Library
(El Camino Real Program Room)
270 Forest Avenue
Palo Alto, CA 94301

December 16, 2015
2 pm – 5 pm

MEETING OBJECTIVES

- Introduce project goals, scope, priorities, and personnel
- Share information about and get input about the overall project
- Reach basic agreement on roles and process for advisory group, including next meeting

POLICY QUESTIONS

The Advisory Group will provide advice on a number of policy questions. Here are a few questions to consider prior to our first meeting.

- What broad priorities should we be focusing on as a community in terms of seismic safety and disaster resilience in the local building stock? One way to think about this is to consider resilience objectives, which can include preventing collapse, preventing loss of life, preventing injuries, helping families plan for sheltering-in-place after an event, preserving neighborhood character, minimizing economic losses, preserving the local economy and tax base, protecting businesses and helping them recover, or balancing earthquake mitigation efforts relative to other community resilience goals.
- How important is it for the City of Palo Alto to more proactively address earthquake risks to local buildings than is currently being done? Rate from 1 (more important) to 10 (less important).
- What is the level of community interest and support at this time for updating the City's approach to managing earthquake risks? Rate from 1 (more important) to 10 (less important).
- Bring your other issues and questions—what's not on this list that's important to you?

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AGENDA

Time	Subject	Lead
2:00 pm	Welcome	George Hoyt
2:05 pm	Introduction of project history, motivations and vision	
2:20 am	Self-Introductions • City of Palo Alto Project Team and key staff • Rutherford + Chekene consulting team • Invited guests and community representatives	
2:50 pm	Overview of project plan • Report on what is currently known, not known, and to be studied in this project regarding seismic vulnerabilities in Palo Alto's existing buildings • Report on state and local legislative context and what other cities have done and are doing • Q&A	Bret Lizundia, Sharyl Rabinovici
3:30 pm	Development of key questions and issues list	All (moderated by Sharyl Rabinovici)
4:00 pm	Stretch break	
4:10 pm	Discussion of plan for Advisory Group role and process	All (moderated by Bret Lizundia)
4:40 pm	Summarize meeting outcomes, planned interim steps, and agenda topics / date for next meeting	Bret Lizundia
5:00 pm	Adjourn	George Hoyt

Seismic Risk Management Program Advisory Committee Meeting #1
Dec 16th, 2015
2pm-5pm

MEETING MINUTES – PROGRAM ADVISORY COMMITTEE MEETING

Attendees:	George Hoyt (GH), Chief Building Official, City of Palo Alto (COPA) Bud Starmer (BS), Building Inspection Supervisor, COPA Nathan Rainey (NR), OES Coordinator, COPA Thomas Fehrenbach (TF), Economic Development, COPA Peter Pirnejad (PP), DSD Director, COPA Nathaniel Rainey (NR), OES, COPA Bret Lizundia (BL), Rutherford + Chekene (R+C) Sharyl Rabinovici (SR), Public Policy and Community Engagement Consultant Marko Schotanus (MS), R+C Anil Babbar Dana Brechwald, Policy Richard Cody, Contractor Al Dorsky, Community Jessica Epstein, Community Sharon Fredlund, Community Annette Glanckopf, Community Jon Goldman, Community Ken Hayes, Architect Doug Hobach, Architect Tom Holzer, Policy Shawn Kelly, Community Judy Kleinberg, Business Interest Teresa Marks, Community Georgina Mascarehas, Community Roxy Rapp, Developer Christopher Rojahn, Engineer/Resident Tim Steele, Developer Nelson Vineyard, Contractor/Resident Ahmad Wani, Community
Minutes Prepared By:	Lisa Green, Admin Assoc II, COPA
ITEMS	DISCUSSION
Welcome	➢ GH: Welcome to the Advisory Committee. This Committee has been put together to get expert advice and have some open discussions.
Introduction of Project History, Motivations and Vision	➢ GH: After the 2014 earthquake Council directed staff to analyze the existing Seismic Hazard Identification Program and make modifications and recommendations. ➢ GH: The goals are to gather technical information, analyze the information, and make recommendations for future policy. ➢ GH: The City adopted its ordinance in 1986 which includes three different categories of buildings. Category I was for unreinforced masonry buildings, except those smaller than 1,900 sf with six or fewer occupants. Category II was for buildings building prior to 1935 with 100 or more occupants. Category III was for buildings built prior to August 1, 1976 with 300 or more occupants. "Soft story" structures or other buildings types currently considered vulnerable were not included. There are 23 buildings on the City's list that have not been retrofitted. ➢ The City wants to turn to the Advisory Committee for advice, expertise, and different perspectives.

	➢ GH: The Committee will look at the policy questions and gather "food for thought." The City will use the advice for future guidelines and to raise awareness. The City wants to hear the experiences, expertise, view points, and opinions of the Advisory Committee.
Self-Introductions	➢ GH introduced City of Palo Alto Project Team and key staff (see above section, "Attendees" list) ➢ SR introduced the Rutherford + Chekene (R+C) consulting team – SR pointing to green packets highlighting the pink card asking attendees to give their name, affiliation, and write down "How do earthquake issues relate to your work or the group you represent?" ➢ GH: Welcomed guests and community representatives (see above section, "Attendees" list). ➢ Attendees introduced themselves, their affiliations, and their interest in the Advisory Committee.
Overview of Project Plan	➢ BL presentation: The project plan overview highlighted what is currently known, not known, and to be studied regarding seismic vulnerabilities in Palo Alto's existing buildings. We want to know/understand the inventory in PA. What kind of structural systems does PA have? We have some idea but we need to understand more. The City Council wants the Advisory Committee to provide advice and input to the project, and hopefully a coordinated set of recommendations for Council to consider. BL summarized some key information that is known based on County assessor files, City GIS files, and earlier inventory efforts. There are over 21,000 tax parcels in PA. Of these over 15,000 are for one and two family residences which are not included in the project tasks for inventories or loss estimates. Of the remaining approximately 6,000 parcels, about 3,600 are multi-family residential with three or more units, and there are about 940 retail, 680 public, 200 industrial, and 540 other occupancies. For most, we have the square footage, year built, and the occupancy. BL presented a slide showing the anticipated level of shaking from two USGS earthquake scenarios on the San Andreas Fault. We currently do not know the structural system of the buildings, or the building types expected to have the greatest aggregate risk of lost units or cost of repairs or reduction in losses from mitigation efforts. We do not yet know the level of community interest in an updated seismic risk management program. Key project tasks include development of an electronic inventory database based on digital files and sidewalks surveys, loss estimates for two earthquake scenarios with and without retrofitting, prioritization of potentially hazardous building types, and recommendation on options for program updates. As information is collected and refined, it will be shared with the Advisory Committee to help them provide advice on recommendations. Key questions include what building types might be included in the future program. What geographical areas do we look at? What do we worry about and not worry about? Older tilt up buildings? Soft story wood frame buildings? Houses on hills? Steel frame buildings? What are the recommendations and what will shape the recommendations? ➢ SR is developing a report on state and local legislative context and what other cities have done and are currently doing. She provided a brief summary to the group. There are currently approximately 50 state laws for earthquakes. Cities are empowered to make laws for earthquake safety, and they will have to mandate what retrofits are applicable. Large incentives do work and they do help with getting through stumbling blocks. The range of activities covered by different cities and the approach they use

varies widely. The Committee will need to think about how we can engage the community more; what will work? Cities have done different things such as mandatory retrofits (Fremont). Some have done it in phases with multiple efforts. What about soft-story retrofits? There was a San Francisco flagship effort; it's a study on line, called the Community Action Plan for Seismic Safety (CAPSS) which led to a current comprehensive program called the Earthquake Safety Implementation Program (ESIP). Think about this type of plan by San Francisco. A recovery plan is very important. A Response plan is also very important. This Committee, if it wants, can recommend that the City look into defining broader community goals and priorities for a comprehensive resilience plan, but what we're dealing with here is the structural mitigation aspect.

Please look at Key Policy Questions for the Advisory Group (Policy Questions). The homework is to check to see what questions are important to you or that you want to know more about. The Committee will need to answer these questions by the end of this process.

San Francisco did a retrofit fair. It was a successful public outreach activity.

There are questions at the bottom of the agenda. Grade them on a scale of 1-10, with 1 most important. Things the Committee will need to consider are what are the priorities of all the buildings; which are more vulnerable (soft story, weak 1st story)? What we want to know is where this question is on your priority level.

- Questions and answers to follow:
- Audience: What standards are you using for loss estimate guidelines?

  BL Reply: We are using the HAZUS methodology, which is the national standard for regional loss estimation of large portfolios of buildings.
- Audience: Will we come up with any safety goals?

  Reply: Yes, first goal will be that buildings don't collapse. However, we have realized that we need to worry about how fast the community can recover. We need structural performance goals that are related to resilience goals.
- Audience: Will you have broad hazard reduction goals? Does PA have incentives?

  PP reply: Yes, but we need to focus on the study/inventory first and not incentivize the wrong things. We have a seismic risk mitigation ordinance in PA; our URM policy was one of the first in the state. It's successful because of the speed of impact and the engagement of the community. We will look at the success of different incentives used and will be looking for recommendations at the end of this process. The Advisory Committee will be getting a report on what was successful and what was not successful for other cities.
- Audience: Regarding the Napa quake - Mobile homes were impacted and the California Department of Housing and Community Development (HCD) oversaw the supports…. There was no real communication between the Building Dept. and HCD. Are you looking at the jurisdictional issues?

  GH reply: No, we haven't. It's complex, and it's a huge hole with a ton of issues. The biggest issue is fire.
- Audience: Question about the bullet point of Resilience - rather than our ideas coming

to you, can you share some of the context you have thought about around the hazard mitigation plan, general plan updates, and any recovery plans? And how is this going to fit into the larger suite of thought in the City?

GH reply: This is a huge topic. We'll start here, but we'll only be able to do so much of that. We can only tackle some of the pieces. PP commented that at this point we are talking about buildings not places. Second step would be to tackle how this connects with the Comprehensive Plan and Sustainability Plan and hope we can get further with this than we started.

- Audience: Will the inventory include small residences as well as larger buildings, schools for example?

  Reply BL: The only buildings that are excluded are one- and two-family homes. The extent to which schools will be included is not known yet.

- Audience: How are we going to prepare for the earthquake and how will we attack it after the quake? Are there going to be programs for inspections to check earthquake stability and quickly assess buildings in a fast manor, like the program San Francisco has?

  Reply: GH says this is a large focus for PA. We are working with EOC. We are currently in contact with our bigger facilities like HP and Space Systems Loral which has plans for post-earthquake buildings safety evaluations using private engineering consultants. We have initiated those conversations and working on those programs. We have included Planning and Fire to come up with a resiliency plan. Council doesn't want people leaving and shutting downtown business and losing income for this issue. . We'll be looking at best practices and setting guidelines.

- Audience: Businesses create a huge influx of people during business hours; we are looking for reassurance for daytime earthquake emergency. Small businesses don't have any plans or preparedness. Are we going to address this?

  Reply GH: OES is here, and they have a strong focus on daytime populations. Ken Dueker knows a lot about this issue, and we'll try to have him come to talk about this issue and how this fits into their effort. We'll continue to build on this topic and include it in the timeline.

- Audience: VM Ware is prepared for an earthquake as well as some other known companies like Roche. Nathan Rainey might be able to expand on this.

- Audience member: We have lots of data for sub-block / city-block level. Some of it is artificially generated, AI. We have a probability/fragility function for every city block. This information might be helpful.

  BL Reply: Yes, we are open to any information that we can obtain if you're willing to share.

- Audience: A question about the chart, the PA Ordinance that had 89 buildings total with only one building that had no change and quite a few that were retrofitted or demolished. What does that really represent? Is that a past study?

  Reply: GH said it was a study that was done in the late 80s where they had an advisory committee with a lot of engineers and representatives from the community. They established what the priority of buildings would be. They established the different three levels of categories. There were originally six levels covering a larger

	scope of PA buildings, but the extent was reduced to the final three categories due to community concerns. They set up some exemptions like historical buildings. We have buildings that haven't been included or touched. BL: The question is do you want to do more than what is currently being done? What's in the ordinance is quite small. Should the ordinance be expanded to include more categories? ➢ Audience: A goal should be setting priorities for the different levels in saving lives and people getting hurt. Some priorities may not be mandated. Reply BL: Back then 30 years ago the priority was on life safety, the riskiest buildings (like unreinforced masonry bearing wall buildings), and how many people are threatened by building damage. As time has gone on, there is a broader way of thinking about possible performance objectives that include reducing building losses and downtime from damage. There is more interest now in keeping people in their homes and businesses to help improve community resilience. After major earthquakes, like the Northridge earthquake, what we know now about vulnerability has deepened and widened. ➢ Audience: What's the scope of this study? Reply PP: Staff is instructed to develop a section of our website with all of our standing committees including this one. There will be a scope of this study, agendas, minutes, as well as all other supporting materials. It will give you the background and information that will provide you with a basis. It was suggested we put up Code information as well. We'll put all this information in a place that is readily available.
Development of key questions and issues list	➢ SR began an open discussion to solicit input and issues that the Advisory Group wants to look into. She took notes on whiteboard comments and questions (see pictures below). • There is a limited geography scope. • What's the vulnerability of the City? • We need a clear understanding of risks. Will we know enough from the inventory to make recommendations and, if not, where are the key information gaps? ➢ BL said this Committee is going into new territory. We will take a good look at the old territory and see what can be improved. We'll do loss estimates on a variety of building types. We'll answer some key things about how will the community be affected. • Will the recovery plan include sufficient City resources? GH says a lot is being done regarding being prepared for earthquake impacts. Right now we are putting Inspectors and Planning personnel through training. • Does the City's current seismic mitigation ordinance only cover buildings in the

downtown area?

- How can we get a more holistic view and approach from the City?
- We need more information sharing: what's already been done and what were the mistakes?
- What is the definition of community? Small business will be struggling to keep their doors open. We want to be careful about what we want the "community" to do.

➢ Audience comment: We need advocacy for small business, renters, and lower income people. They are vulnerable. It's important to remember that policies will affect people in different ways.

➢ Audience comment: There are 3,630 multi-family buildings over two units. It's got profound implications.

➢ SR: Write your comments on the yellow notecard included in the green folder. We'd like to get a pulse. Is this important? Is there interest?

Five people turned in postcards. Written comments received are below (Scale: 1 = highest and 10 = lowest):

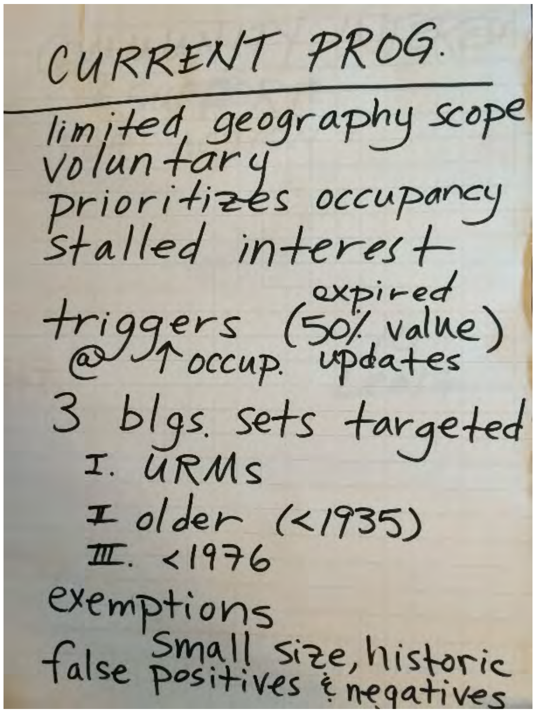
- Importance of structural vulnerability issues for Palo Alto:
  - 1
  - 1
  - "1" if there are a large number of buildings that could collapse in a magnitude 7.2 or larger event, 3 to 4 if not.
  - 4
  - "7" – we should encourage owners to be proactive participants (i.e., rather than solely relying on city government).
  - 8
- Community interest in the City doing more on this issue:
  - 2
  - 5 to 6 – could be higher if presented correctly (e.g., What will this do for me?"
  - 6
  - 7
  - 10

MEETING MINUTES – PROGRAM ADVISORY COMMITTEE MEETING

Discussion of plan for Advisory Group role and process	➢ BL presentation: What's the Advisory Committee approach? The scope is broad and we need to narrow the focus. Presented the Advisory Group Process slide. ➢ There will be six meetings for this plan. It will be very challenging to fit all the information sharing, discussions, and development of recommendations we need in this amount of time. These meetings have to be efficient and effective. ➢ Draft Advisory Committee Process and Questions will give us a sense of the scope. This Committee will need to corral this issue and get a focus. We need to come to a resolution or get a consensus. ➢ There will be a report that will be available to the Committee about what other communities are doing. ➢ By February, we will have the bulk of the Palo Alto inventory work done. We'll share what we learned. We should have performance and resilience goals. What level of safety are we looking for? ➢ The March meeting could be a retreat for the group. ➢ The Policy & Services Committee will become involved and then it will go to Council. ➢ Do we want to have a Chair, Co-Chair, or no Chair? Do we want to take votes? What are the rules? When do you want to meet, morning, or afternoon?
Summarize meeting outcomes, planned interim steps, and agenda topics/date for next meeting	➢ PP: What are we trying to deliver, what are the expectations? We'll get an initial seismic inventory of our vulnerable buildings first. We'll have to get more technical data and what criteria are we going to use? What is the definition of vulnerable? Soil types? After the survey what will we do with that information? What management plan will we come up with? What incentives? Will it be an optional or mandatory ordinance? Which ones will we decide to retrofit, what does retrofit mean? We should have clear expectations and deliverables for the next meeting. ➢ PP: We'll have meeting minutes that will list what decisions were made and the action steps we still need to take. Each meeting will have a clear expectation and deliverables. ➢ PP: We'll send a Doodle request to get a consensus on when is the next meeting. A website will be on Development Services website, under Task Force. It will have all related information for this meeting. ➢ GH comment: We are not doing a full survey of all the buildings in PA, just in certain areas. We have a limited budget to work with. We are in a discovery phase. When this is complete the Committee will create policies and go to Policy & Services. ➢ PP: Our goal is two hour meetings with recommendations. The exception will be the retreat. Maybe we can get a Technical Advisory Committee (TAC) as a sub group. BS understands all the Utilities requirements, no need for a Utilities Rep in this meeting. ➢ When possible, the goal is two weeks before the meeting we'll have materials available on the website. ➢ Audience: Would like to see the subgroups on the next agenda.

MEETING MINUTES – PROGRAM ADVISORY COMMITTEE MEETING

Action Items	➢ For the January meeting, a Doodle request will be sent for a consensus on the date and time. *Post-Meeting Note:* The January meeting has been scheduled for 1/27/16, 2-4pm at the downtown library. ➢ A link to the website will be sent. ➢ The January agenda will be made available on the website. ➢ Please look at Key Policy Questions and think about answers. Add to the questions if necessary.


CURRENT PROG.
limited geography scope
voluntary
prioritizes occupancy
stalled interest
triggers (50% value) expired
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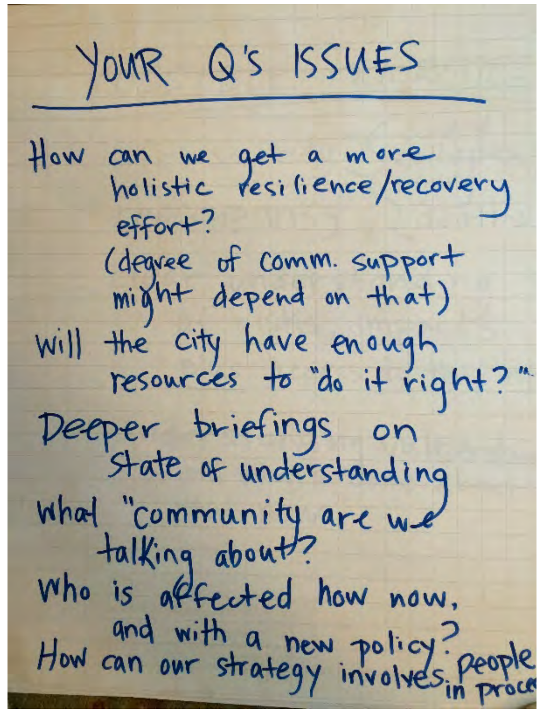
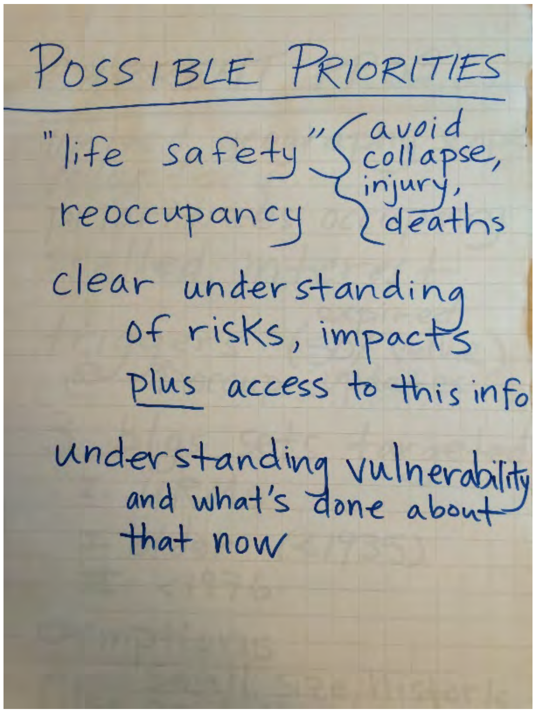
II older (<1935)
III. <1976
exemptions
small size, historic
false positives & negatives


YOUR Q'S ISSUES
How can we get a more holistic resilience/recovery effort?
(degree of comm. support might depend on that)
Will the city have enough resources to "do it right?"
Deeper briefings on state of understanding
What "community are we talking about"?
Who is affected how now, and with a new policy?
How can our strategy involves people in proce


POSSIBLE PRIORITIES
"life safety"
reoccupancy
avoid collapse, injury, deaths
clear understanding of risks, impacts
plus access to this info
understanding vulnerability and what's done about that now

City of Palo Alto

Seismic Risk Management Program

Advisory Group Meeting #1

December 16, 2015

Project Plan Briefing

Project Goals

- Make a leading program even better
- Extensive city and stakeholder involvement
- Efficient inventory creation
- Focused loss estimation
- Thoughtful, consensus-based, holistic recommendations for program updates

Project Plan Overview Topics

- Summary of current Palo Alto ordinance status
- What is currently known?
- What is currently <u>not</u> known?
- What will be studied in this project regarding seismic vulnerabilities in Palo Alto's existing buildings?

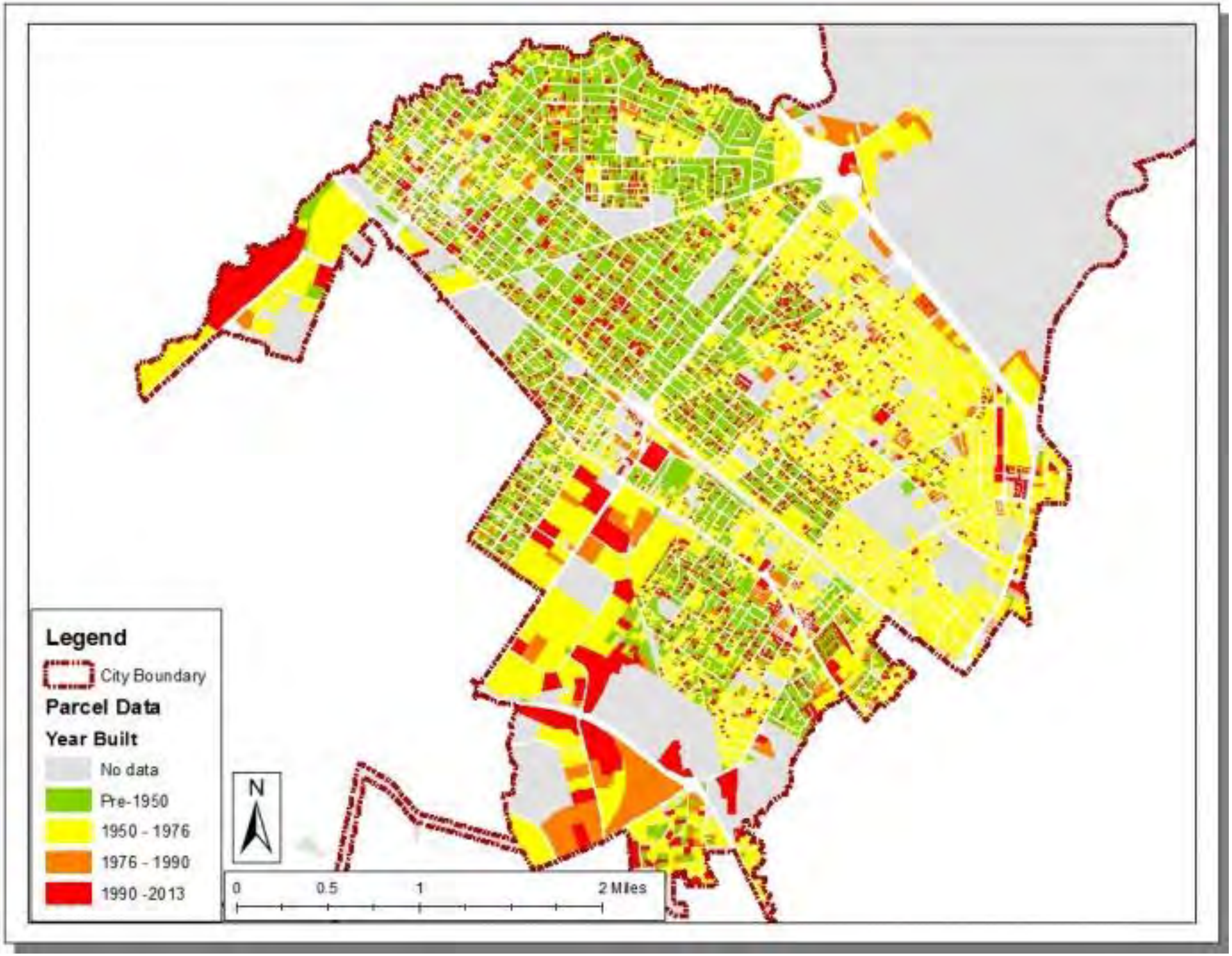
Current Palo Alto Ordinance

	Category I (URM over 1900 sf & 6 occupants)	Category II (Before 1935 and over 100 occupants)	Category III (Before 8/1/76 and over 300 occupants)	All Categories
Total	47	19	23	89
Retrofit	22	13	5	40
Demolished	14	2	5	21
Demo Proposed	0	0	4	4
Exempt	1	0	0	1
No change	10	4	9	23
Source: 12/9/14 City of Palo Alto Policy and Services Committee staff report. Status as of September 2014.				

What is Currently Known?

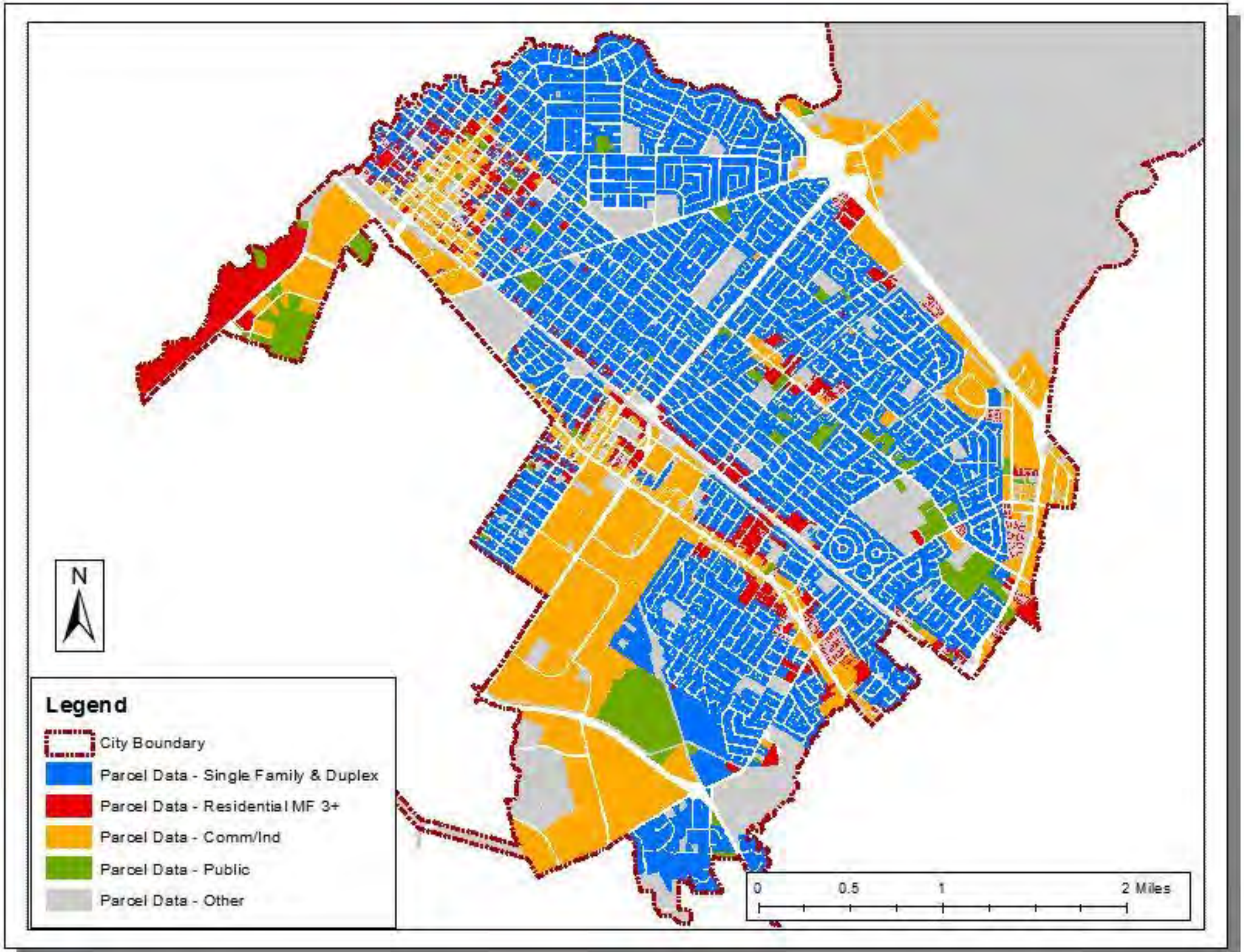
- From County assessor files, we have:
  - APN, number of parcels
  - Year built, occupancy type
  - Square footage, number of stories
- From City GIS files we have:
  - Shape file of building footprint
  - Location by latitude/longitude
- From earlier inventory efforts, we have:
  - Inventory forms for select set of buildings
  - Wood frame soft-story survey by SJSU and Palo Alto Fire Department

Year Built



Legend
City Boundary
Parcel Data
Year Built
No data
Pre-1950
1950 - 1976
1976 - 1990
1990 -2013
N
0
0.5
1
2 Miles

Occupancy



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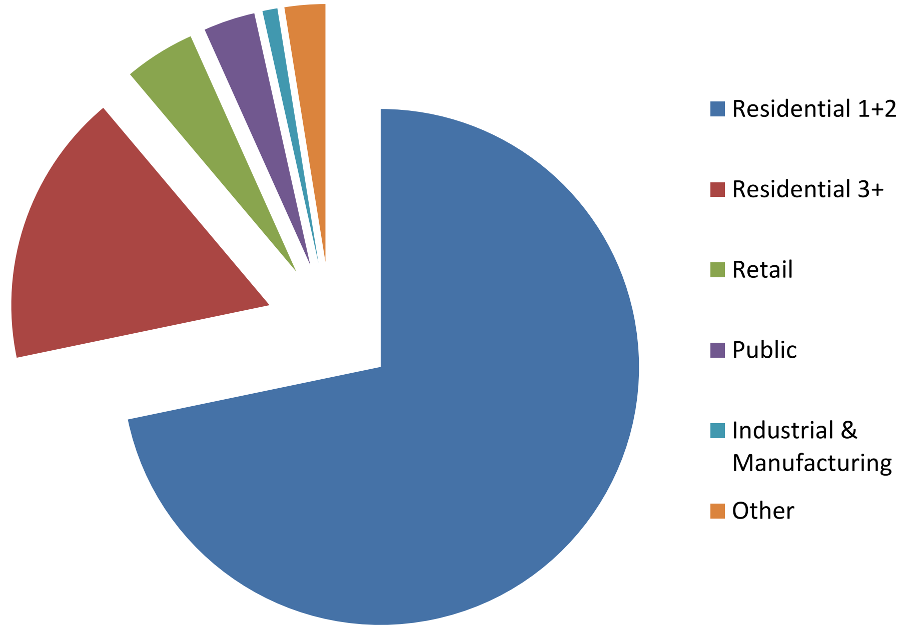
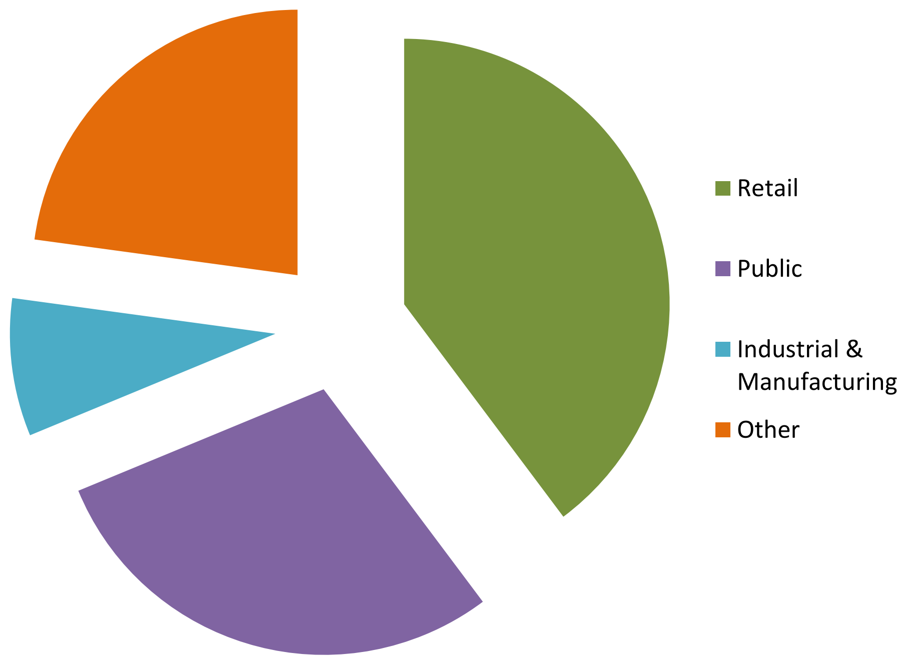
Parcels in Scope

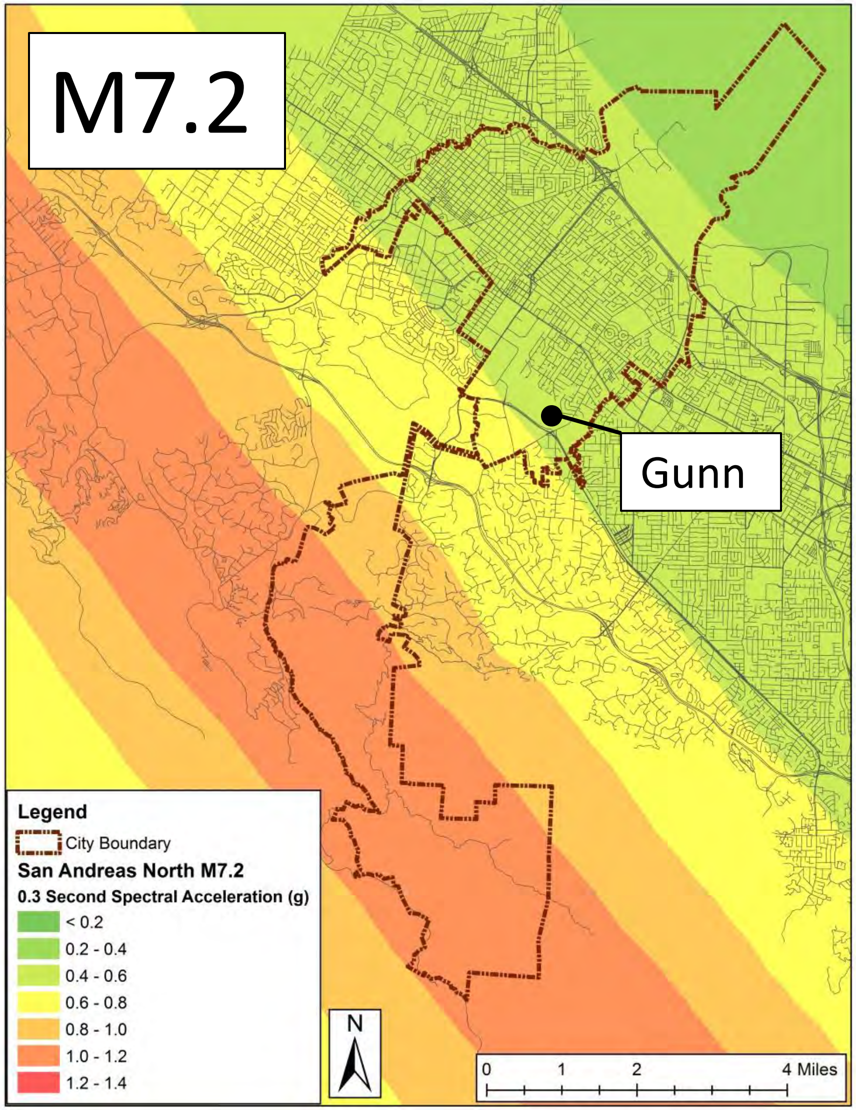
- Total PA parcels: 21,187
- 1 and 2 family: 15,198

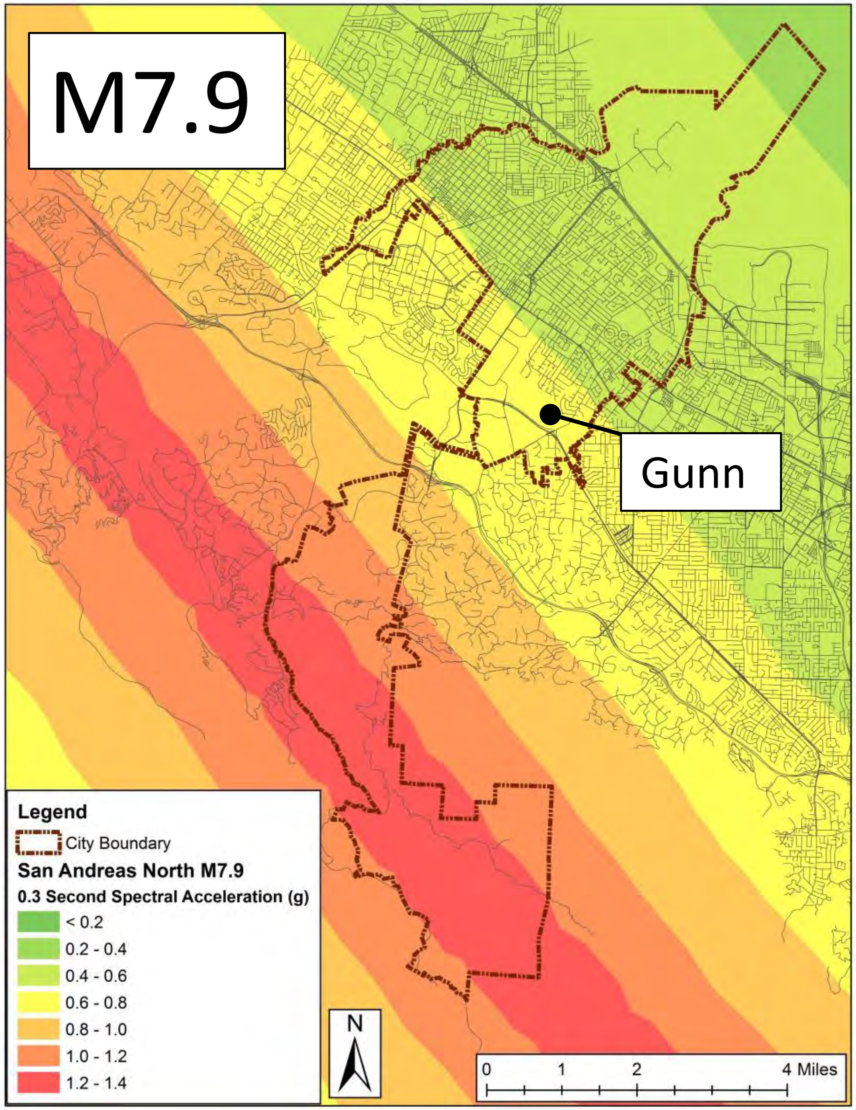
- Remaining: 5,989
  - 3 or more unit residential: 3,630
  - Retail: 938
  - Public: 684
  - Industrial/mfr: 198
  - Other: 539





What is Currently Known?





What is Currently Not Known?

- Structural systems of buildings in assessor files
- Actual number of buildings that are in different building types, including those considered potentially hazardous

What is Currently Not Known?

- Building types expected to have the greatest **aggregate** damage
  - Largest risk of lost units
  - Largest cost of repair
- Achievable reduction in losses from retrofit of selected buildings
- Effectiveness of past retrofit work in current context

What is Currently Not Known?

- Level of community interest in an updated seismic risk management program

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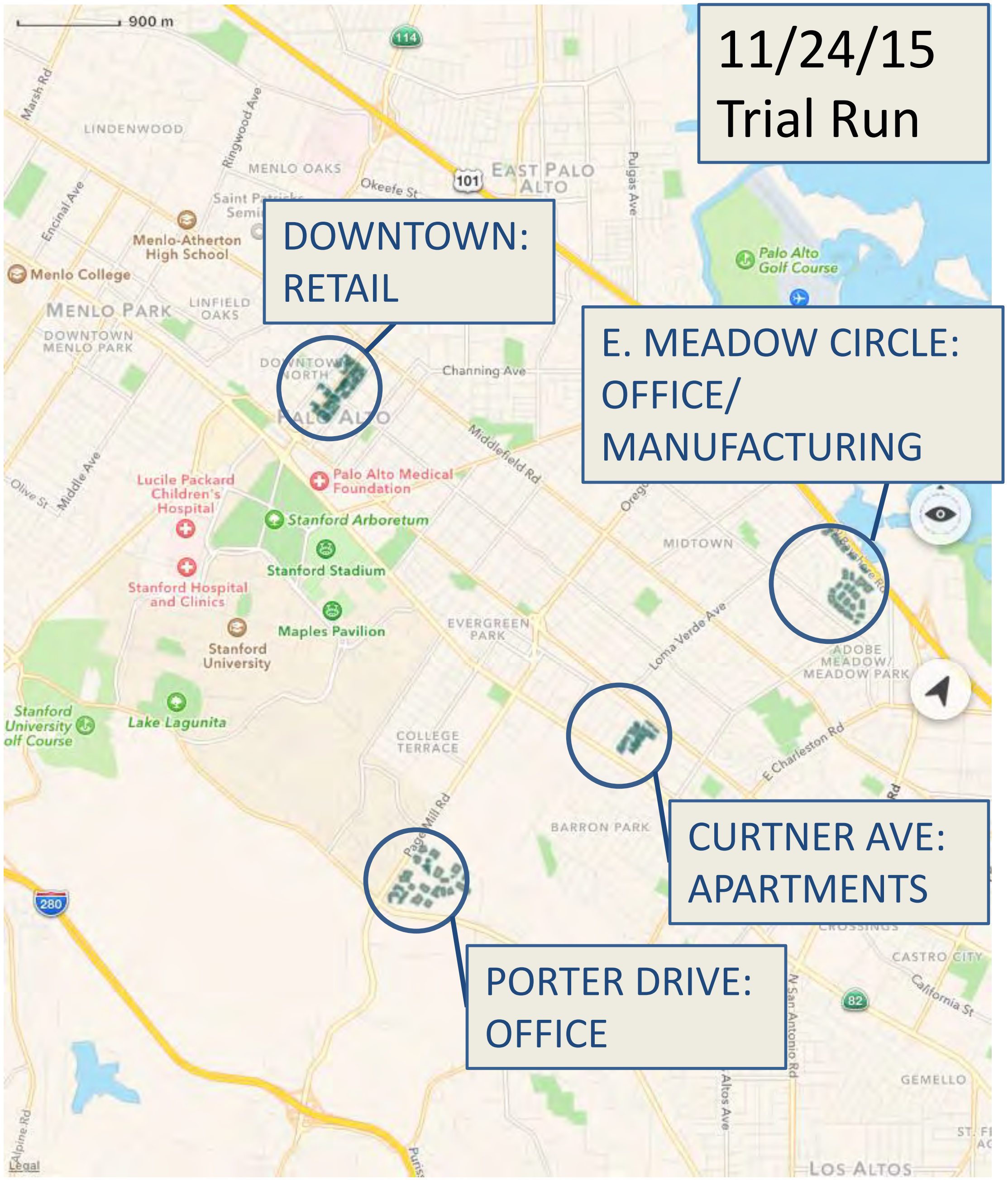
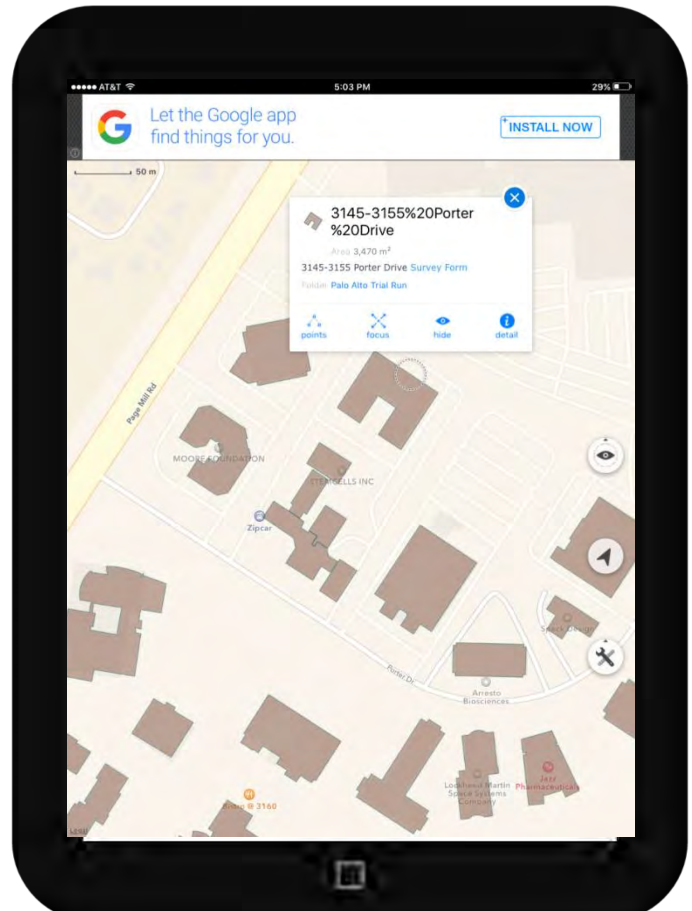
Key Project Tasks: Understand Building Stock

- Digital files
- Internet
- Review of drawings
- Sidewalk survey
  - Trial run
  - Sidewalk survey

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detail
Page Mill Rd
Zipcar
Porter Dr
Arresto Biosciences
Lockheed Martin Space Systems Company
Jazz Pharmaceuticals

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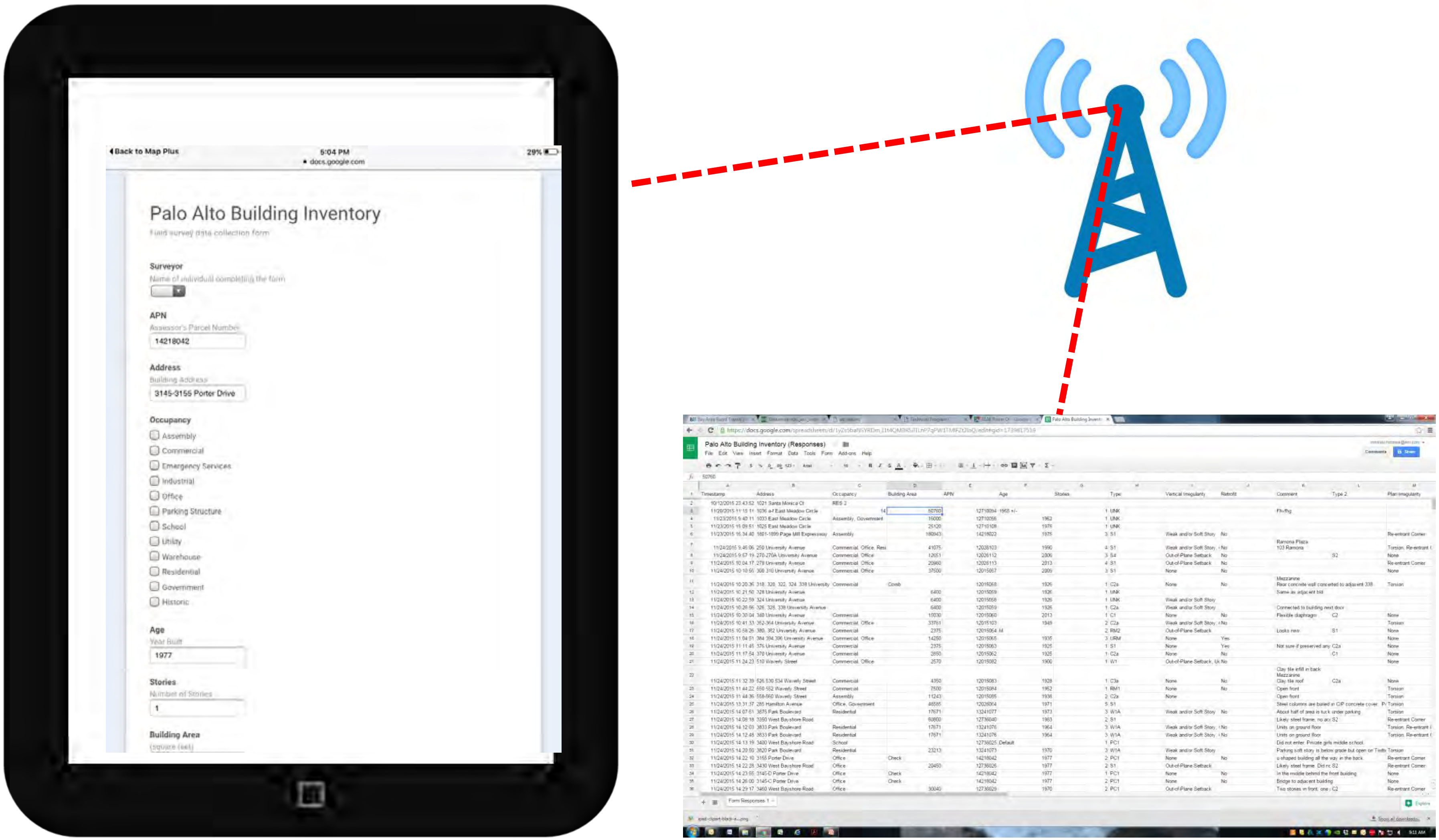

Back to Map Plus
5:04 PM
docs.google.com
29%
Palo Alto Building Inventory
Field survey data collection form
Surveyor
Name of individual completing the form
APN
Assessor's Parcel Number
14218042
Address
Building Address
3145-3155 Porter Drive
Occupancy
Assembly
Commercial
Emergency Services
Industrial
Office
Parking Structure
School
Utility
Warehouse
Residential
Government
Historic
Age
Year Built
1977
Stories
Number of Stories
1
Building Area
(square feet)
Palo Alto Building Inventory (Responses)

Key Project Tasks: Understand Potential Impacts

- Loss estimates
  - Two scenarios
  - Dollar losses and percent damaged
  - By building type and location
  - With retrofit and without
- Realistic retrofits:
  - Conceptual retrofits with cost estimates

Key Project Tasks: Prioritize Building Types & Conditions

- Understanding of hazardous buildings evolves
- Building code typically gets more stringent
- Possible hazardous building types:
  - Remaining URM
  - Multi-unit wood frame buildings with weak first stories
  - Older concrete

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Key Project Tasks: Prioritize Building Types & Conditions

- Possible hazardous types (cont.)
  - Older tilt-up buildings
  - Older steel moment frames
  - Hillside homes
  - Mobile homes without bracing
  - Buildings on sites subject to fault displacement, landslides or liquefaction

Key Project Tasks: Recommend Policy Directions

- Advisory Group input and consultant analyses on options that should be considered in a program update
  - What and why
  - Who and how

Timeline

2015

- October 15: Project kickoff meeting
- November 24: Trial run of sidewalk survey
- Today: Advisory Group kickoff meeting

2016

- January: Inventory complete
- February: Loss estimates
- March/April "Retreat": Preliminary alternatives
- May/June: Refine recommendations
- Summer: City Staff/Committee/Council review
- October: End of project

Q&A: Clarification about Elements of the Project Plan

State and Local Policy Context

- Active area of policy innovation in California and elsewhere
- Consensus on need for action
- State laws give cities latitude to widen and strengthen their approaches
- Palo Alto is “average” in terms of its current scope and requirements

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What are Other Cities Doing?

- Programs generally address specific building types by structural features and/or use or critical functions
- Programs also vary in:
  - Degree of emphasis on mandates and enforcement
  - Amount of time until requirements kick in
  - Technical definitions and standards
  - Types of assistance offered
  - Roles of community and consultant input

The Example of Bay Area Soft-Story Policies: Varied and Evolving

- Identify, prioritize, ramp up
- Different timelines based on "tiers"

Increasingly Stringent

Soft-Story Program Type	***Inventory Only***	***Notify Only***	***Mandatory Screening***	***Mandatory Evaluation***	***Mandatory Retrofit***
Jurisdiction	Santa Clara County (2003) San Jose (2003) In Development: Hayward	San Leandro (2006) Sebastopol (2011) Richmond (2012)	Oakland (2009) → San Francisco (2013) →	Berkeley (2010) → Alameda (2011)	(2014) (2015) (2014) Fremont (2005)

Compiled by S. Rabinovici, 2015.

San Francisco's Flagship Effort

- CAPSS 5-year effort (over 12 years)
- 30-year implementation plan
- URMs, soft-story, private schools, masonry chimney, façade, houses, neighborhood clusters and beyond
- Resilience target focus: safety and recovery speed and strength


Here Today—Here Tomorrow:
The Road to Earthquake Resilience in San Francisco

A Community Action Plan for Seismic Safety

ATC Applied Technology Council

The Disaster Cycle

Preparedness

- Neighborhood Emergency Response Team training (NERT)

Incident

Response

- Emergency Response Plans
- Shelter-in-Place Protocols

Short Term Recovery

- Post-Event Reconstruction Standards
- Building Occupancy Resumption Program (BORP)

Long Term Recovery & Planning

- Building Codes
- Local Hazard Mitigation Plans
- Alquist-Priolo Special Studies Zone Disclosure

Mitigation

- Retrofit Ordinances
- Transfer Tax Rebates
- Triggers

Possible Community Goals and Priorities for Reducing Building Risks

- Increase understanding of local risks and impacts
- Increase building stock quality
  - Increase safety
  - Reduce economic losses
  - Limit disruption and speed recovery
- Less need for services during and after events
- Build back better

Key Questions for the Advisory Group (Policy Questions Handout)

- Many choices shape a program:
  - Inclusion & exclusion criteria
  - Requirements & standards
  - Pace and prioritization
  - Technical and financial assistance
  - Process transparency and public participation
  - Intensity of enforcement
  - Post-event measures

Your Thoughts & Questions

- Priority issues the Advisory Group should focus on
- Community goals and priorities
- Importance and level of community interest in updating the City's approach
- What's not been brought up yet that's important to you?

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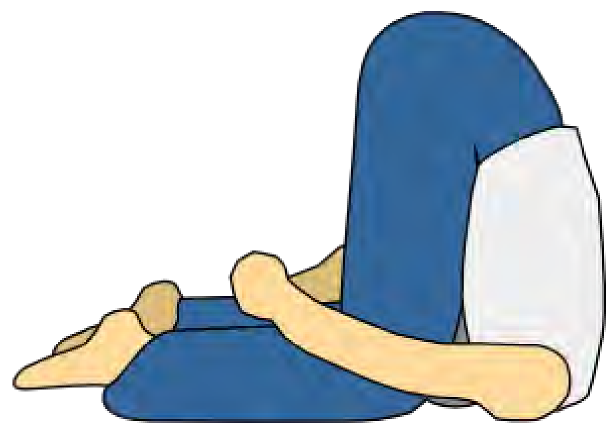
[10 minute Stretch Break]



Advisory Group Approach

- Scope of Advisory Group effort
- Limited number of meetings, so they all have to be very efficient
- Planned topics and timeline

Advisory Group Process

- Chair, co-chairs, or no chair?
- Voting, polls, or consensus?
- Distribution of information material:
  - Before meetings, at meeting, and/or after meetings?
  - How far in advance?
- Website plans
- Morning or afternoon meetings?

Meeting Wrap-Up and Follow-Ups

- Outcomes from today
- Minutes
- Date for next meeting
  - Options: Tu 1/19, Wed 1/20, Wed 1/27
- Meeting materials
  - Next agenda
  - Findings:
    - Preliminary Inventory results
    - Legislative and Local Program Best Practices report

City of Palo Alto Seismic Risk Management Program
Draft Advisory Group Process

The City has created an Advisory Group to provide input about community priorities regarding updating Palo Alto's earthquake risk mitigation programs and policies. Up to six, approximately monthly meetings are planned. Potential topics are as follows.

Meeting	Approximate Timing	Agenda Topics
1	December 16, 2015	• Introduce overall project motivations, scope, and goals • Share information about what is known, not known, and to be studied in this project regarding earthquake vulnerable buildings • High level presentation on what other cities are doing • Discuss the Advisory Group's role and how its time and input can best be used • Establish how the Advisory Group will do its work

2	January (ideally before main loss estimate is run)	• Review initial inventory information gathered
		  o Trial run results, sidewalk survey locations, preliminary findings
		• Presentation of loss estimate approach
		  o Methodology overview, planned earthquake scenarios, output metrics
		• Review draft summary legislative review and local government best practices assessment
		• Discuss potential new policy directions and issues

3	February (after inventory and loss estimates are run)	• Review draft inventory report and loss estimate results • Review final legislative review and local government best practices assessment reports • Discuss implications of the above in terms of setting community building performance/resilience goals • Discuss relative risk and issues of prioritization and timeline • Establish criteria for evaluating policy alternatives

Meeting	Approximate Timing	Agenda Topics
4	March (potential longer retreat-style meeting)	• Review final inventory and loss estimate report • Presentation of conceptual retrofit approaches • Generate short list of broad policy alternatives • Conduct preliminary evaluation of policy short list
Presentation to Policy and Services Committee		
5	May (after draft summary reports are developed	• Review draft seismic management alternatives and recommendations report • Discuss potential stakeholder engagement strategies and other key program management issues going forward
6	June	Review of updated draft management plan report • Review revisions based on previous comments • Final input and plan for dissemination of findings

City of Palo Alto Seismic Risk Management Program
Topics for Advisory Group Process

December 14, 2015

Broad Policy Priorities and Readiness to Act

1. What broad priorities should we be focusing on as a community in terms of seismic safety and disaster resilience in the local building stock?
    - *One way to think about this is to consider resilience objectives, which can include preventing collapse, preventing loss of life, preventing injuries, helping families plan for sheltering-in-place after an event, preserving neighborhood character, minimizing economic losses, preserving the local economy and tax base, protecting businesses and helping them recover, or balancing earthquake mitigation efforts relative to other community resilience goals.*
2. How important is it for the City of Palo Alto to more proactively address earthquake risks to local buildings than is currently being done? Rate from 1 (more important) to 10 (less important).
3. What is the level of community interest and support at this time for updating the City's approach to managing earthquake risks? Rate from 1 (more important) to 10 (less important).
4. Is enough known about existing vulnerabilities in the building stock to proceed with developing specific policy and program proposals? (If not, what information is still needed?)
5. How swiftly should the City seek to act on these issues (scale of 1-slower to 10-faster)?

Program Scope: Privately-Owned Buildings

6. Building Types:
    a. Should remaining unreinforced masonry buildings be included (i.e., those under 1,900 sf with 6 or fewer occupants)?
    b. Should wood frame soft-story buildings be included?
    c. Should older concrete buildings be included
    d. Should older tilt-up concrete buildings be included?
    e. Should older steel moment frame buildings be included?
    f. Should hillside homes be included?
    g. Should mobile homes without a supplemental earthquake bracing system be included?
    h. Should buildings on sites subject to fault displacement, landslides, or liquefaction be included?

i. What other types should be included (if any)?

7. Inclusion Criteria:
    a. Should age (year built) be a criterion?
    b. Should the number of occupants be a criterion?
    c. Should the current use or occupancy class be a criterion?
    d. Should certain combinations of criteria be organized to create "tiers" of structures that are treated differently with regard to such things as requirements, incentive eligibility, penalties, and/or timelines?

8. Exclusion / Exemption Criteria:
    a. Should properties owned or occupied by non-profit or community service oriented organizations (e.g., churches) be exempt?
    b. Should special policies be developed for historic or landmark properties?

9. Notification and Transparency:
    a. Should all included owners be notified at once at the beginning, or should notification occur in stages based on certain criteria?
    b. Should the addresses and compliance status of properties included in the program be proactively made public, for instance on a regularly updated city website?

Program Scope: Publically-Owned Buildings

10. Should part of the program involve evaluating or strengthening City-owned structures, particularly those needed for critical services?

Program Elements

11. Should Palo Alto's seismic mitigation program emphasize voluntary initiatives, mandatory measures, or use a mix of these approaches?
12. Should the program include more stringent triggers for upgrading?
13. Should the program include a mandatory screening process?
14. Should the program include mandatory evaluations?
15. Should the program include mandatory retrofits?
16. Should the program include mandatory signage?
17. Should the program include mandatory notification of current and potential tenants or lease holders?
18. Should the program include placement of formal notice on title or deed?
19. Should the program provide protection from future regulatory action for some period of time following compliance?
20. Should enforcement include financial penalties, and if so, of what magnitude?

Rating Programs

21. Should Palo Alto have its publically-owned buildings rated, such as per new US Resiliency Council standards (1 to 5 stars for Safety, Damage and Recovery indices), or the University of California's original system (Good, Fair, Poor, Very Poor), or FEMA P-154 (numeric score related to collapse potential)?
22. Should ratings be encouraged for private buildings?
23. Should ratings be required for certain building types?

Retrofit Requirements and Standards

24. Should the program hire an external consultant to advise and develop retrofit standards or rely on existing approaches?
25. Should special guidelines or trainings be developed and offered for engineers and/or local contractors in terms of how to complete work that adheres to program requirements?

Incentives and Handling of Costs

26. Should the program expedite processing and waive, or offer reduced permit fees, for projects involving retrofit work?
27. Should the program offer development bonuses for projects involving retrofit work completed that meets certain criteria?
28. Should the program offer waivers of policy requirements (e.g., parking requirements) for retrofit projects that meet certain criteria?
29. Should owners be limited in the amount and/or pace at which retrofit or other program compliance costs are passed on to tenants in the form of rent increases?

Planning for Post-Event Reconstruction and Replacement

30. Should the program seek to develop proposals for post-event repair, rehabilitation, and retrofit requirements?
31. Should the City develop a Building Occupancy and Resumption Program, permitting individual owners to establish a relationship with an on-call structural engineer to perform post-earthquake evaluations of their buildings?
32. Should the City encourage or fund additional strong motion instrumentation in selected buildings and free-field sites?
33. Should the City increase ATC-20 training of its staff?
34. Should the City link its inventory database to post-event planning and data collection?

Beyond Buildings: Readiness, Relationships, Response, Recovery, and Research

35. Should the program include a significant public education and awareness-building component?
36. Should the program include an effort to build the capacity of local organizations to understand and respond to earthquake threats?
37. Should the program include efforts to build partnerships with and/or policies related to local schools and universities—public, private, or both?
38. Should the program include efforts to build partnerships with local (small to large) businesses and employers—public, private, or all sectors?
39. Should the updated program seek to develop and implement policy strategies to address nonstructural aspects of seismic risk, such as damage to contents, building re-occupancy, business resumption and retention, or shelter-in-place capacity?
40. Should the City adopt a policy to collect voluntarily or mandatory information at time of building permit that identifies and classifies retrofit projects for use in future evaluation of retrofit technologies and approaches?
41. Should the City investigate methods for increasing the structural requirements for cell phone towers, such as increasing the Importance Factor used in seismic design to a value of 1.5?
42. Should the City investigate approaches for understanding and addressing threats to basic utilities such as water and power?
43. Should the City consider developing requirements for private-school buildings?
44. Should the City develop a façade maintenance ordinance?
45. Should the City develop a program for identifying post-earthquake shelter facilities?

Other Questions

46. What other issues and questions not on the list above should be considered?

CITY OF PALO ALTO

Meeting Agenda

Seismic Risk Management
Program Advisory Committee

From: George Hoyt
Chief Building Official
Development Services
City of Palo Alto
285 Hamilton Avenue
Palo Alto, CA 94301

Project: City of Palo Alto Seismic Risk Management Program **Job #:** 2015-087S
Subject: Agenda for 1/27/16 Advisory Group 2nd Meeting (AG2)

Our proposed topics, objectives, distribution materials, agenda, and issues for the second Advisory Group session are described below.

MEETING DATE, LOCATION, AND TIME

Downtown Library	January 27, 2016
(El Camino Real Program Room)	2 pm – 4pm
270 Forest Avenue	
Palo Alto, CA 94301	

MEETING OBJECTIVES

- Review project and Advisory Group process status
- Report and discussion of legislative review and local government best practice reports
- Report and discussion of initial inventory information gathered and planned activities

PRE-MEETING MATERIALS

- Minutes from AG1
- Agenda
- Advisory Group website link with additional project documents

AT-MEETING MATERIALS

- Preliminary consultant short reports: (1) inventory, (2) state legislation, and (3) local programs
- Meeting slides regarding state and local policies and inventory activities
- One-page summarizing project objectives, timeline, and Advisory Group role

AGENDA

2:00 pm	Welcome	George Hoyt / Sharyl Rabinovici
2:05 pm	Review project and Advisory Group process status • Review/approve minutes from 12/16/15 AG1meeting • Review project document availability and administrative efforts (e.g., website) • Re-cap current Palo Alto policies and programs	
2:20 pm	Review one-year project end goals and Advisory Group role, including detailed project timeline • Potential use of a technical advisory subgroup	Bret Lizundia
2:40 pm	What are other communities doing? • Summary of report on state legislation • Summary of report on local programs • Discuss policy questions that relate model programs	Sharyl Rabinovici
3:10 pm	What we've learned so far about Palo Alto's building stock seismic vulnerabilities • Trial run results, sidewalk survey locations, preliminary findings • Overview of loss estimate approach • Loss estimate scenarios planned • Replacement cost values used in loss estimates • What will we be able to say after collecting and analyzing this data • Discuss inventory methodology and policy questions that relate to technical details	Bret Lizundia
3:45 pm	Decide on Advisory Group next meeting agenda, interim steps, and date/time for next meeting	Sharyl Rabinovici
4:00 pm	Adjourn	

Seismic Advisory Group
Meeting #2
January 27th, 2016
2-4pm

MEETING MINUTES – SEISMIC RISK MANAGEMENT ADVISORY GROUP

Attendance By:	Peter Pirnejad (PP), Development Services Director COPA George Hoyt (GH), Chief Building Official COPA James Henrikson (JH), Fire Marshal COPA Bud Starmer (Bud S), Building Inspection Supervisor COPA Nathan Rainey (NR), OES Coordinator COPA Jeremy Dennis (JD) Planning Manager COPA Blake Salzman (Blake S), Contract Plans Examiner COPA Bret Lizundia (BL), Principal, Rutherford+Chekene (R+C) Sharyl Rabinovici (SR), sub consultant to R+C Ahmad Wani, Community Al Dorsky, Community Anil Babbar, Tenants Annette Glanckopf, Community Chris Rojahn, Engineers Dana Brechwald (DB), Policy Doug Hohbach, Engineers Judy Kleinberg (JK), Business Interests Ken Hayes, Architects Teresa Marks, Community Tim Steele, Developers Tom Holzer, Policy City Staff Unable to Attend: Elena Lee, Senior Planner COPA Hung Nguyen, Project Engineer COPA
Minutes Prepared By:	Blake Salzman, Contract Plans Examiner
ITEMS	DISCUSSION
Introduction	General: ➢ Introduction by GH: The focus of this meeting is to present information developed since the last meeting. The Advisory Group will be given an update on information posted to the Advisory Group webpage, recent activities and what items are coming up that the advisory group should be aware of. Goals for Meeting: ➢ BL reviewed the meeting agenda with the group. Goals for the meeting are to review the project progress, re-review and reiterate project goals and the role of the Advisory Group, clarify questions

	regarding Palo Alto's seismic hazard ordinance requirements, present information from the legislative and local government best practices reports, discuss inventory findings and plans for the upcoming sidewalk surveys, and discuss the timing for the next Advisory Group meeting. • GH will walk through the COPA website, and instruct the group on how to find key documents related to the Advisory Group and the project in whole. The website address is: http://www.cityofpaloalto.org/gov/depts/ds/srmag.asp • Have an open discussion on whether or not anyone in the group has any missing best practices that they think should be included in the project. • Discuss some of the details regarding the inventory and loss estimate tasks and review the intended outcome. • Have a clear picture of the purpose of the Advisory Group. PowerPoint Presentation: A copy of the presentation slides shown during the meeting will be posted on the Advisory Group webpage. Review of Minutes: ➢ The previous meeting minutes were reviewed, and the group had no additional comments regarding these minutes. Introduction of Group Members from COPA: ➢ GH introduced James Henrikson, Fire Marshal, and Jeremy Dennis, Planning Manager, to the group as they were unable to attend the previous Advisory Group meeting.
Advisory Group Webpage	➢ GH led the group in a demonstration of how the Advisory Group webpage works. The webpage can be found here: http://www.cityofpaloalto.org/gov/depts/ds/srmag.asp ➢ The files on the webpage create a timeline of documents that have been created in relation to this project, with the newest documents shown at the top. The history of documents was discussed as well as the intent for each step. ➢ At the last meeting, the group asked for more information about current COPA regulations related to the Seismic Hazards Identification program. The Ordinance can be found under the link

	"CPAMC 16.42 Seismic Hazards Identification Program". Information about incentives handled by the planning department can also be found on the webpage. ➢ During the discussion regarding the review of the Advisory Group Webpage, the topic of current regulations was briefly discussed. Questions regarding whether or not the current incentives given by the municipal code applied to only the CD district was asked by the group. It was clarified that the floor area bonus was the only aspect that was applied to the "CD District." ➢ The Floor Area Bonus program was discussed, including the geographic limits in the City where that incentive can be used.AG member Ken Hayes noted that the program extended to the areas between Forest and Addison as well.
Program Timeline	➢ The timeline and purpose of the Advisory Group was discussed. ➢ A general timeline for the project as well as the Advisory Group meetings was shared by BL. The loss estimate without retrofits to the building stock is expected to take place by the next meeting, and loss estimate with retrofit to selected building types will take place following Advisory Group Meeting #3. ➢ Presentation of findings to the Policy and Services Committee is currently planned between Advisory Group Meetings 5 and 6. ➢ The project is expected to end in October, with the recommendations to Council taking place in the summer. ➢ PP wanted to clarify that potential incentives would not be decided on as part of this program, but rather recommendations would be made with how to move forward after the end of this project. BL confirmed that incentives may be considered during the advisory group meetings and reflected in the recommendations made on the issues and project features that the Advisory Group and project team believe are beneficial for the City to consider. SR stated that a forthcoming Best Practices report would cover types of incentives that other cities have used.
Best Practices	➢ SR began the discussion about state legislation and local programs

	by describing some of the key entities that govern earthquake mitigation plans and policies in California. She also reviewed some of the major pieces of legislation that COPA is obliged to comply with and that govern how mitigation work can be done. .SR found that existing laws approach seismic risk management in different ways, including:
	• Building code provisions;
	• Use-specific, such as schools and hospitals;
	• Building type specific requirements, the most prominent of which is the state's unreinforced masonry law;
	• Planning and zoning rules; and,
	• Financing and taxation policies. For example, property taxes cannot be increased because of added value due to a seismic upgrade.
	
	➢ SR then presented a framework for looking at similarities and differences between local programs. Cities can be categorized as Inactive, Learning, or Leading depending on how many policy measures they have in place, how many building types are addressed, and how successful those programs have been.
	  • Leading cities tend to have mandates in place, devote more resources to managing and enforcing their programs, and address more than one building type.
	  • Learner cities are investing in information gathering, risk assessment, and community engagement to lay the groundwork for future policy efforts.
	
	➢ PP asked where Palo Alto currently falls on the Learning/Leading scale. SR replied that Palo Alto is a Leader for URMs and is now a Learner with regards to other building types and through this project is being set up well to become a Leading city.
	
	➢ PP asked how many other cities are using a Floor Area Ratio (FAR) bonus in their seismic risk management programs and what the frequency of retrofitting in those cities has been compared with the time since the original passage of the ordinance. SR said that FAR programs for seismic work are rare and there is no effectiveness data available. The Planning Department may have data available that could be used to analyze its effectiveness in Palo Alto.
	
	➢ The group questioned how Palo Alto's voluntary system or other

	development incentives would work during future time periods experiencing a less robust economy. This should be considered for the long-term success of the project. ➢ DB brought up the concern that she has found that incentive-based programs tend to reward those that would complete the project regardless of the incentive, but projects that are more financially challenged have difficulty regardless of the incentive. She also noted that it is important to have phased approaches to reduce difficulties such as owners arranging financing or tenant displacement. ➢ JK asked how can program effectiveness be measured and what has been the experience with displaced residents during retrofitting. SR stated that a few cities have data but most information we have about impacts on owners and tenants are anecdotal.
Inventory	➢ BL discussed the amount of structures that will be a part of the study based on detailed review work R+C has been conducting. ➢ Sidewalk surveys are expected to start on February 4th with Palo Alto Building and Fire staff and on February 11th with Stanford structural engineering graduate students. ➢ The group was shown the model of seismic events that would be used for the purpose of determining losses. ➢ BL explained how losses would be defined. The loss will be calculated as the percentage of damage multiplied by the replacement cost of the building. He noted that deaths and casualties are not included in the scope of the loss estimate. ➢ BL noted that the Hazus methodology has default values for replacement costs based on occupancy type and geographic location using RS Means values. He noted that the values are lower than typical construction costs on the Peninsula. ➢ The Advisory Group concurred that the replacement cost values presented are noticeably lower than those in the current market. There was general interest in investigating revised values specific to Palo Alto, perhaps by using a multiplier on the default values.

	This may be addressed using a Technical Advisory Committee. Several Advisory Group members expressed interest in being part of such a committee. It was agreed that a future email would be sent to the group to organize a side discussion of this specific issue.
Action Items	➢ The inventory including loss estimate without retrofit is expected to be completed by the next AG meeting. ➢ The legislative review and local government best practice reports will be distributed via the webpage prior to the next AG meeting. ➢ The group is open to discussion or research regarding the cost of replacement construction to help in the loss estimates. ➢ Timing and agenda for the next meeting was discussed and the goal is to have the meeting mid-March, mid-week, and in the afternoon. .

City of Palo Alto

Seismic Risk Management Program

Advisory Group Meeting #2
January 27, 2016

Agenda and Objectives

- Review project and Advisory Group (AG) status
- Review project goals and AG role
- What are other communities doing?
- Update on what we've learned about Palo Alto's building stock
- Next steps, including next meeting

Input and Intended Outcomes

- Input from the Advisory Group
  - Is the website helpful?
  - Are there other program and policy options we haven't mentioned?
  - Whether the Advisory Group or a Technical Advisory Group wants to weigh in on the replacement costs used in the loss estimates
- Intended Outcomes
  - You have a clearer picture of the Advisory Group's purpose and scope and key milestones on the project timeline
  - You are better informed about what other communities are doing and what policy options we will be considering moving forward
  - You have a better understanding of the building stock that we will be studying and about the loss estimates we will be performing

Project and AG Process Status

- Review of minutes from 12/16/15 AG1 meeting
- Review of document availability on website
- Re-cap of current Palo Alto seismic ordinance

Document Availability

- Seismic Risk Management Program Website: http://www.cityofpaloalto.org/gov/depts/ds/srmag.asp
- Currently Includes
  - Contract scope of work
  - Key City documents: 12/9/14 Council minutes and Policy and Services memo
  - AG agendas, minutes, and PowerPoint presentations
  - Policy questions to consider
- Coming
  - Consultant reports, results of project tasks, project timeline

http://www.cityofpaloalto.org/gov/depts/ds/srmag.asp

SRMAG - City of Palo Alto

CITY OF PALO ALTO

AAA Search...

View Text Version Tuesday, January 26, 2016 51°F

Visiting | Doing Business | Government | Services | Community Partners | I want to...

City Home > ... > Departments > Development Services > SRMAG

Feedback

EXPLORE

- Government Home
- Departments Home
- Development Services Home
- Welcome
- Hours and Location
- Advisory Groups
- Blueprint
- Building
- Fire Prevention Bureau
- Green Building
- Planning and Community Environment
- Public Works
- Utilities
- How Are We Doing?
- Technology Partners

My Palo Alto

Phonebook

Seismic Risk Mitigation Information

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Seismic Risk Mitigation Advisory Group (SRMAG) Information

Last Updated: Jan 22, 2016

SRMP Advisory Group Meeting #2 Agenda 1/27/2016
Revision Date: 1/27/2016

Seismic Risk Management Program Advisory Committee Members 1/15/2016
Revision Date: 1/15/2016

SRMP Advisory Group Meeting #1 Agenda 12/16/2015
Revision Date: 12/16/2015

SRMP Advisory Group Meeting #1 Minutes 12/16/2015
Revision Date: 12/16/2015

SRMP Advisory Group Process Draft 12/16/2015
Revision Date: 12/16/2015

SRMP Advisory Group Meeting #1 Project Plan Briefing 12/16/2015
Revision Date: 12/15/2015

SRMP Advisory Group Questions 12/14/2015
Revision Date: 12/14/2015

Rutherford + Chekene Project Team
Revision Date: 12/1/2015

CPA Seismic Risk Management Project Scope of Work and Deliverables
Revision Date: 11/23/2015

Policy and Services Meeting Agenda 12/09/2014
Revision Date: 12/9/2014

Policy and Services Meeting Minutes 12/09/2014
Revision Date: 12/9/2014

8:44 PM

Re-Cap of Current Ordinance

	Category I (URM over 1900 sf & 6 occupants)	Category II (Before 1935 and over 100 occupants)	Category III (Before 8/1/76 and over 300 occupants)	All Categories
Total	47	19	23	89
Retrofit	22	13	5	40
Demolished	14	2	5	21
Demo Proposed	0	0	4	4
Exempt	1	0	0	1
No change	10	4	9	23
Source: 12/9/14 City of Palo Alto Policy and Services Committee staff report. Status as of September 2014.				

Re-Cap of Current Ordinance

- Original ordinance
  - Palo Alto Municipal Code
  - Chapter 16.42 Seismic Hazards Identification Program (passed 1986)
  - Applies to buildings in the three categories anywhere in the city
  - Only structural system explicitly covered is URM
  - Engineer report is mandatory; doing the work is voluntary. Reports were due long ago (1990).
- Zoning ordinance
  - Palo Alto Municipal Code
  - Chapter 18.18.070 Floor Area Bonuses
  - Covers buildings in Commercial Downtown (CD) District

Re-Cap of Current Ordinance

- CD District is split into
  - CD-C Commercial
  - CD-S Service
  - CD-N Neighborhood
- Zoning benefits if:
  - CD-C and Floor Area Ratio ≤ 3.0 or
  - CD-N/CD-S and FAR ≤ 2.0
- If building is not historic:
  - Retrofit permits sf increase of greater of 25% or 2500 sf
- If building is historic:
  - Retrofit permits sf increase of greater of 50% or 5000 sf
- Many other specific rules

Before Meeting

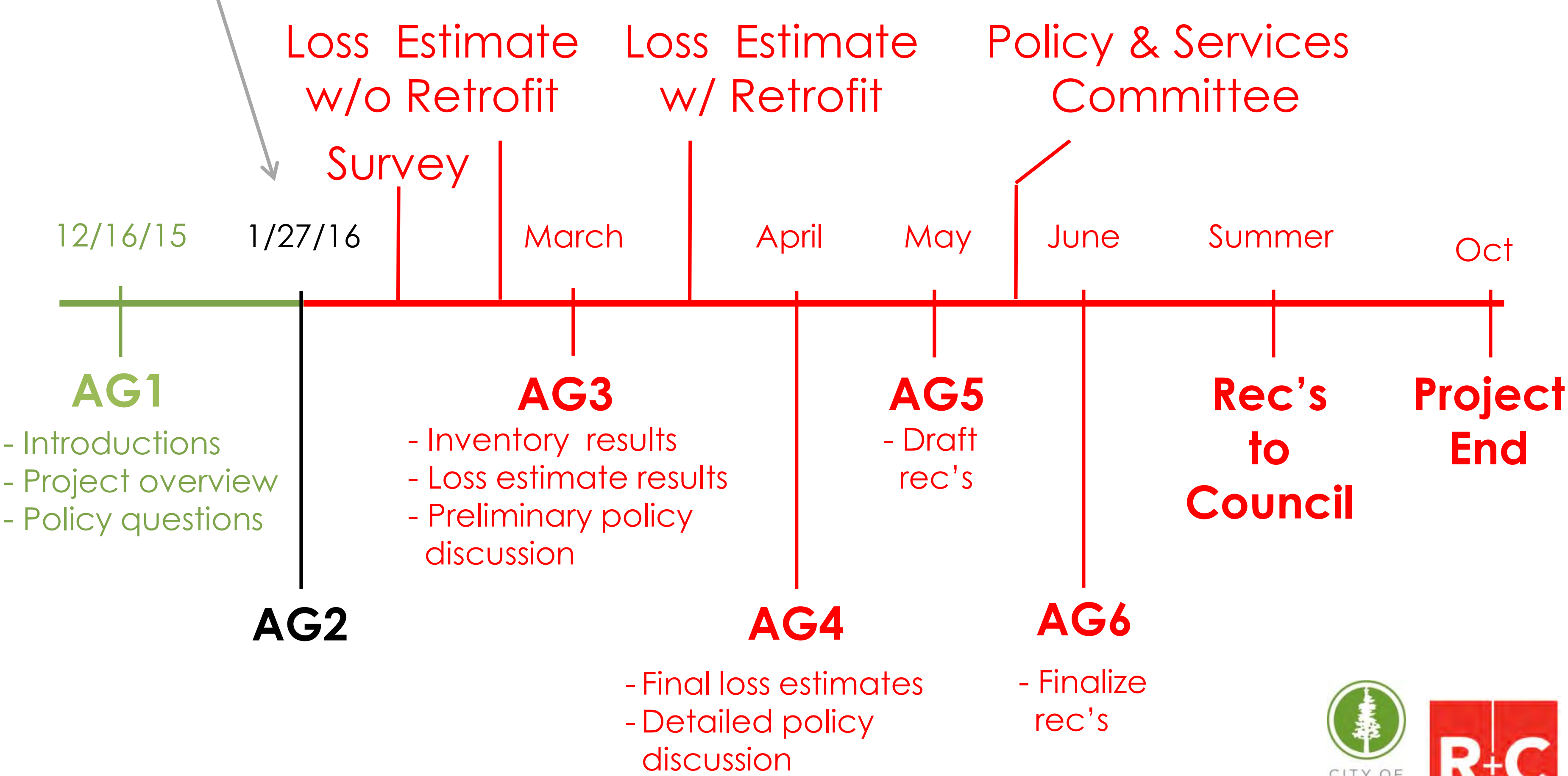
- AG1 minutes
- AG2 agenda
- AG website

At Meeting

- Recap Palo Alto policies
- State legislative review
- Local policy review
- Update on inventory and loss estimate efforts

Purpose of Advisory Group

To review and discuss implications of the project's technical findings and provide input about community concerns, priorities, and preferences.



CITY OF PALO ALTO

R+C

What are Other Communities Doing?

- Task 2 report on state legislation
- Task 3 report on local programs

Overview: State Level Policy Context

- Numerous existing laws
  - Building-specific
  - Planning related
  - Financing
  - URM buildings
- Current developments
  - Some leadership
  - Recent failed proposals
  - "PACE" funding

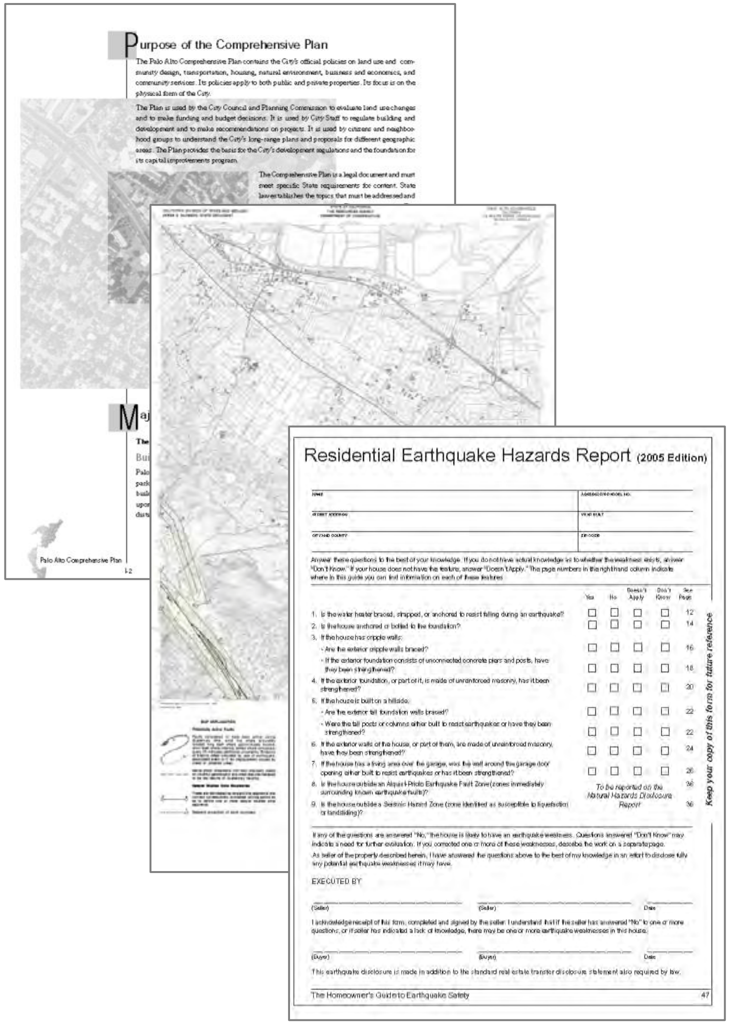
R+C

Building-Specific Requirements

- CODES
  - Code minimums for new construction
  - Standards for rehabilitation, including historic structures
- USES
  - Hospitals, public schools, and essential facilities
- TYPES
  - Mandated unreinforced masonry programming

Planning Requirements

- General Plan Seismic "Safety" Element
- Alquist-Priolo Earthquake Fault Zones
- Real estate disclosure and education requirements



Financing and Taxation

- Fundraising authority highlights
  - General obligation bonds
  - Mello-Roos Districting (?)
  - PACE loans
- Provisions for handling of property taxes for the costs of needed seismic retrofit

State Unreinforced Masonry Law (SB547, 1986)

- URMs can kill
- All hazardous jurisdictions must have program
- By 2006:
  - 98% of cities had complied
  - 70% retrofitted or demolished

Photo: EERI, 1989.

Agency and Program Highlights

- Building Standards Commission
  – Administers triennial code updates
- Seismic Safety Commission (CSSC)
  – Statewide planning and coordination
- California Earthquake Authority (CEA)
  – Small residential insurance and grants
- Concrete Coalition
  – Volunteer-created inventory effort

Federal Mandates & Opportunities

- Disaster Management Act of 2000
  - Requires Local Hazard Mitigation Plan
  - Palo Alto is <u>revising for 2017 renewal</u>

- FEMA Hazard Mitigation Grant Program
  - Open window for <u>Notices of Interest letters ends 1/29/16</u>

State Laws Give Cities Broad Authority

- Codes: cities can set adoption pace, stringency, trigger terms, etc.
- URMs: cities can choose from notification to voluntary to mandatory
- Retrofit requirements can be less stringent than contemporary code when justified by cost-benefit ratio

A Spectrum of Broad Policy Options

1. Maintain the status quo
2. Expand current voluntary program to address additional building types or uses
3. Make current voluntary URM program mandatory
4. Create new mandatory program that address one or more additional building types or uses
5. Combination of alternatives 2, 3, and 4
6. Other alternatives

R+C

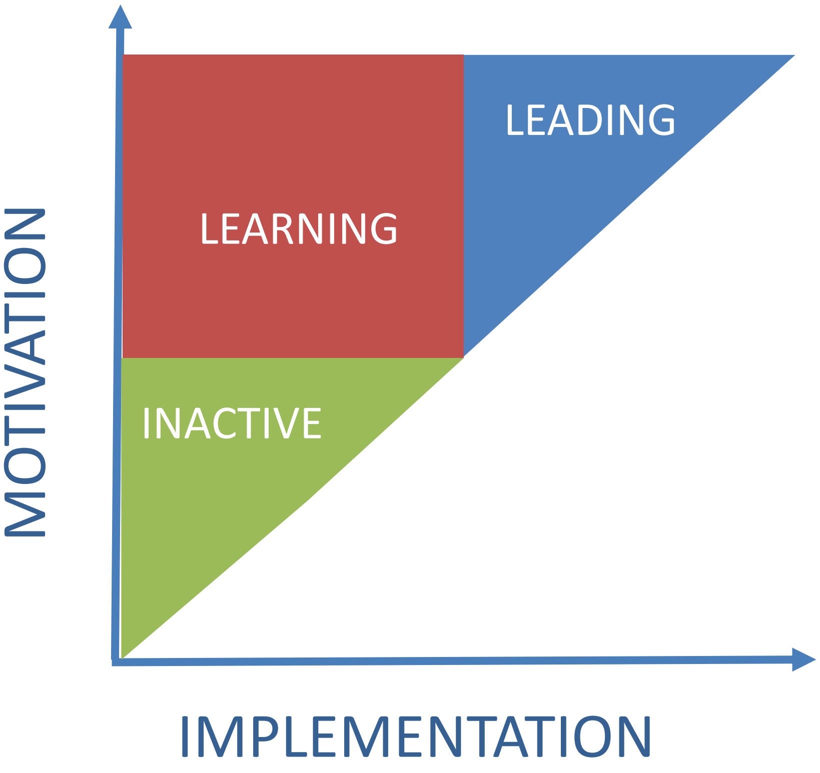
Overview: Local Program Review

- Framework for analyzing what cities are doing:
  - Inactive, Learning, and Leading Cities
- Leading cities are differentiated by:
  - Focused vs. comprehensive in nature and effectiveness
  - Policy development trajectory
  - Program design distinctions

What are Other Cities Doing?

California:

- 482 cities total
- 283 (59%) in high EQ hazard areas



Concept adapted from May and Birkland, 1994.

What Distinguishes Earthquake Program “Leadership”?

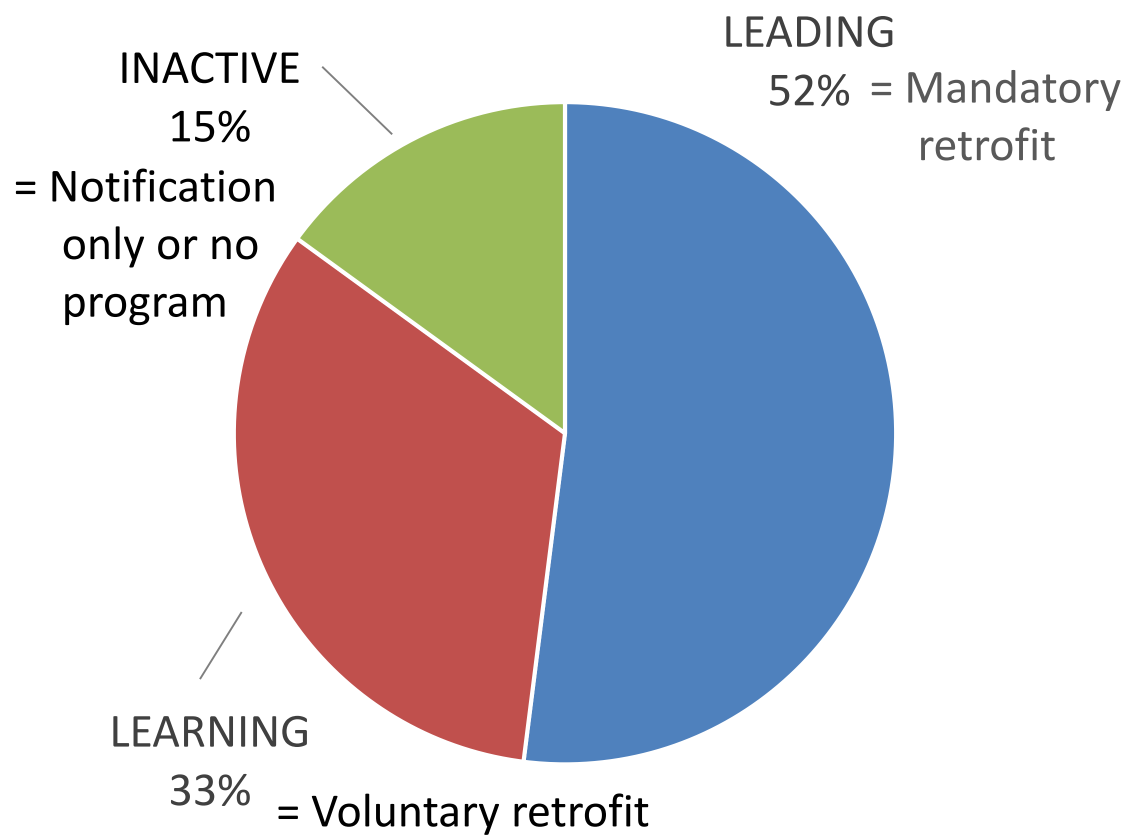
- Some form of mandated action
- Higher motivation, commitment and capacity
- Higher implementation effectiveness

URM Progress Statewide (2006)

Effectiveness:

3x more buildings retrofitted or demolished in Leading cities

California Cities by Strength of URM Program Type and Effectiveness



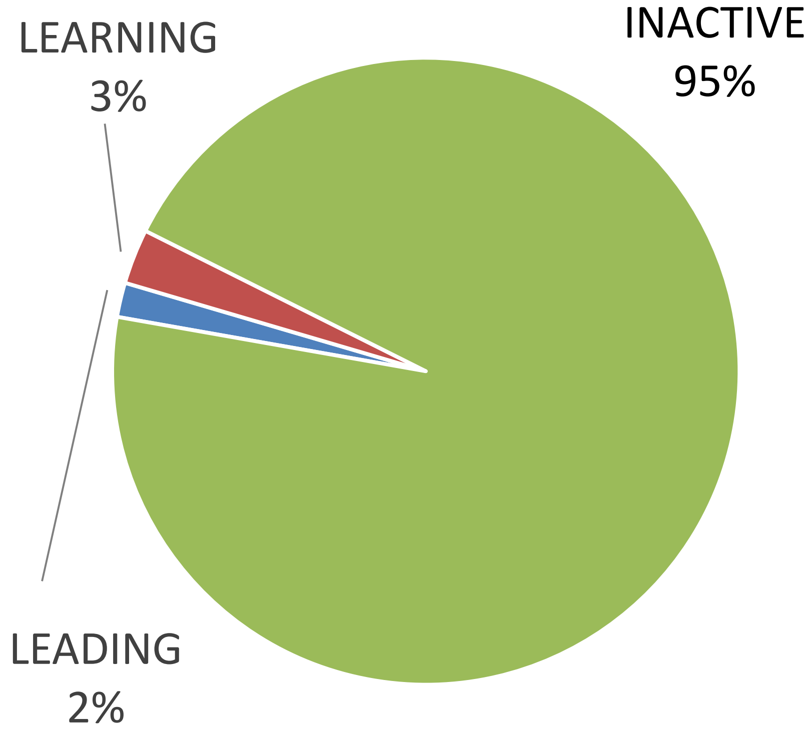
Data Source: CSSC, 2006 (Table 3).

Soft-Story Progress Statewide

Effectiveness:

In Leading cities, 10-30% have been retrofitted

California Cities by Strength of Soft-Story Efforts



Source: S. Rabinovici, unpublished data.

Bay Area Learners and Leaders in Soft-Story Programs

LEARNING | LEADING

Increasing Requirements

Inventory Only	***Notify Only***	**Voluntary Retrofit**	***Mandatory Screening***	***Mandatory Evaluation***	***Mandatory Retrofit***
Santa Clara County San Jose	San Leandro Richmond Sebastopol		Oakland San Francisco	Berkeley Alameda	Fremont

In Development: Hayward

Compiled by S. Rabinovici, 2015.

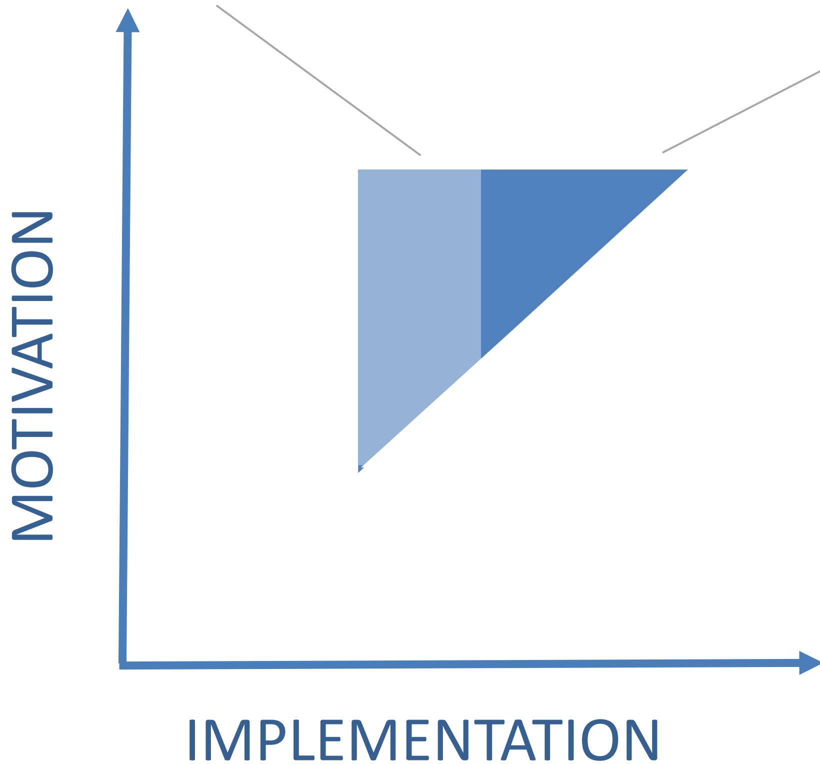
What Makes "Comprehensive Leadership" Different?

FOCUSED LEADERS

- Mandates for one building type (URM) and/or high implementation success

COMPREHENSIVE LEADERS

- Inventories of other building types
- Ordinances for other building types
- Stricter requirements
- Quicker timetables
- More resources devoted
- More enforcement
- % retrofits completed
- Larger and wider variety of incentives
- In-depth plans for further risk reduction efforts



Other Ways to Be Comprehensive: Link to Other Disaster Cycle Programs

Preparedness

- Neighborhood Emergency Response Team Training (NERT)
- Public Education

Incident

Response

- Emergency Response Plans
- Shelter-in-Place Protocols

Short Term Recovery

- Post-Event Reconstruction Standards
- Building Occupancy Resumption Program (BORP)

Long Term Recovery & Planning

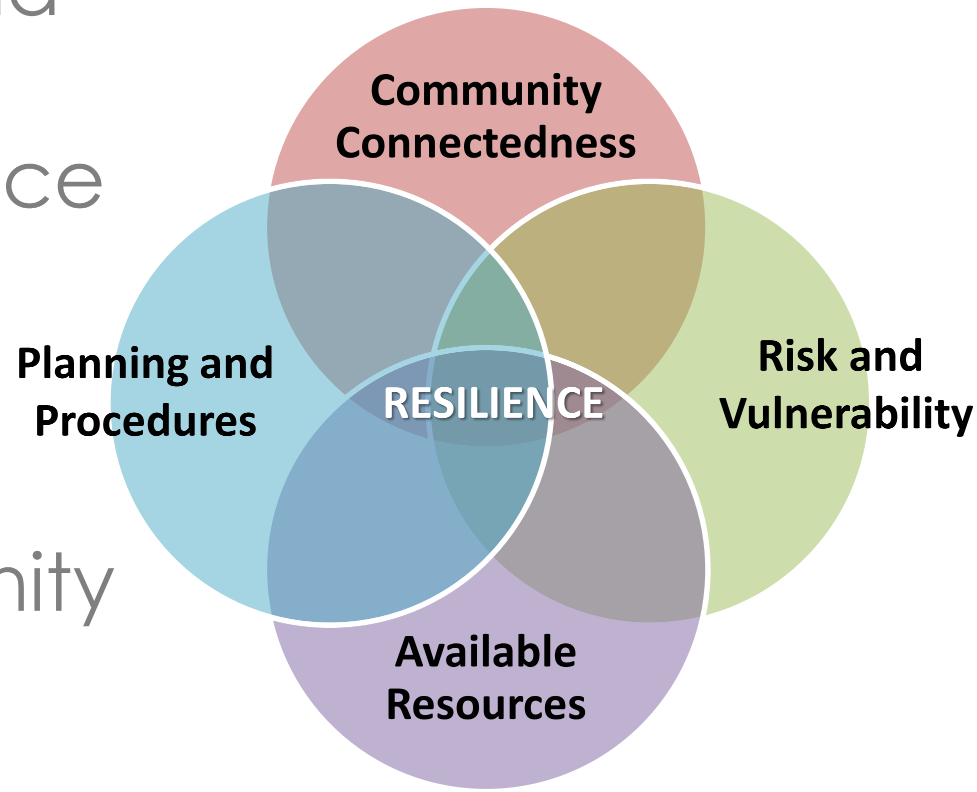
- Building Code and Standards Adoption
- Local Hazard Mitigation Plans
- Real Estate Disclosure

Mitigation

- Retrofit Ordinances
- Transfer Tax Rebates, Loans, or Grants
- Triggers

Other Ways to Be Comprehensive: Link to Overall Community Resilience

- Sustained effort and integration across threats and resilience goals
- High capacity, commitment, capacity, community involvement, and partnerships



Source: Torrens Resilience Institute, 2012.

Example Resilience Leaders

- San Francisco, CA
- Los Angeles, CA
- Oakland, CA

- ❑ Volunteer-based and <u>paid</u> partnerships: ABAG, SPUR, USGS, ATC, EERI, SEAONC…
- ❑ Strong and committed local leadership
- ❑ All Rockefeller 100 Resilient Cities

Profiles of Local Seismic Mitigation Efforts

COMPREHENSIVE-LEADING

- Berkeley, CA – Mandatory Soft-Story Retrofit plus robust Disaster Cycle and Resilience Programs

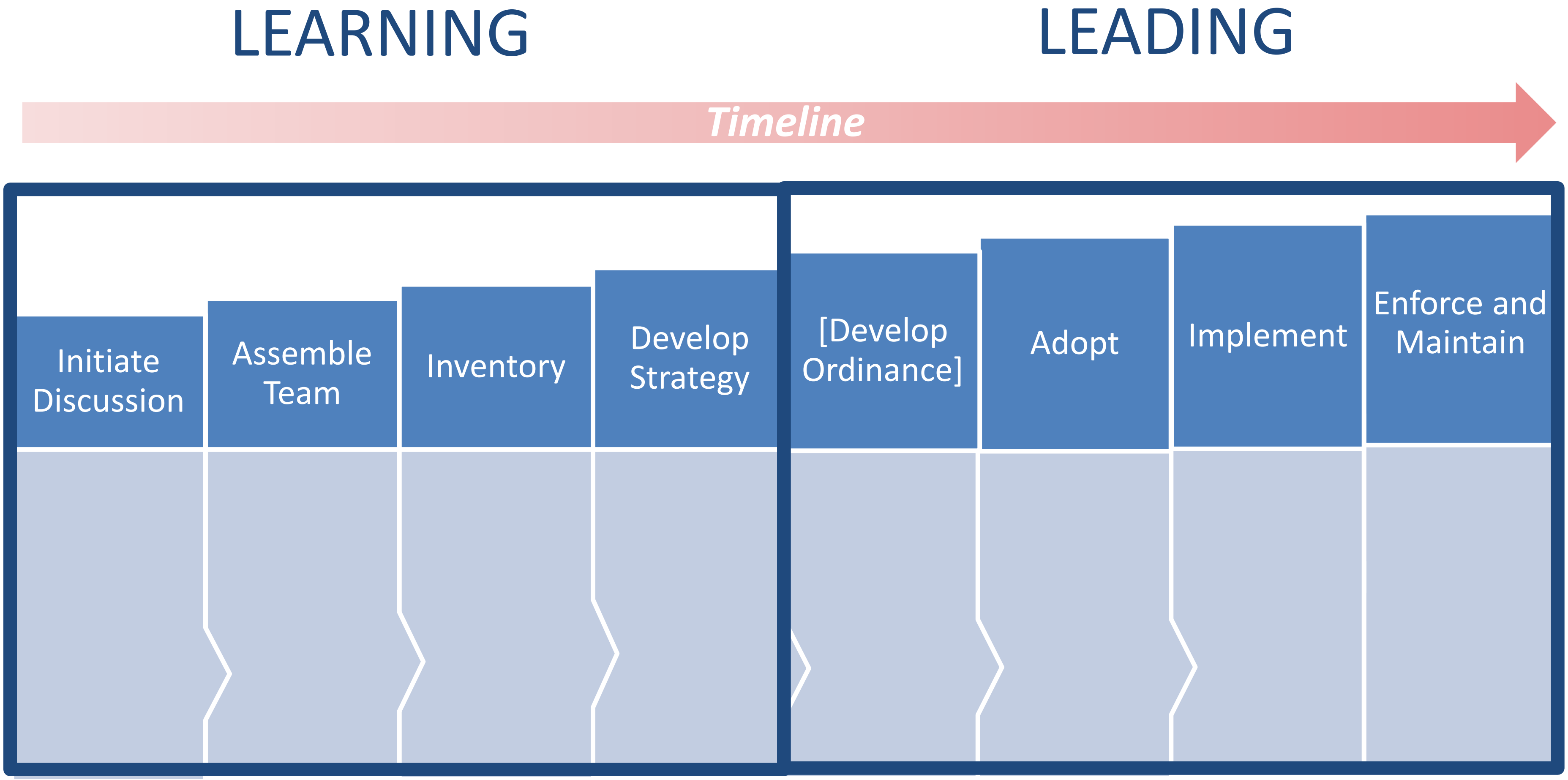
FOCUSED-LEADING

- Fremont, CA – Mandatory Soft-Story Retrofit
- Alameda, CA – Mandatory Soft-Story Evaluation

LEARNING

- Hayward, CA – Developing Soft-Story Approach
- Albany, CA – Soft-Story Inventory

Policy Development Process



Variations in Mitigation Approaches Among Leading Cities

- Inclusion, exclusion, and prioritization criteria
  - Inventory method
  - Age, occupancy, height, # of units
- Compliance timelines by tiers
- Types of incentives and assistance offered
- Cost-sharing arrangements
- Community and technical input approaches

City of Berkeley, CA -- 2005

Number of Soft-Story Buildings	Building Inventory	Notification of Tenants	Mandated Screening or Engineering Report	Mandated Retrofit	
321	X	X	X	X	
Accepted Retrofit Standards	Tiers		Timeframe		
			Evaluation	Permit	Completed
ASCE 41-06 ASCE 41-06 FEMA P-807 Chapter A4 of 2012 IEBC	Phase 1 Evaluation findings determine inclusion in Phase 2 mandated retrofit program		2 years (under previous soft story ordinance)	2 years	4 years
Soft Story Criteria	Incentives		Other Considerations		
Wood-frame residential buildings with five or more residential units permitted for construction prior to 1978	Tenant pass through of 100% over 15 years Can apply for a hardship extension of 1-year		Must install automatic gas shut-off valves Acceleration of deadlines apply under certain circumstances		

Source: Dana Brechwald, ABAG, unpublished report, 2015.

City of Alameda, CA -- 2009

Number of Soft-Story Buildings	Building Inventory	Notification of Tenants	Mandated Screening or Engineering Report	Mandated Retrofit
70	**X**	**X**	**X**	

Accepted Retrofit Standards	Priority Tiers	Timeframe		
		Evaluation	*Permit*	*Completed*
IEBC Chapter A4 of 2006	N/A	1.5 years	N/A	N/A

Soft Story Criteria	Incentives	Other Considerations
Wood-frame multi-unit residential buildings with five or more dwelling units permitted for construction prior to December 17, 1985 and where the ground floor portion contains parking or other similar open floor space and have one or more levels above the ground floor	Engineering report filing fees reductions based on time until report is submitted: 100% reduction if within 3 months 75% reduction if within 6 months 50% reduction within 9 months 25% reduction within 12 months	Must install an earthquake-activated gas shutoff valve within 60 days of notification of inclusion in the inventory Reduction in parking requirements for existing facilities Retrofitting removes buildings from the inventory for a period of 15 years after retrofit

Source: Dana Brechwald, ABAG, unpublished report, 2015.

City of Fremont, CA -- 2002

Number of buildings	Building Inventory	Notification of tenants	Mandated Screening or Engineering Report	Mandated Retrofit
22	X		X	X

Accepted Retrofit Standards	Tiers	Timeframe		
		Evaluation	Permit	Completed
City of Fremont Building Code sections 7-10302 and 7-10304	Group 1: 10 units or more than two stories	N/A	2 years	4 years
	Group II: 10 or less units and fewer than three stories high		2.5 years	5 years

Soft Story Criteria	Incentives	Other Considerations
Wood frame, multi-unit (3 or more) residential buildings constructed before January 1, 1978	Waived plan check and building permit fees for the seismic retrofit work if done within the appropriate timeframe	Condo conversions must comply

Making Things Public: Forums, Lists, Signs, Tenants, and Notices

City of Alameda Soft Story List (3/2015)

1500	ALAMEDA	AVE	HOMEOWNERS ASSOCIATION
2128	ALAMEDA	AVE	AHMETSPAHIC MEHMED & DZEVAHIRA
1455	BAY	ST	KREISS NORMAN S
3215	BRIGGS	AVE	COMMON AREA OF TRACT 3365
3221	BRIGGS	AVE	LUCCHESE BRUNO J TR
3224	BRIGGS	AVE	MARTINEZ PETER E & ANGELITA C TRS
3225	BRIGGS	AVE	LUCCHESE BRUNO J TR
3228	BRIGGS	AVE	LAKEPARK LODGE PARTNERSHIP & MARIE HINTON FAM ETAL
3250	BRIGGS	AVE	MUSSER LORRAINE D TR & ASHBAKER ROBERT A & DIANE
301	BROADWAY		NOBLE COMMUNITY MANAGEMENT
470	BUENA VISTA	AVE	DER YIM N & QUAN K
520	BUENA VISTA	AVE	JAZMIN JOSE P & BETTY TRS
547	BUENA VISTA	AVE	MAHMOUDIAN M & MURRAY T C TRS EXEMPTION
434	CENTRAL	AVE	MENDOZA GENARO
475	CENTRAL	AVE	KAHN MELVIN TR
600	CENTRAL	AVE	PEREZ HEIDI & DONALD PEREZ TRS & PEREZ HEIDI
724	CENTRAL	AVE	SHAFFER E G TR TRUST I & E G TR NON EXEMPT TR
831	CENTRAL	AVE	HO ALBERT M & SERENA S
1704	CENTRAL	AVE	GOLDSTEIN RUTH B TR
1715	CENTRAL	AVE	ASRANI FAMILY LP
1732	CENTRAL	AVE	MAR WAYNE & HUANG NUAN Q TRS
1812	CENTRAL	AVE	SYCAMORE OF ALAMEDA HOA
1836	CENTRAL	AVE	HASSEN ABDEL K & FATIMA TRS
2026	CENTRAL	AVE	JAN RICHARD & NANCY
2037	CENTRAL	AVE	FOSTER EDWARD J TR
2043	CENTRAL	AVE	VETTERLI ELIZABETH TR & LUNDBORG WILDA M TR
2050	CENTRAL	AVE	CHOW LALIE K
2053	CENTRAL	AVE	JABER SAM & BILLIE J TRS
2101	CENTRAL	AVE	MAGNOLIA HOMEOWNERS ASSOCIATION
2115	CENTRAL	AVE	HOMEOWNERS ASSOC
2119	CENTRAL	AVE	GALETTO MARIO & ALBINA M
2253	CENTRAL	AVE	SASAKI ROBERT J TR
1515	CHESTNUT	ST	NGUYEN XUAN Q & DANG NGOC B
1531	CHESTNUT	ST	LEE MALCOLM P & SHU M

NOTICE

YOU ARE REQUIRED BY LAW

TO COMPLETE A SOFT STORY SCREENING FORM BY SEPTEMBER 15, 2014

Nearly 3000 buildings like yours have already returned their screening forms. Many owners have begun their required upgrades, while many are not required to retrofit at all. Act now to avoid penalties!

R+C

Other Kinds of Comprehensive: More Types, Uses, and Features

- San Francisco, CA
  - CAPSS led into 30 year ESIP implementation plan
  - Adopted: soft-story >4 units, mandatory evaluations for private schools
  - In progress: façade ordinance
  - Collaborations: SPUR, ATC, SEONC, 100RC…
  - Preparedness: shelter-in-place, 72hours.org
  - Planned: programs for smaller residential

Other Kinds of Comprehensive: Critical Infrastructure and Systems

- Los Angeles, CA
  - 2013 Mayoral leadership and Technical Advisory Group
  - Resilient by Design report and plan:
    - Buildings
    - Telecomm
    - Water
  - Adopted: soft-story >4 units, voluntary building rating system program
  - Collaborations: USGS, SEAOC, CalOES, 100RC…

Comprehensive Programs Can Still Falter

- Santa Monica, CA
  - 1994 mandatory retrofit ordinance for steel office towers, older concrete buildings and wood multi-story apartment houses

  - City leadership revived inventory efforts that stagnated for 20 years by funding a 2014 study
    (No notifications, timeline or enforcement)
  - In progress: figuring out how to proceed based on their findings
  - Collaborations: SEAOC, ConcreteCoalition…

What Kind of Approach is Right for Palo Alto?

- Unique policy background
- Inventory update
- Loss estimation and risk assessment
- Advisory Group engagement
- Evaluate alternatives
- Recommend directions

Update on Building Vulnerabilities

- Building inventory update
- Sidewalk survey update
- Loss estimate update

Building Inventory

- Significant effort reviewing, processing, combining digital tax assessor files, GIS files, and SJSU/Palo Alto Fire Department survey of soft-story wood frame buildings

- Converted tax parcels to buildings

- Summarized certain aspects of inventory

- Begun planning for sidewalk survey using inventory results

Parcels in Scope

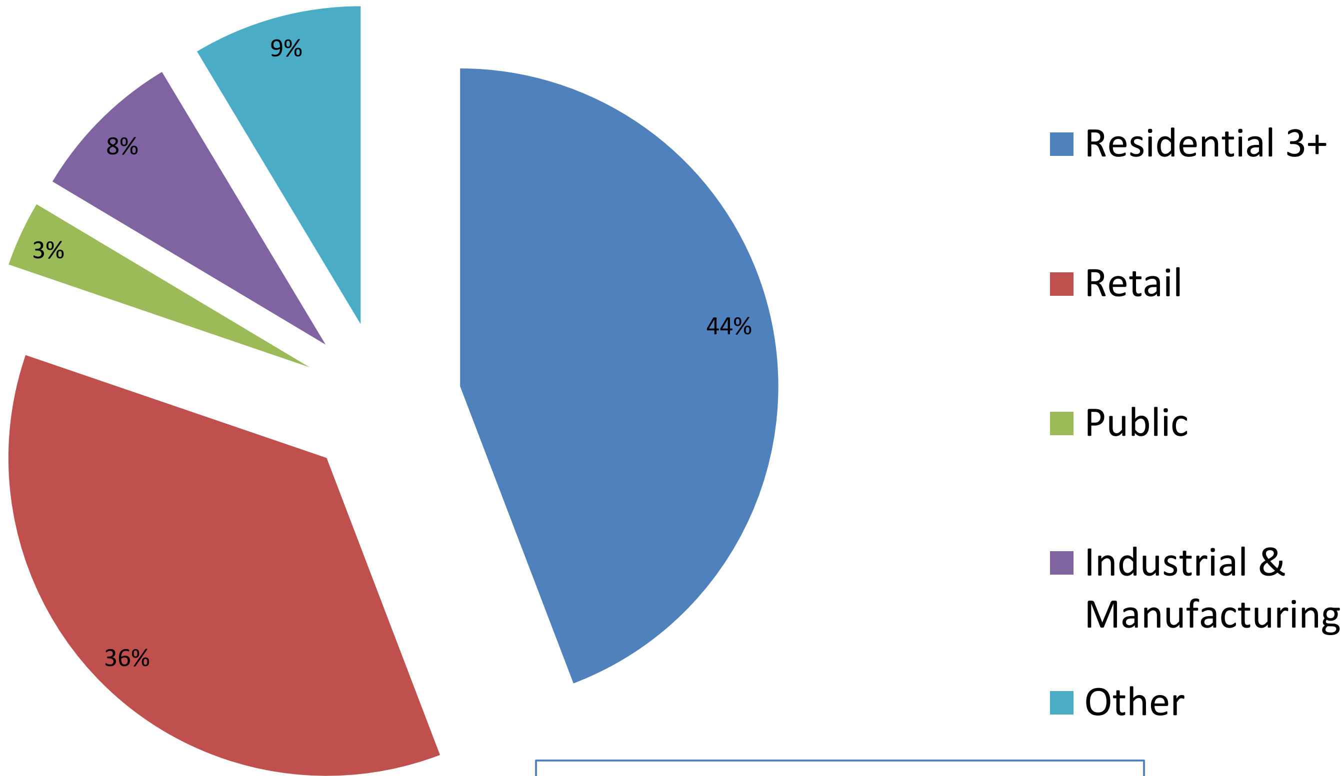
- Total Palo Alto parcels: 21,187
  - 1 and 2 family: <u>15,198</u>
  - Remaining parcels: 5,989

- 3 or more unit residential parcels: 3,630
  - Actual distinct buildings: 1,324

- Other occupancy types: 2,369
  - Removed 961 designated as Possessory Interest
  - Remaining buildings: 1,408

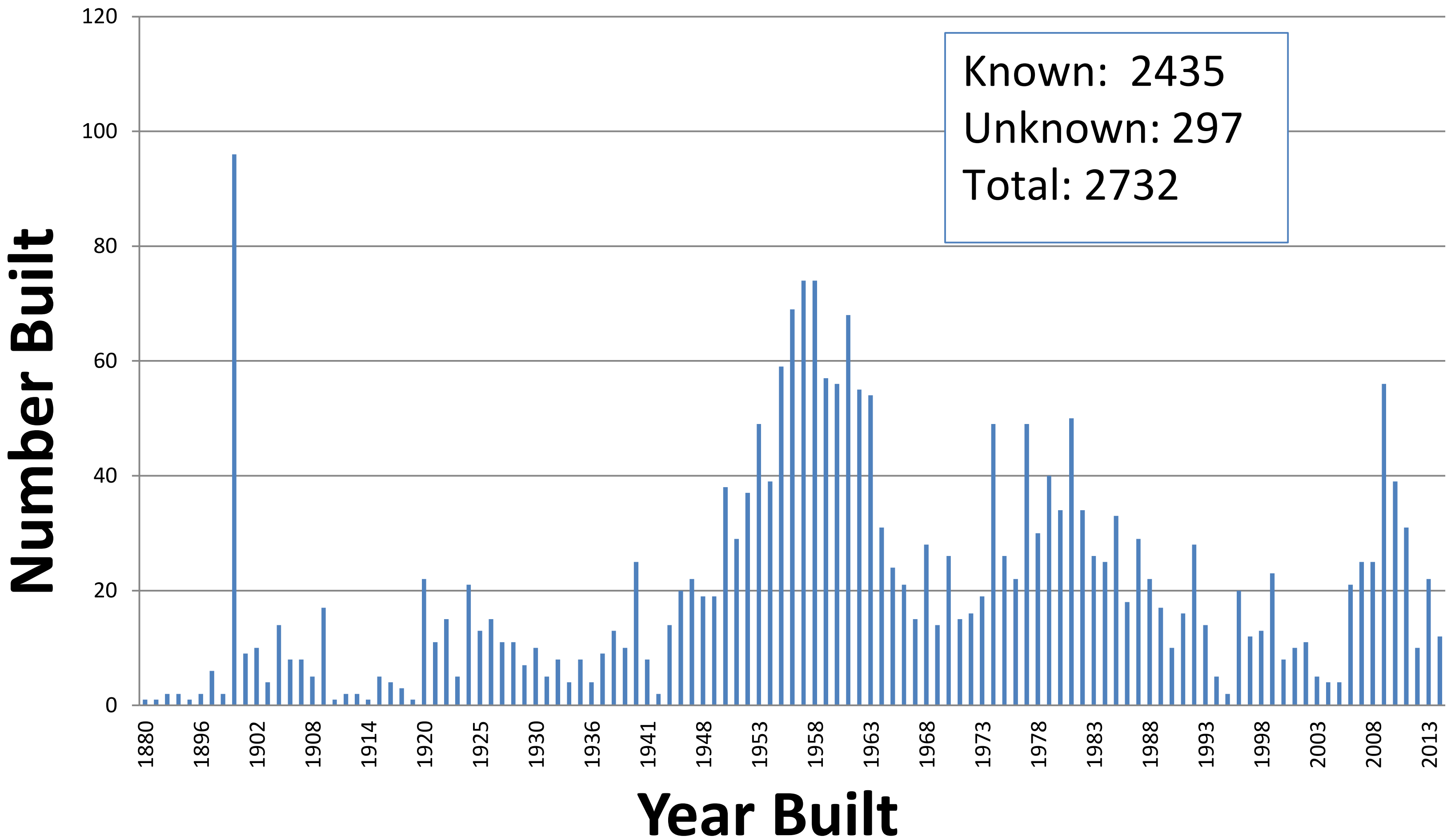
- Total in Study Group: 1,324 + 1,408 = **2,732**

Study Group Occupancy Types

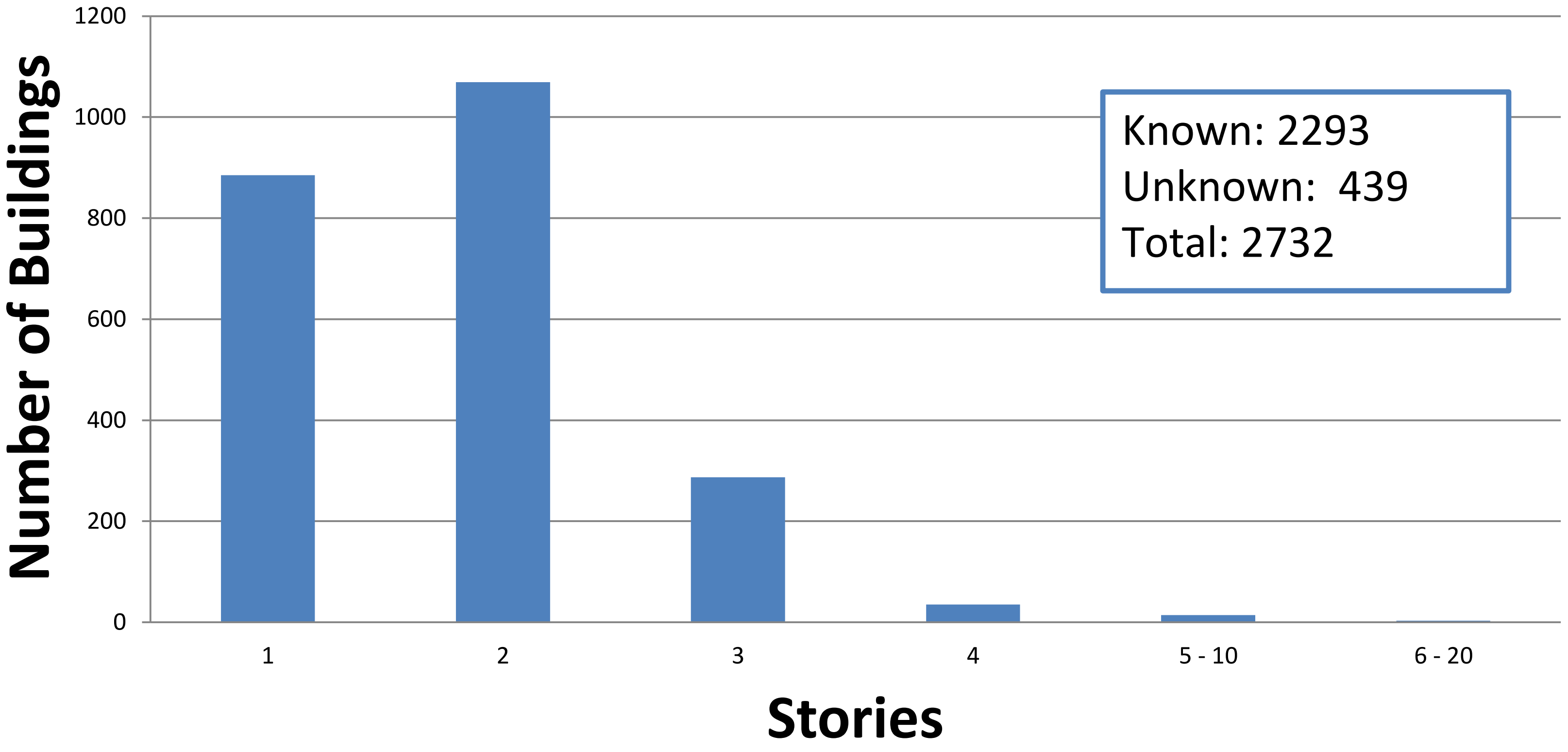


Soft Story Wood Frame Multi-Family Residential: 94 buildings

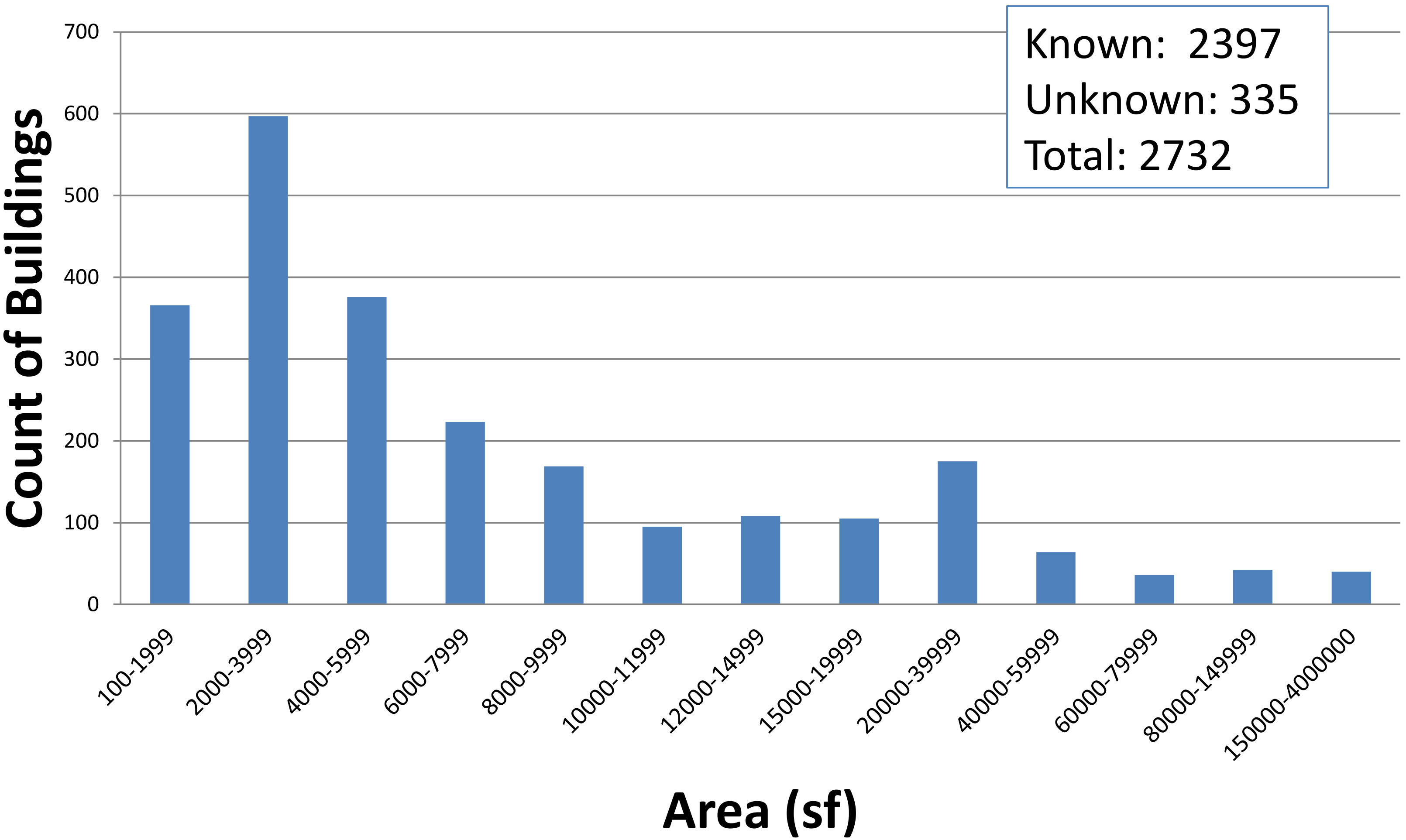
Study Group Year Built



Study Group Number of Stories



Study Group Area of Building



Study Group Building Materials

Quality Class	
A: Structural Steel Framing	31
B: Reinforce Concrete Columns and Beams	11
C: Masonry-type Exterior Walls	651
D: Wood Framing	1451
S: Specialized/not in above categories	105
Unknown	483

Building Material vs. Model Building Type

- A. Structural Steel Framing
  - S1: Steel moment-resisting frame
  - S2: Steel braced frame
  - S3: Light metal building
  - S4: Steel frames with cast-in-place concrete shear walls
  - S5: Steel frames with unreinforced masonry infill walls

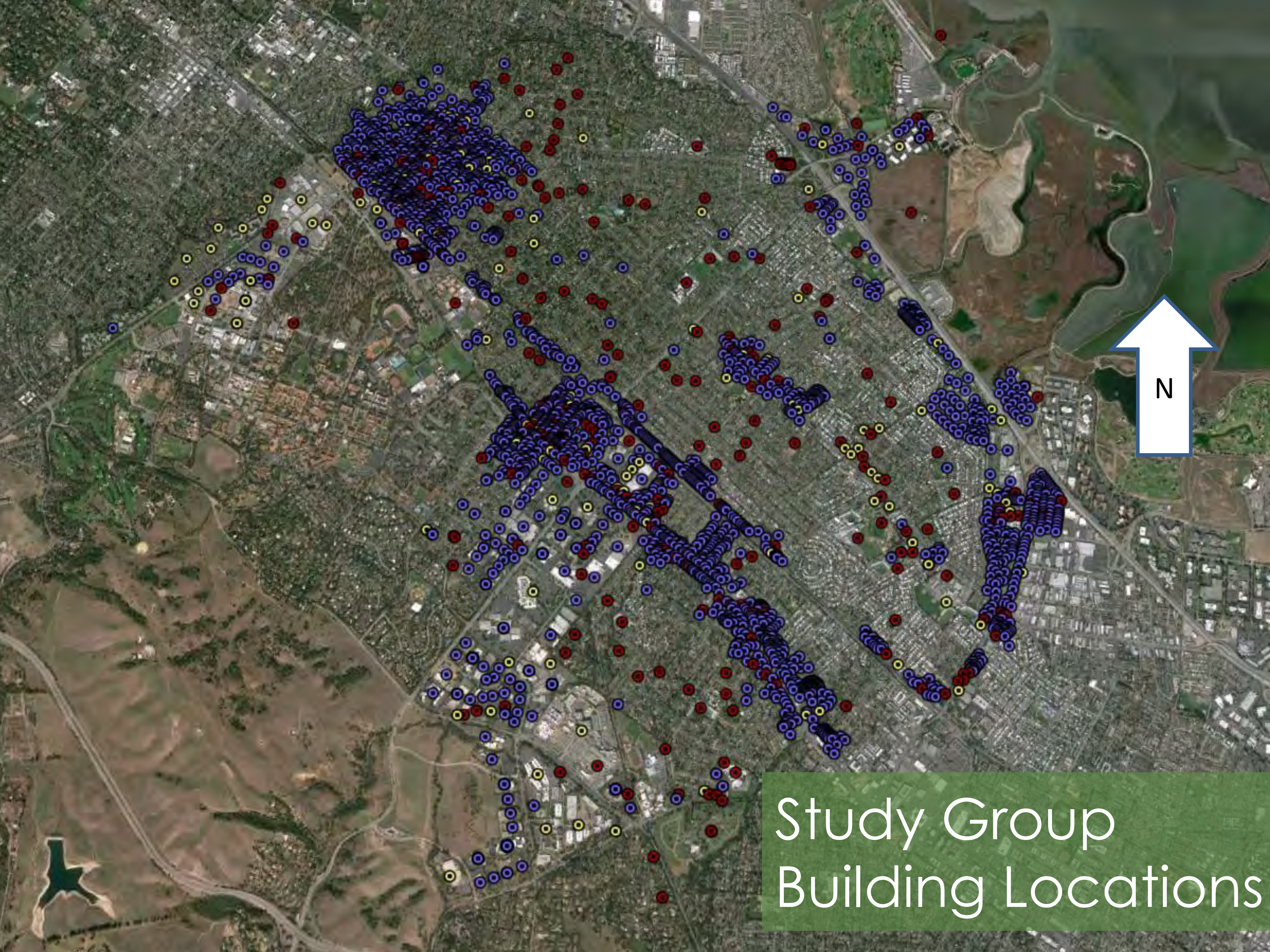
Key Parameters for Input to Loss Estimates

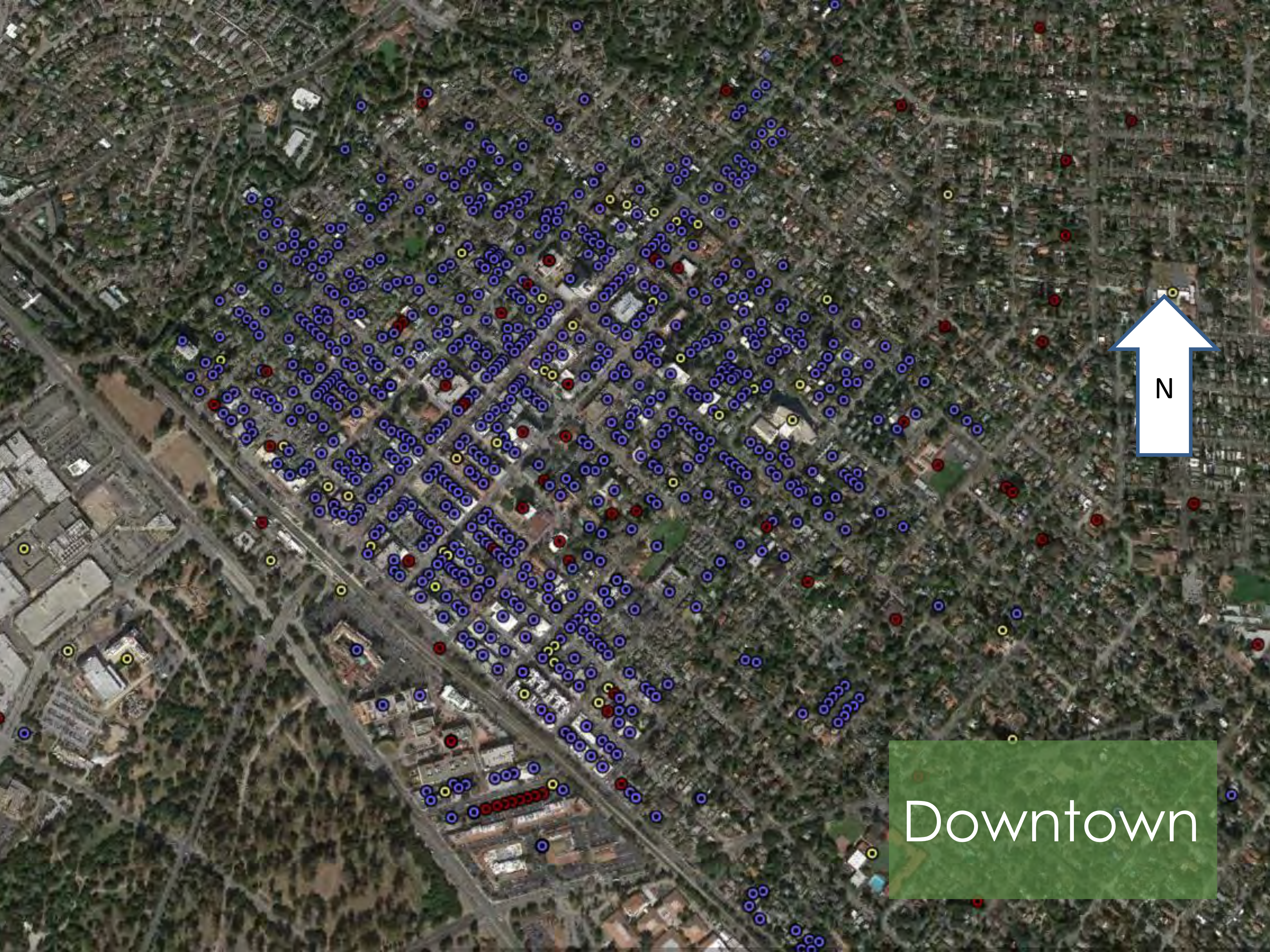
Key Parameters	Known	Unknown	Total
LAT/LONG	2732	0	2732
Year Built	2435	297	2732
Stories	2293	439	2732
Building Area	2397	335	2732
Occupancy	2207	525	2732
Model Building Type	0	2732	2732
Quality Class	2249	483	2732
Building Value	0	2732	2732

Legend for Plots	
Color	**Indicates**
Red	0-2 Parameters Known
Yellow	3-4 Parameters Known
Blue	5- 6 Parameters Known

R+C

Study Group Building Locations

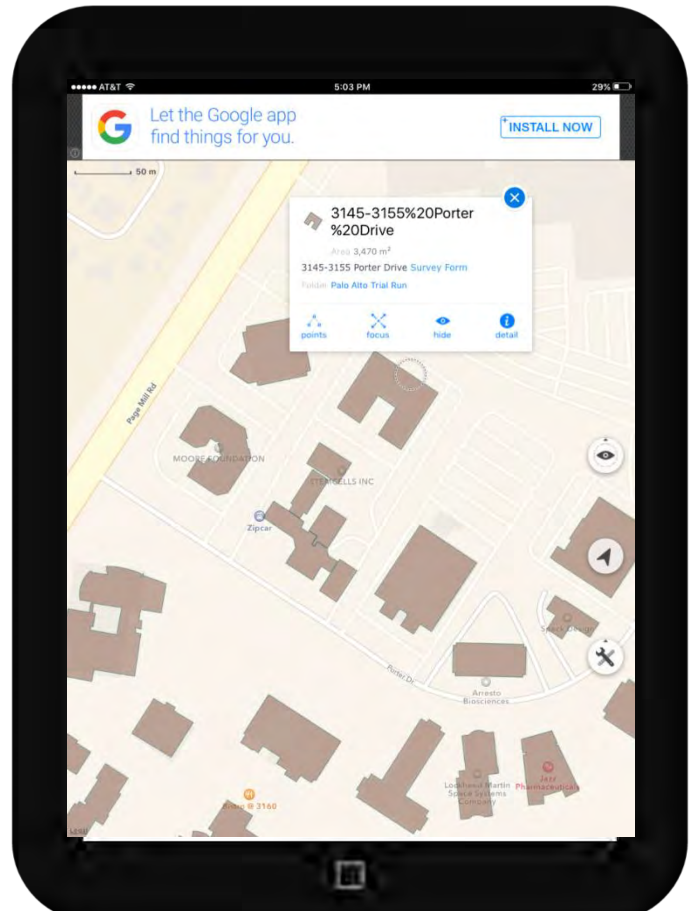



N
Downtown

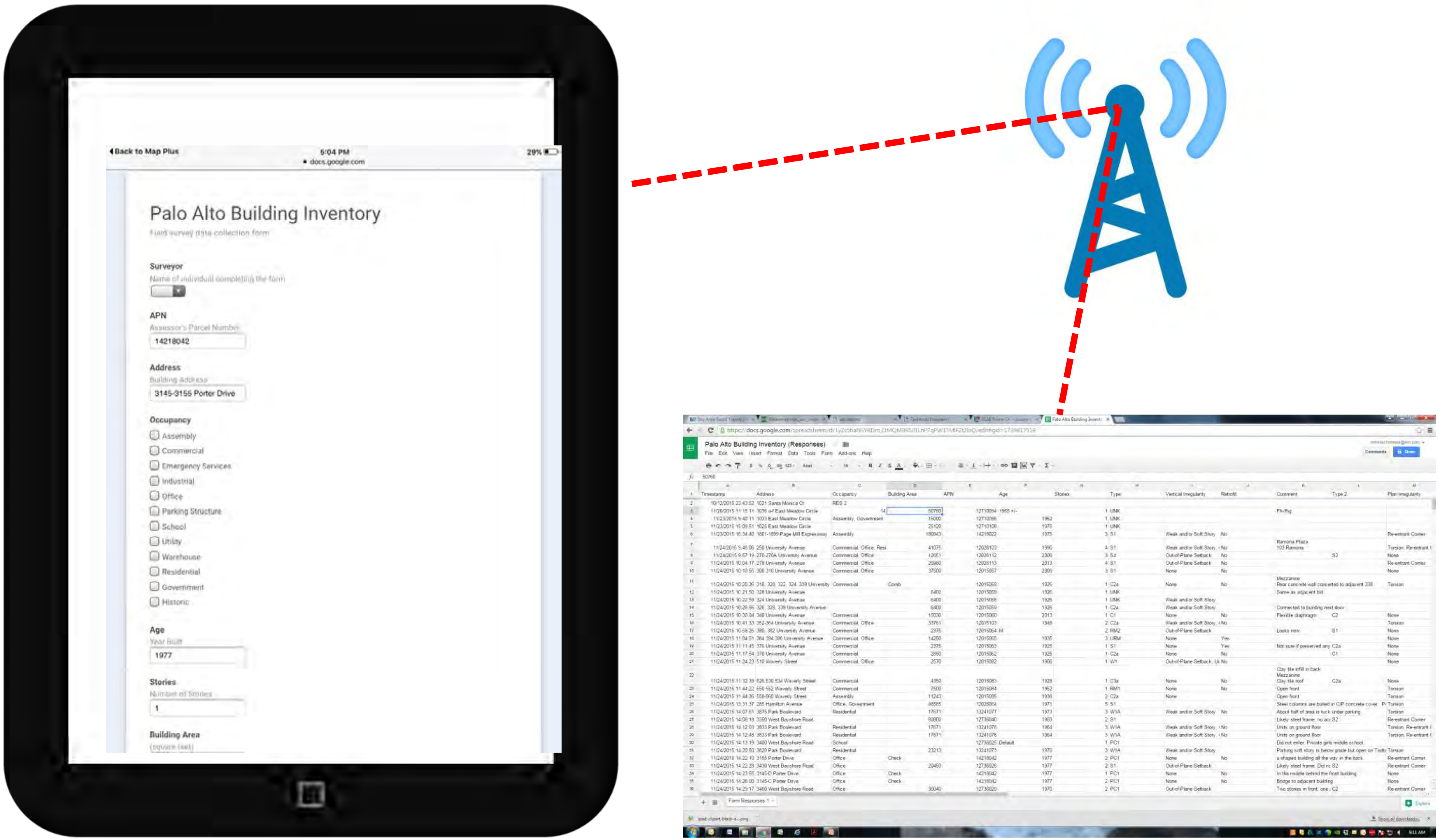

N
California Avenue/
Page Mill Road Area

Soft-Story Wood Frame Multi-Family Residential Buildings

Sidewalk Survey



R+C



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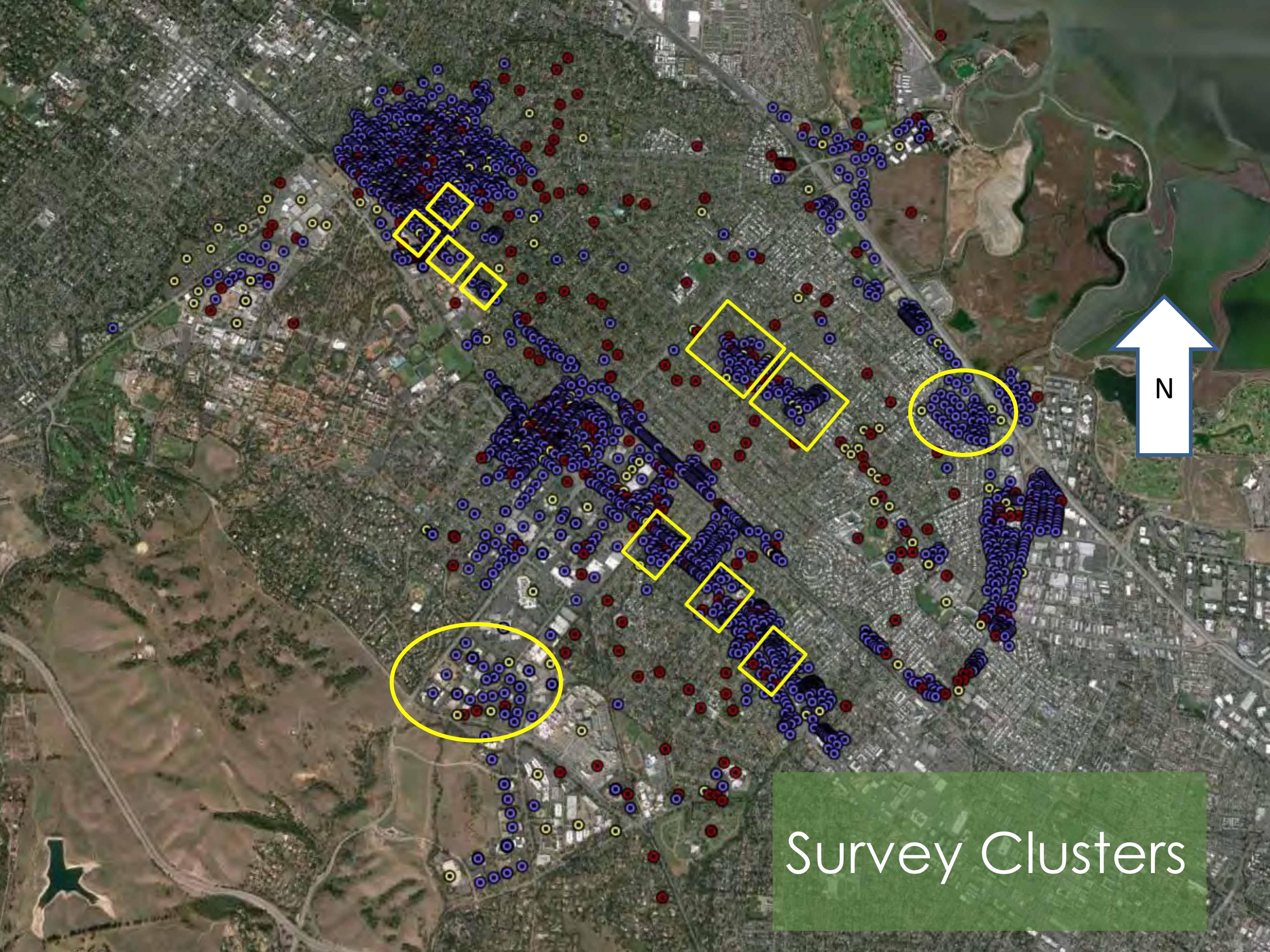
docs.google.com
29%
Palo Alto Building Inventory
Field survey data collection form
Surveyor
Name of individual completing the form
APN
Assessor's Parcel Number
14218042
Address
Building Address
3145-3155 Porter Drive
Occupancy
Assembly
Commercial
Emergency Services
Industrial
Office
Parking Structure
School
Utility
Warehouse
Residential
Government
Historic
Age
Year Built
1977
Stories
Number of Stories
1
Building Area
(square feet)
Palo Alto Building Inventory (Responses)

Sidewalk Survey

- February 4 with building/fire department
- February 11with Stanford structural engineering graduate students/professors
- Post-processing and checking of uploaded surveys
- Follow-up survey quality assurance checks

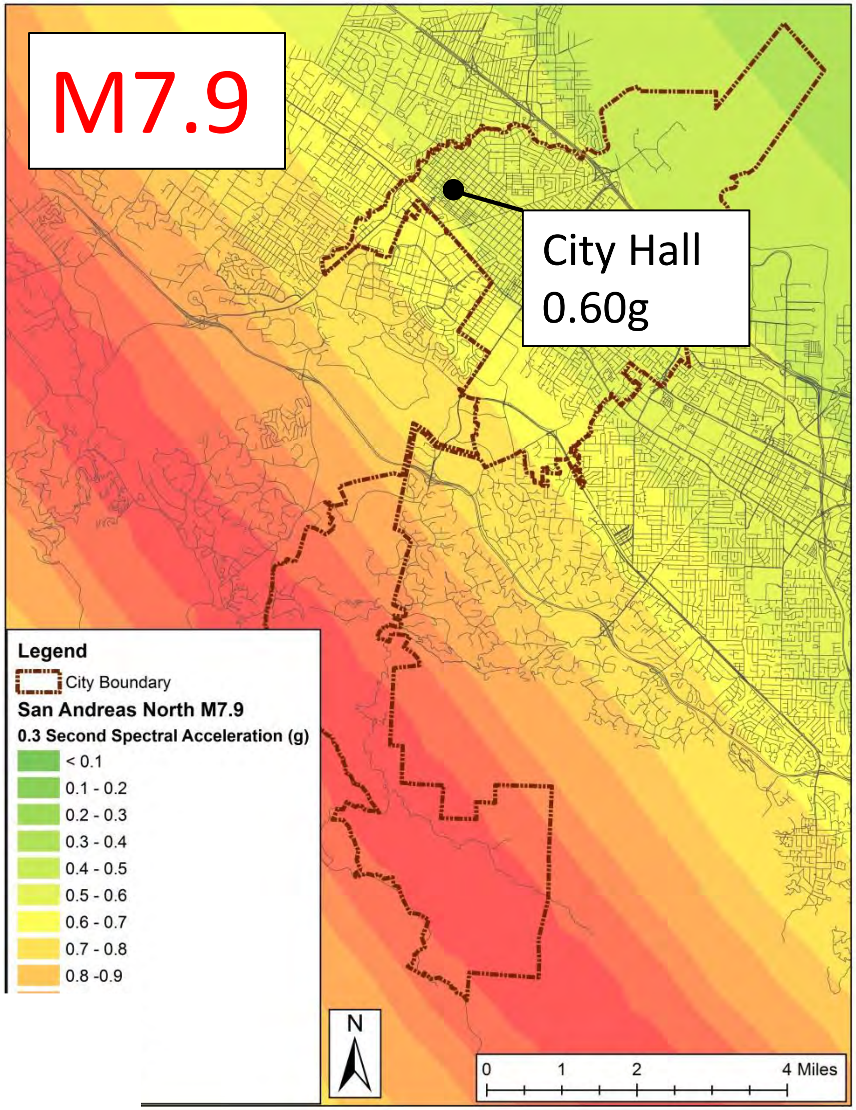

N
Survey Clusters

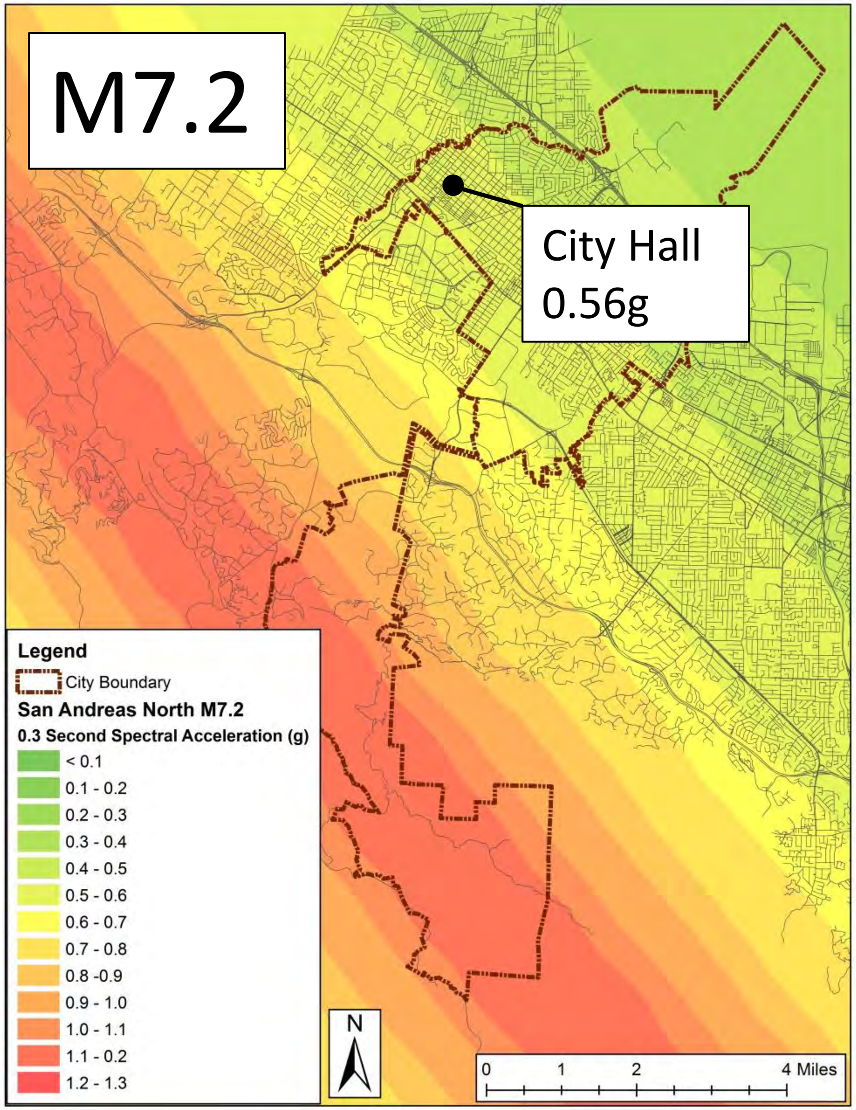
Loss Estimates

- Two scenarios
- Initial run: <u>without</u> new retrofit
- Develop conceptual retrofits with cost estimates
- Second run: <u>with</u> new retrofit
- Dollar losses and percent damaged
  - By building type and location
  - With retrofit and without

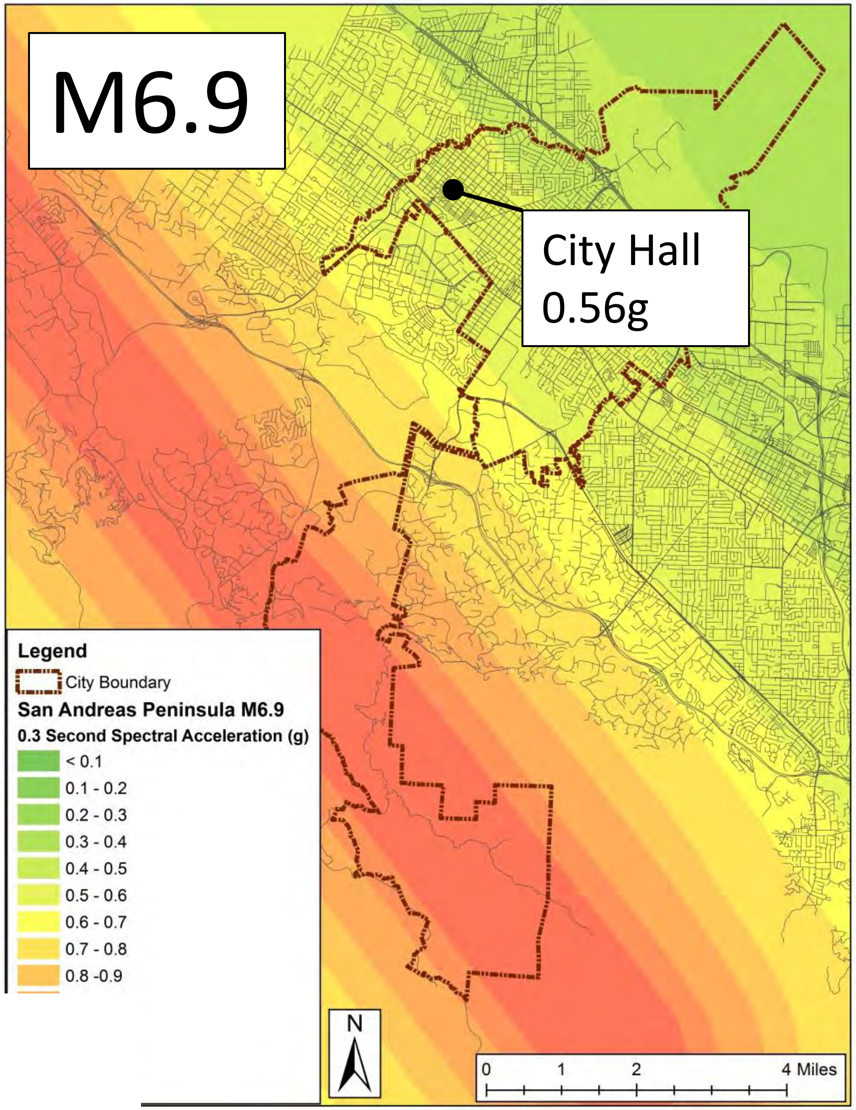
R+C

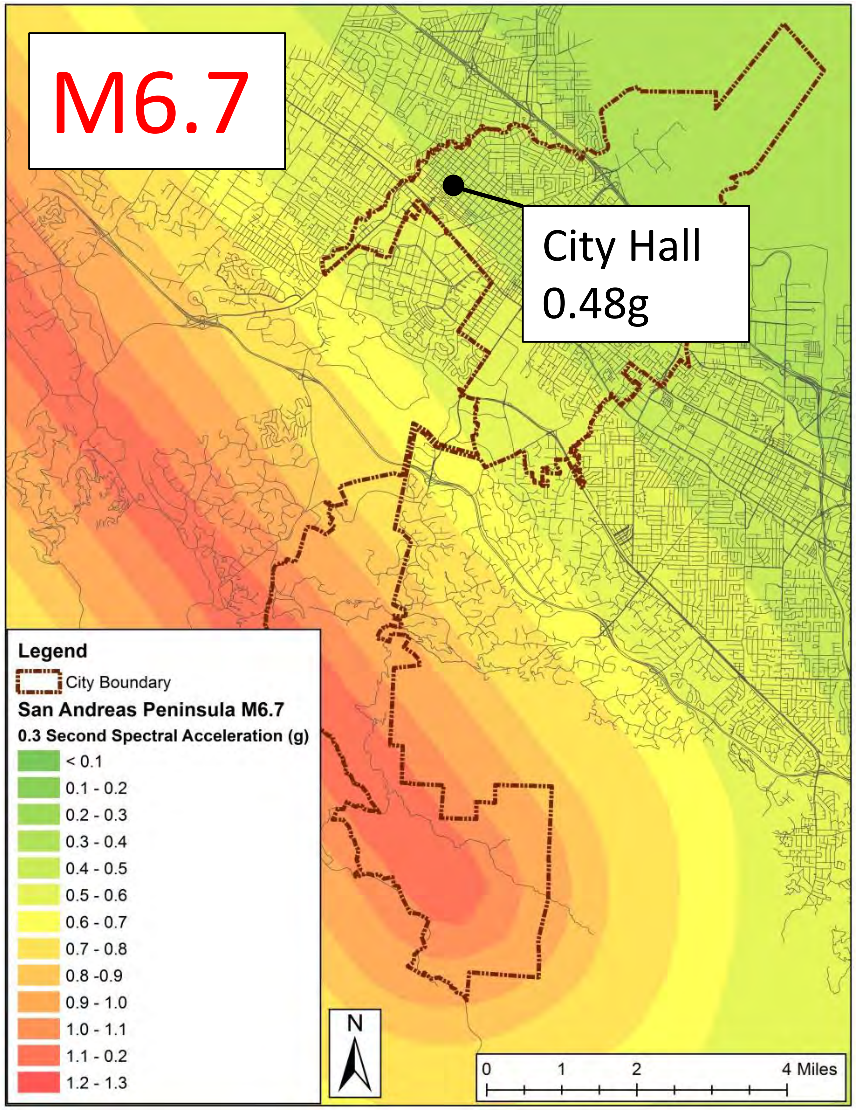
Earthquake Scenarios





Earthquake Scenarios





Loss Estimates Will Provide

- Building types expected to have the greatest **aggregate** damage
  - Largest risk of lost units
  - Largest cost of repair
  - Geographic concentrations of largest loss
- Achievable reduction in losses from retrofit of selected buildings
- Effectiveness of past retrofit work in current context

Issue: Replacement Cost

- Loss = Cost of Damage / Replacement Cost

- Example: $100,000 loss in a building that would cost $2,000,000 to replace

  Loss = $100,000 / $2,000,000 = 5%

Issue: Replacement Cost

- Hazus program has default replacement costs in $/square foot

- Example: 10,000 sf building with a replacement cost of $200/sf

Replacement cost = 10,000 sf x $200/sf

Replacement cost = $2,000,000

Issue: Replacement Cost ($/sf)

- Hazus default full replacement cost models are based on RS Means (2014)
- Location factors for Palo Alto: Residential = 15%, Commercial = 11%
- Is use of the default values acceptable?

Hazus Occupancy Class	Definition	Average Palo Alto Cost per Square Foot
RES3A	Multi Family Dwelling – duplex	$130.75
RES3B	Multi Family Dwelling – triplex/quad	$114.94
RES3C	Multi Family Dwelling – 5-9 units	$206.41
RES3D	Multi Family Dwelling – 10-19 units	$194.12
RES3E	Multi Family Dwelling – 20-49 units	$212.26
RES3F	Multi Family Dwelling – 50+ units	$199.90
RES4	Temp. Lodging	$217.83
RES5	Institutional Dormitory	$234.44
RES6	Nursing Home	$238.07
COM1	Retail Trade	$121.66
COM2	Wholesale Trade	$118.13
COM3	Personal and Repair Services	$143.47
COM4	Professional/ Technical/Business Service	$194.52
COM5	Banks	$281.88
COM6	Hospital	$372.59
COM7	Medical Office/Clinic	$267.85
COM8	Entertainment & Recreation	$248.61
COM9	Theaters	$186.45
COM10	Parking	$84.59
IND1	Heavy	$144.71
IND2	Light	$118.13
IND3	Food/Drugs/Chemicals	$229.48
IND4	Metals/Minerals Processing	$229.48
IND5	High Technology	$229.48
IND6	Construction	$118.13
REL1	Church	$118.13
AGR1	Agriculture	$199.08
GOV1	General Services	$152.63
GOV2	Emergency Response	$259.52
EDU1	Schools/Libraries	$193.00
EDU2	Colleges/Universities	$214.91

Meeting Wrap-Up and Follow-Ups

- Outcomes from today
- What will be added to the website
- Next steps
  - Survey and processing
  - Loss estimate
- Date for next meeting in March
  - Options: x, y, z
- Scope of next meeting
  - Review inventory findings
  - Review loss estimate results

CITY OF
PALO
ALTO

City of Palo Alto Seismic Risk Management Program

Mitchell Park Library
3700 Middlefield Rd
Midtown Room

Thursday, March 17, 2016	☒ Discussion ☒ Action

Our proposed topics, objectives, distribution materials, agenda, and issues for the third Advisory Group session are described below.

MEETING DATE, TIME, AND LOCATION

- Date: Thursday, March 17, 2016
- Time: 2pm – 4pm
- PLEASE NOTE DIFFERENT LOCATION: Mitchell Park Library (Midtown Room)
  3700 Middlefield Rd
  Palo Alto, CA 94303

MEETING OBJECTIVES

- Review preliminary inventory and loss estimation results
  - Replacement Cost technical task group progress
- Review features and effectiveness of select local mitigation program models
- Establish process for moving from loss estimates to policy alternatives and recommendations

PRE-MEETING MATERIALS

- Minutes from AG2
- Agenda for AG3
- Task 2 Legislative Review document

Notes:

CITY OF
PALO
ALTO

City of Palo Alto Seismic Risk Management Program

Mitchell Park Library
3700 Middlefield Rd
Midtown Room

Thursday, March 17, 2016 AGENDA

AGENDA

Time	Subject	Lead
2:00 pm	Welcome	George Hoyt / Bret Lizundia
2:05 pm	Project Business • Review/approve minutes from 1/27/16 AG2 meeting • Quick recap of activities since last meeting	
2:15 pm	Discussion of preliminary inventory and loss estimation results • Sidewalk survey findings • Report and discussion of replacement cost technical advisory subgroup • Status of preliminary loss estimates • Implications	Bret Lizundia
3:00 pm	Discussion of program effectiveness and selected local mitigation program options • Goal setting and measures of effectiveness • Specific local program features and implementation considerations that can promote success for Palo Alto	Sharyl Rabinovici
3:30 pm	Establish the process for moving from loss estimates to policy recommendations • Topics, timing, and formats for next meeting and beyond	All/Bret Lizundia
4:00 pm	Adjourn	

Seismic Advisory Group
Meeting #3
March 17th, 2016
2-4pm
Mitchell Park Library

MEETING MINUTES – SEISMIC RISK MANAGEMENT ADVISORY GROUP

Attendance By:	Peter Pirnejad (PP), Development Services Director COPA George Hoyt (GH), Chief Building Official COPA James Henrikson (JH), Fire Marshal COPA Nathan Rainey (NR), OES Coordinator COPA Evon Ballash (EB) Assistant Building Official COPA Blake Salzman (Blake S), Contract Plans Examiner COPA Elena Lee, Senior Planner COPA Bret Lizundia (BL), Principal, Rutherford + Chekene (R+C) Sharyl Rabinovici (SR), sub consultant to R+C Al Dorsky, Community Anil Babbar, Tenants Annette Glanckopf, Community Dana Brechwald (DB), Policy Doug Hohbach, Engineers Jessica Epstein, Policy Ken Hayes, Architects Georgina Mascarenhas, Community Roxy Rapp, Developers Chris Rojahn, Engineers Tim Steele, Developers Tom Holzer, Policy
Minutes Prepared By:	Blake Salzman, Contract Plans Examiner
ITEMS	DISCUSSION
Introduction	General: ➢ Introduction by GH: Meeting minutes for Seismic Advisory Group Meeting on 01/27/16 were approved by group. George provided a quick update of the project over a busy month and a half. Sidewalk surveys have been completed, the resulting information has been quality controlled, then entered into FEMA's Hazus program, and loss estimates have been performed. ➢ The project timeline was re-reviewed based on the current progress. The timeline is available on the Seismic Advisory Group webpage.
Replacement Cost Methodology	➢ Based on the last meeting's discussion of the replacement cost in which the default values used in Hazus were reviewed, it was clear that the replacement cost values should be revised. The cost needs to be updated for inflation and increased based on location.

	It includes the construction bid costs, plus soft costs for demolition, third party inspection, permit fees, utility fees, and design fees. Costs that are not included are abatement, project management costs, financing, legal fees, accessibility compliance costs, etc. ➢ The Technical Advisory Committee (TAC) related to replacement cost methodology held a conference call on 3/7/16 to review proposed changes to increased replacement values. The increased costs were still deemed low. Agreement was reached on targets for the revised values. The updated values prepared by R+C were distributed and no exceptions were taken. R+C's sub consultant then made minor adjustments upward for some of the non-targeted occupancies to provide an appropriate ratio to the other costs. These final costs were used in the loss estimates and were shown in the meeting presentation. ➢ Occupancies focused on by the TAC were multi-family residential, offices for professional services, high technology, medical office, and retail. The costs used were intended to represent average values appropriate for all of Palos Alto, including both the downtown areas and those in the southern part of the City.
Inventory	➢ BL discussed the sidewalk surveys and collection of data to be used for the loss estimates. ➢ The inventory started from tax assessor files, GIS files, Google Earth, the 1980s building survey by COPA, and the 12/9/14 COPA Policy and Services memo on seismic compliance status that was the genesis of this program. Single family and two-family dwellings are not included in the scope of the inventory. Stanford University was also not included in the scope of the inventory. ➢ The bulk of the work was a field sidewalk survey using the app created for documenting visual assessments, with extensive quality assurance, and resurveying as necessary. In terms of overall scope, 2645 buildings were included in the study.
Loss Estimate	➢ BL discussed the overall loss estimates based on the entire study group. Estimates were based on a M7.9 and a M6.7 seismic event. Both events were calculated with retrofit and without retrofit. The total replacement value of the buildings is $23 billion, and total

contents replacement value within those buildings is $24 billion.

- The largest group of buildings of the inventory is wood frame small residential buildings. The greatest value of buildings comes from wood frame commercial and industrial. There is a total of 9 un-retrofitted URM bearing wall buildings in the study. There is also a surprising amount of tilt up concrete structures.

- The cost of building replacement by occupancy type was presented. The occupancy with the largest number of buildings and most expensive aggregate total value is professional and technical office buildings.

- The group reviewed the age of the study group buildings. The largest group in the study was built between the first seismic code in Palo Alto in 1926 and the SEAOC bluebook used in the 1961 UBC. The oldest buildings (pre 1927) had the largest average building damage ratio. Steel moment built pre 1927 had an average building damage ratio of 44%,compared to 4% for those built after code changes following the 1994 Northridge Earthquake.

- The loss estimate accounts for features such as year built, square footage, occupancy, design level, retrofit status, soft story status, height, and model building type.

- The estimated building damage in a M7.9 earthquake is $1.9 billion, and it is $900 million for the M6.7 event. The number of buildings with a damage ratio greater than 20% is estimated at 227 in a M7.9 event, but only 19 in a M6.7 event.

- The three-year average in boom development times for Palo Alto is $400 million in total construction. The total repair of $1.9 billion in damage would take at least 5 years based on the boom time average of $400 million if no other work were done. Actual repair would likely take much longer.

- The structural systems with the highest building damage ratios are steel frame with masonry infill, URM bearing wall, and concrete frame with masonry infill. The systems with the largest aggregate damage in dollar losses are concrete shear wall, concrete tilt up and wood frame commercial and industrial.

Implications for Policy Options	➢ BL discussed the implications of the loss estimate and how it could effect the policy options for Palo Alto moving forward. ➢ The estimated loss in a major event and potential reduction from retrofitting are significant. For example, retrofitted URM buildings had an average building damage of 4% compared to 29% for non-retrofitted. ➢ Addressing building types with the largest aggregate dollar losses (rather than simply the highest damage ratios) will lead to the greatest reduction in losses. These include soft story wood frame buildings, older concrete buildings, older tilt up buildings, and older steel moment frame buildings. ➢ Soft story deficiencies significantly increase the percentage of building with large loss ratios and approximately double the average damage ratio.
Best Practices	➢ SR reviewed policy options for Palo Alto based on the assessment of other local models. ➢ Programs were broken down by targeted building types, requirements, priority tiers, timelines, and incentives. Palo Alto's current program targets a mix of building criteria (structural system and occupant load). Floor area ratio bonus incentives are available in downtown locations ➢ Sunshine measures are ensuring publicity and knowledge of seismic risks. This is not taken full advantage of in the current system. ➢ Palo Alto's current program relies on voluntary action and planning incentives such as the floor area bonus. The options for addressing the remaining properties are to mandate evaluation, retrofit, or increase voluntary program. ➢ URM programs are required to report to the state, so and published reports on effectiveness (defined as retrofitting or demolishing) are available. Soft story buildings have been a focus

	for the City. 25% of soft story buildings in Berkeley that were mandated to perform an evaluation performed a retrofit within 2 years.
Action Items	➢ What is the right policy package for Palo Alto? This will be one of the final tasks of the advisory group. ➢ Scope of the next Advisory Group meeting will include review loss estimate of retrofitted buildings and continued policy option discussion. If the group is available for a 3-hour meeting, it would be ideal for the amount of information that needs to be covered during the next meeting. ➢ PP wants to schedule a meeting with the planning department to discuss planning incentives and to determine if those will be pursued. ➢ The agenda for the next Advisory Group meeting will include information on people/units affected by soft-story, loss estimation with retrofit and retrofit costs, reactions from AG to loss estimates and current program effectiveness/intensity. The group also wanted to discuss any factors given for time of occupancy in buildings.

City of Palo Alto

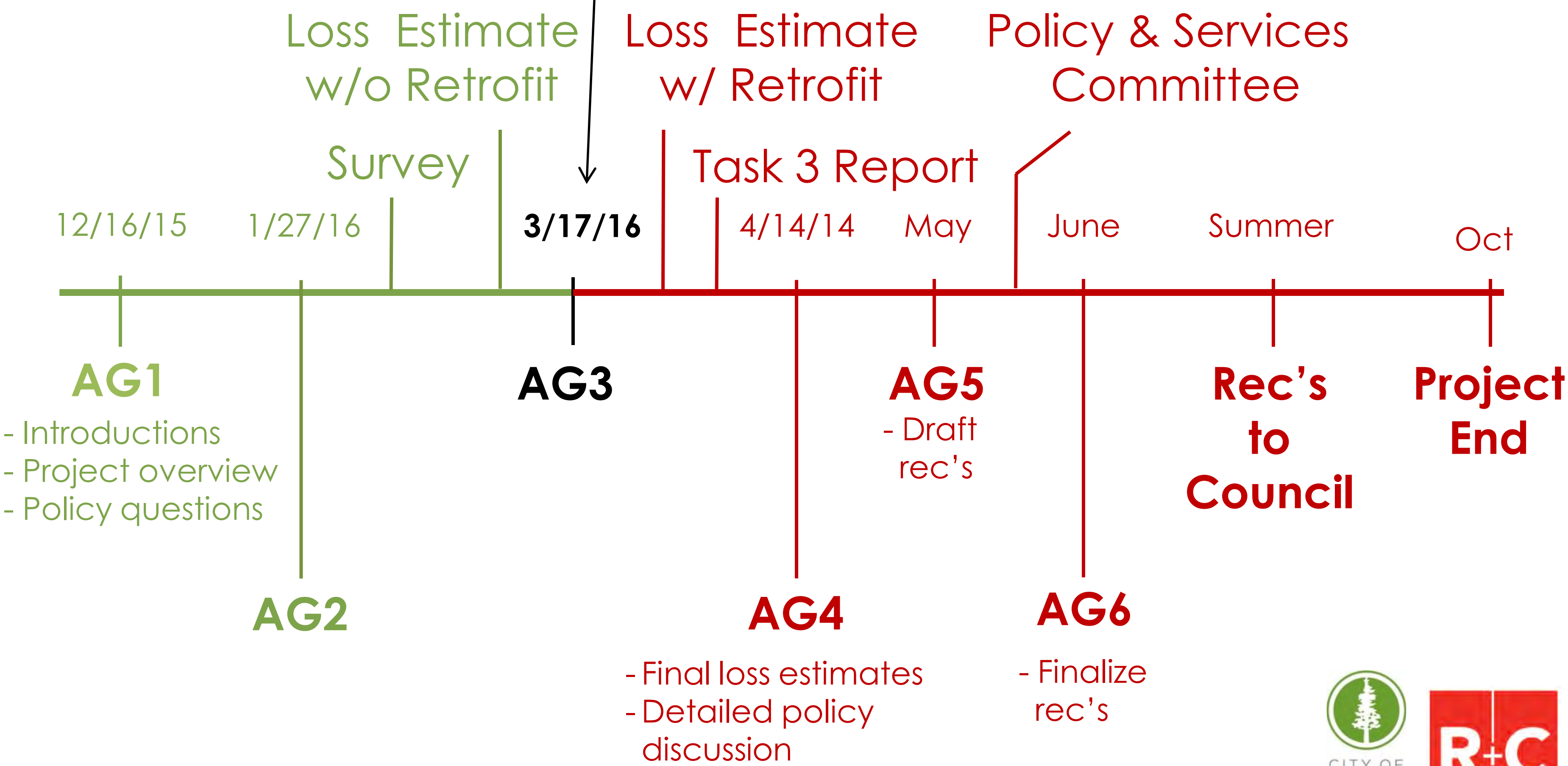
Seismic Risk Management Program

Advisory Group Meeting #3
March 17, 2016

Before Meeting
- AG2 minutes
- AG3 agenda
- Task 2 report

At Meeting
- Update on inventory and loss estimate efforts
- Local program goals, effectiveness, and options
- Start policy process discussion

Purpose of Advisory Group
To review and discuss implications of the project's technical findings and provide input about community concerns, priorities, and preferences.



Project and AG Process Status

- Review of minutes from 1/27/16 AG2 meeting

- Seismic Risk Management Program Website: http://www.cityofpaloalto.org/gov/depts/ds/srmag.asp
  - Added content includes slides from last meeting and Task 2 report

Inventory and Loss Estimates

- Replacement cost Technical Advisory Committee (TAC) report
- Inventory update
- Loss estimate results for existing building stock

Replacement Cost TAC Report

Reminder:

- Hazus program has default replacement costs in $/square foot

- Example: 10,000 sf building with a replacement cost of $400/sf

Replacement cost = 10,000 sf x $400/sf
= $4,000,000

Calculating Loss

- Loss = Cost of Damage / Replacement Cost
- Example: $200,000 loss in a building that would cost $4,000,000 to replace

Loss = $200,000 / $4,000,000 = 5%

Issue: Replacement Cost ($/sf)

- Hazus default full replacement cost models are based on RS Means (2014)
- Location factors for Palo Alto: Residential = 15%, Commercial = 11%
- **At the Advisory Group Meeting #2, we concluded the default values should be revised for Palo Alto**

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GOV2	Emergency Response	$259.52
EDU1	Schools/Libraries	$193.00
EDU2	Colleges/Universities	$214.91

R+C

Costs Included in Hazus Default Values

- Bid cost (what owner pays the contractor directly)
- A default location factor for Palo Alto. **This needs adjustment.**
- 2014 dollar values
  This needs adjustment to 2016 dollars.

R+C

Soft Costs Sometimes Included in Loss Estimates

- Demolition of existing building and limited site work
- Design fees for architect and engineers
- Testing and inspection costs
- Permit fees
- Utility connection fee
- Owner change order contingency

Costs Typically Not Included in Loss Estimates

- Hazardous material abatement costs
- Occupants-in-place costs
- Accessibility costs
- Historic building costs
- Relocation/interruption costs (though sometimes done)
- Project management costs
- Renovation costs
- Financing costs
- Repair of existing conditions
- Legal fees
- FF&E (furniture, fixtures, and equipment) is not included since Hazus calculates content damage separately.

Replacement Cost TAC Report

- R+C and Vanir Construction Management prepared proposed adjustments to RS Means values.
- Reviewed in 3/7/16 TAC conference call
- TAC recommended increased values in general, and identified target values for selected common occupancies.
- R+C updated values and distributed them to Advisory Group; no objections received.
- Vanir reviewed values and refined a few upward for estimating consistency in non-target occupancies. Those were used in loss estimates.

Hazus Occupancy Class	Definition	RS Means 2014 Average Palo Alto Cost $/SF[1]	Market Factor / Adjustment for Palo Alto	Revised Average $/SF - 2014	Escalation Factor from 2014 costs to 2016	Average $/SF Cost of New Bldg. - 2016 Costs	Demo & Minimal Sitework (5' around Bldg.) $/SF	Average $/SF of Replaced Bldg. - 2016 Cost	Soft Cost Premium[2]	Average $/SF of Replaced Bldg. w/ Soft Costs - 2016 Cost	Multiplier (Replaced with soft costs / RS Means)
RES3A	Multi Family Dwelling – duplex	$130.75	40%	$183	10%	$201	$17.50	$219	20%	$263	2.01
RES3B	Multi Family Dwelling – triplex/quad	$114.94	40%	$161	10%	$177	$17.50	$195	20%	$233	2.03
RES3C	Multi Family Dwelling – 5-9 units	$206.41	**40%**	$289	10%	$318	$17.50	$335	20%	**$402**	1.95
RES3D	Multi Family Dwelling – 10-19 units	$194.12	40%	$272	10%	$299	$17.50	$316	20%	$380	1.96
RES3E	Multi Family Dwelling – 20-49 units	$212.26	40%	$297	10%	$327	$17.50	$344	20%	$413	1.95
RES3F	Multi Family Dwelling – 50+ units	$199.90	40%	$280	10%	$308	$17.50	$325	20%	**$390**	1.95
RES4	Temp. Lodging	$217.83	40%	$305	10%	$335	$17.50	$353	20%	$424	1.94
RES5	Institutional Dormitory	$234.44	50%	$352	14%	$401	$25.00	$426	20%	$511	2.18
RES6	Nursing Home	$238.07	50%	$357	12%	$400	$25.00	$425	20%	$510	2.14
COM1	Retail Trade	$121.66	**80%**	$219	10%	$241	$17.50	$258	20%	**$310**	2.55
COM2	Wholesale Trade	$118.13	60%	$189	10%	$208	$17.50	$225	20%	$270	2.29
COM3	Personal and Repair Services	$143.47	60%	$230	10%	$253	$17.50	$270	20%	$324	2.26
COM4	Professional/ Technical/Business Service	$194.52	**65%**	$321	12%	$359	$17.50	$377	20%	**$452**	2.33
COM5	Banks	$281.88	40%	$395	12%	$442	$25.00	$467	20%	$560	1.99
COM6	Hospital	$372.59	50%	$559	14%	$637	$35.00	$672	20%	$807	2.16
COM7	Medical Office/Clinic	$267.85	**20%**	$321	10%	$354	$17.50	$371	20%	**$445**	1.66
COM8	Entertainment & Recreation	$248.61	25%	$311	12%	$348	$25.00	$373	20%	$448	1.80
COM9	Theaters	$186.45	35%	$252	12%	$282	$25.00	$307	20%	$368	1.98
COM10	Parking	$84.59	20%	$102	10%	$112	$17.50	$129	20%	$155	1.83
IND1	Heavy	$144.71	25%	$181	10%	$199	$17.50	$216	20%	$260	1.80
IND2	Light	$118.13	25%	$148	10%	$162	$17.50	$180	20%	$216	1.83
IND3	Food/Drugs/Chemicals	$229.48	30%	$298	12%	$334	$17.50	$352	20%	$422	1.84
IND4	Metals/Minerals Processing	$229.48	30%	$298	12%	$334	$17.50	$352	20%	$422	1.84
IND5	High Technology	$229.48	**40%**	$321	14%	$366	$17.50	$384	20%	**$461**	2.01
IND6	Construction	$118.13	30%	$154	10%	$169	$17.50	$186	20%	$224	1.89
REL1	Church	$118.13	50%	$177	12%	$198	$25.00	$223	20%	$268	2.27
AGR1	Agriculture	$199.08	10%	$219	12%	$245	$17.50	$263	20%	$315	1.58
GOV1	General Services	$152.63	40%	$214	10%	$235	$17.50	$253	35%	$341	2.23
GOV2	Emergency Response	$259.52	40%	$363	14%	$414	$25.00	$439	35%	$593	2.28
EDU1	Schools/Libraries	$193.00	40%	$270	12%	$303	$25.00	$328	35%	$442	2.29
EDU2	Colleges/Universities	$214.91	60%	$344	12%	$385	$25.00	$410	35%	$554	2.58

Notes:

1. RS Means average cost includes RS Means default location factors to adjust national average to Palo Alto of 15% for residential and 11% for commercial.
2. Soft costs include architect and engineer design fees, testing and inspection, utility connection fee, permits, and an allowance for owner change order contingency.
3. Costs are intended to be representative of averages in Palo Alto across the town, including downtown areas together with other areas in the city.
4. Costs were previously prepared following a 3/7/16 discussion with the Palo Alto Seismic Risk Program Advisory Group Technical Advisory Committee. Percentages in red are minor updates from the 3/7/16 values based on internal review between Rutherford + Chekene and Vanir Construction Management to achieve improved relative ratios between different occupancy types.

Replacement Costs Used

Target Occupancies

- 5-9 Unit Residential: $402/sf
- 50+ Unit Residential: $390/sf
- Retail Trade: $310/sf
- Professional/Technical Office: $452/sf
- Medical Office: $445/sf
- High Technology: $461/sf

- Costs are1.7-2.6 times the RS Means default values.

- Costs are intended to be representative of averages across the town.

Building Inventory Sources of Information

- Digital tax assessor files
- GIS files
- Google Earth and Street View

- 1980s Palo Alto Building Dept. survey for the 1986 ordinance
- SJSU/Palo Alto Fire Dept. survey of soft-story wood frame
- 12/9/14 memo on compliance status with City ordinance

- Field sidewalk survey
- Extensive quality assurance and re-surveying

R+C

Buildings in Scope of Study

- Total Palo Alto parcels: 21,187
  - 1 and 2 family: -15,198
  - Remaining parcels: **5,989**

- 3 or more unit residential parcels: 3,630
  - Actual distinct buildings: 1,324

- Other occupancy types: 2,369
  - Removed 961 designated as "Possessory Interest" - 961
  - Remaining buildings: 1,408

- Initial total in study group: 1,324 + 1,408 = 2,732

- Following field surveys, final total in study group: **2,645**

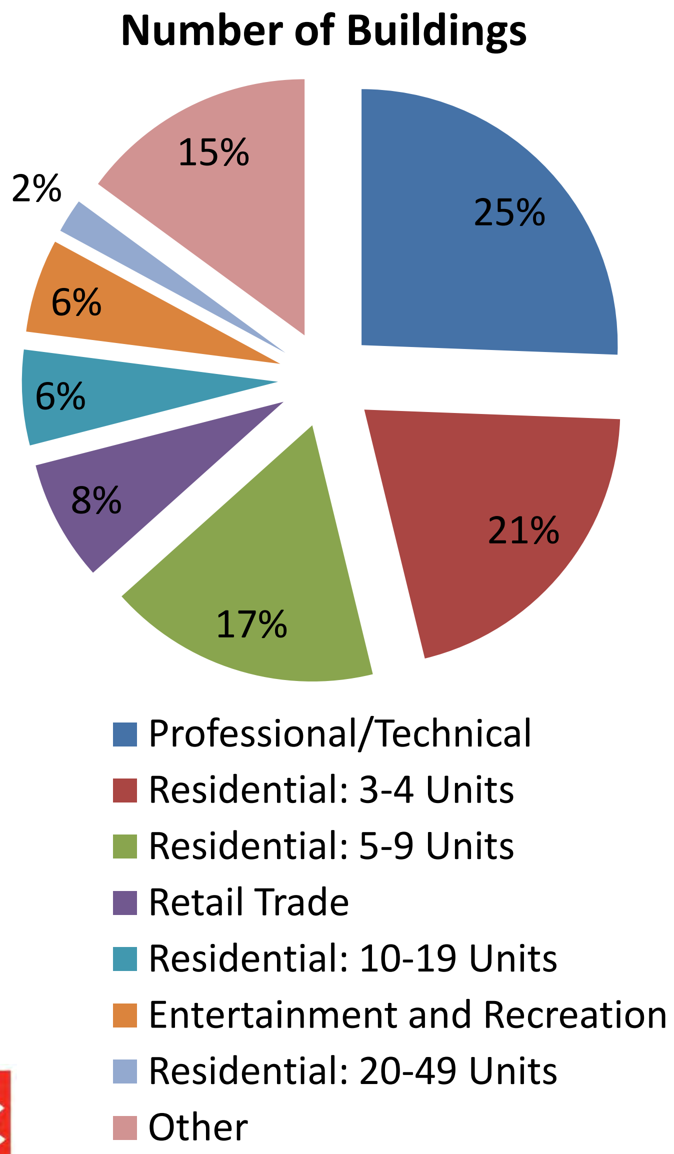
What is the Total Exposure?

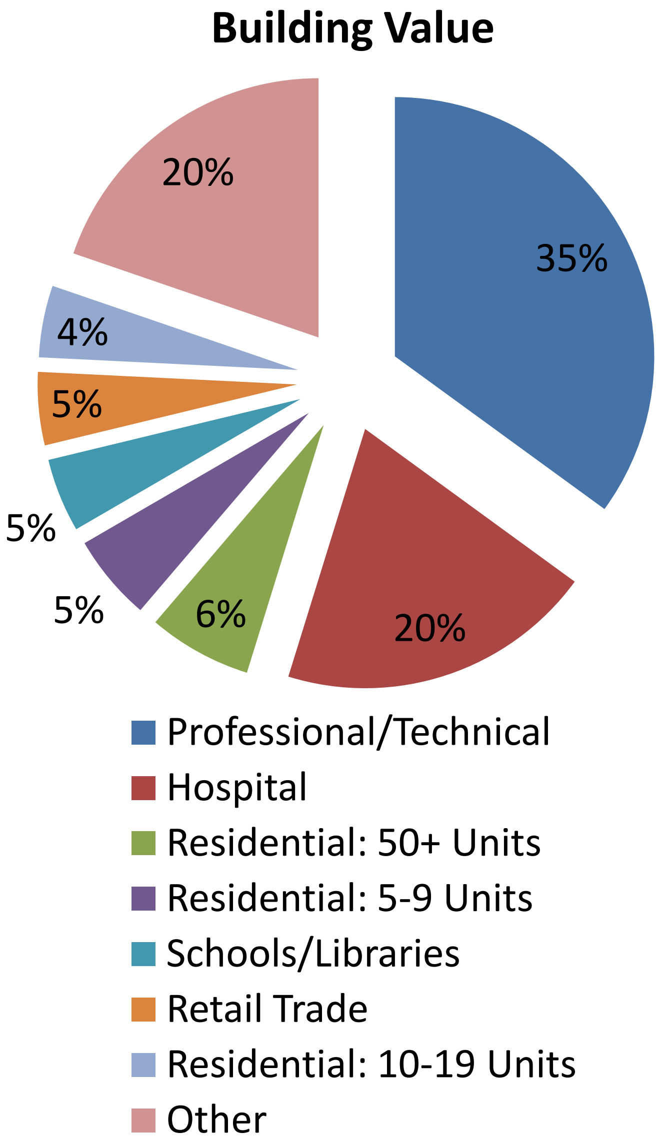
- Number of buildings:
  2,645
- Total replacement value of buildings:
  $23B
- Total value of contents:
  $24B

What are the Major Building Types?

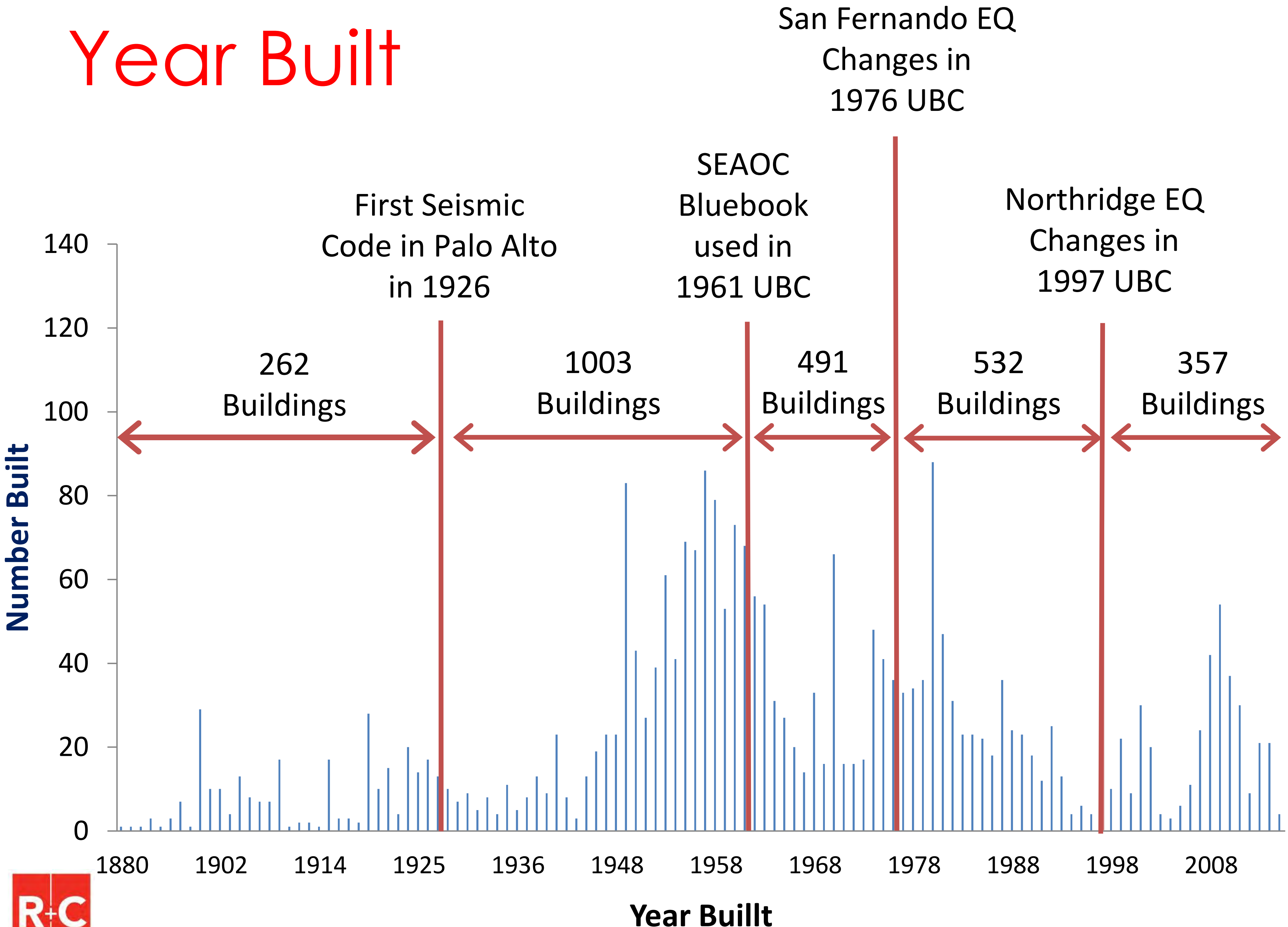
Model Building Type	Description	Number of Buildings	Aggregate Building Value ($M)
W2	Woodframe commerical/industrial	309	5,442
C2	Concrete shear wall	320	4,059
PC1	Concrete tilt-up	242	3,368
W1a	Woodframe larger residential	336	3,331
RM1	Reinforced masonry, wood floor	285	1,822
S2	Steel braced frame	51	1,780
W1	Woodframe smaller residential	898	1,278
S1	Steel moment frame	68	958
RM2	Reinforced masonry, concrete floor	35	226
C3	Concrete frame with masonry infill	10	208
S3	Steel light metal frame	44	182
PC2	Precast concrete frame	5	125
C1	Concrete moment frame	18	117
S4	Steel frame with concrete shear walls	13	72
URM	Unreinforced masonry bearing wall	9	15
S5	Steel frame with masonry infill	2	3
Totals		**2,645**	**22,986**

Study Group Occupancy Types





Year Built

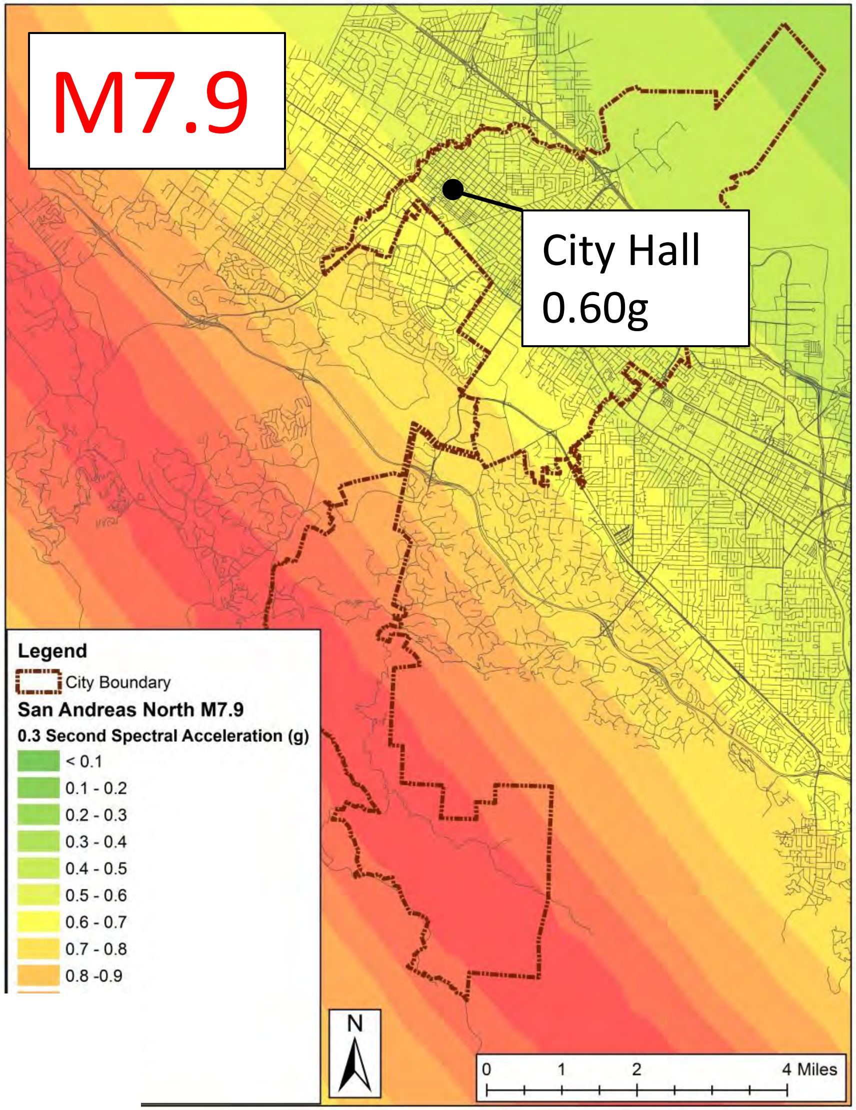


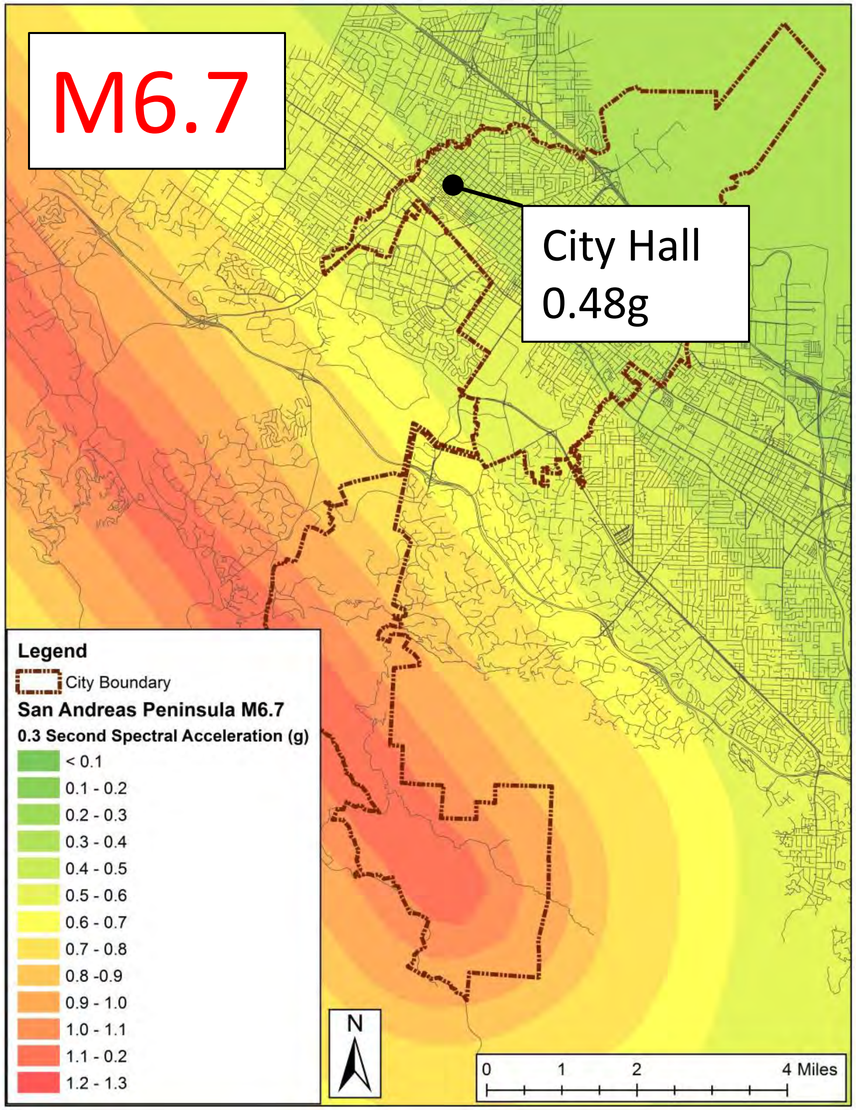
R+C

Loss Estimates

- Two scenarios
- Today: Initial run, <u>without</u> new retrofit
- Future:
  - Develop conceptual retrofits with cost estimates
  - Second run: <u>with</u> new retrofit

Earthquake Scenarios





Loss Estimation Features

Model Building Type

Occupancy

Height

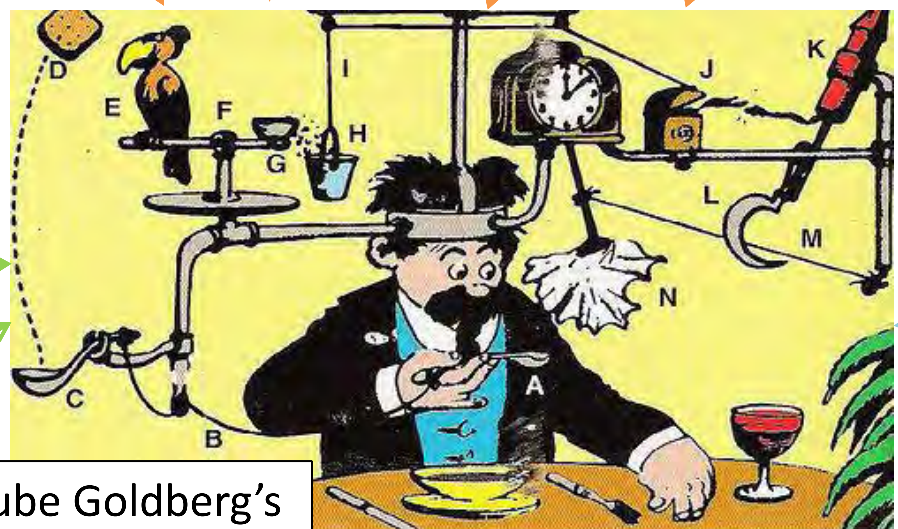
Year Built

Design Level

Square Footage

Retrofit Status

Soft Story Status



Earthquake Shaking (M7.9/M6.7)

Soil Conditions at Site

Distance from Fault

Replacement Cost

Content Value

Rube Goldberg's Version of Hazus

Building Damage ($, % for M7.9/M6.7)

Content Damage ($, % for M7.9/M6.7)

What are the Total Losses?

Earthquake Scenario	Building Value ($B)	Content Value ($B)	Estimated Building Damage ($B)	Average Building Damage Ratio	Number of Buildings with Damage Ratio ≥ 20%	Estimated Content Damage ($B)	Average Content Damage Ratio	Total Building & Content Damage ($B)
M7.9	23.0	23.6	1.9	8%	227	0.9	4%	2.9
M6.7	23.0	23.6	0.9	4%	19	0.5	2%	1.4
Ratio of M7.9 / M6.7			**2**	**2**	**12**	**2**	**2**	**2**

Takeaway: Ratio for $ loss and average % damage is about 2, but is about 12 for number of buildings with over 20% loss.

How Do the Building Losses Compare to Permit Valuations Processed Per Year?

- M7.9 building losses: $1.95B
- Palo Alto permit valuations
  - 2013/2014: $336M
  - 2014/2015: $480M
  - 2015/2016: $191M first half, say $382M total
  - Three-year average in boom times: $400M
- $1.95B repair and replacement costs ÷ $400M/year = 5 years

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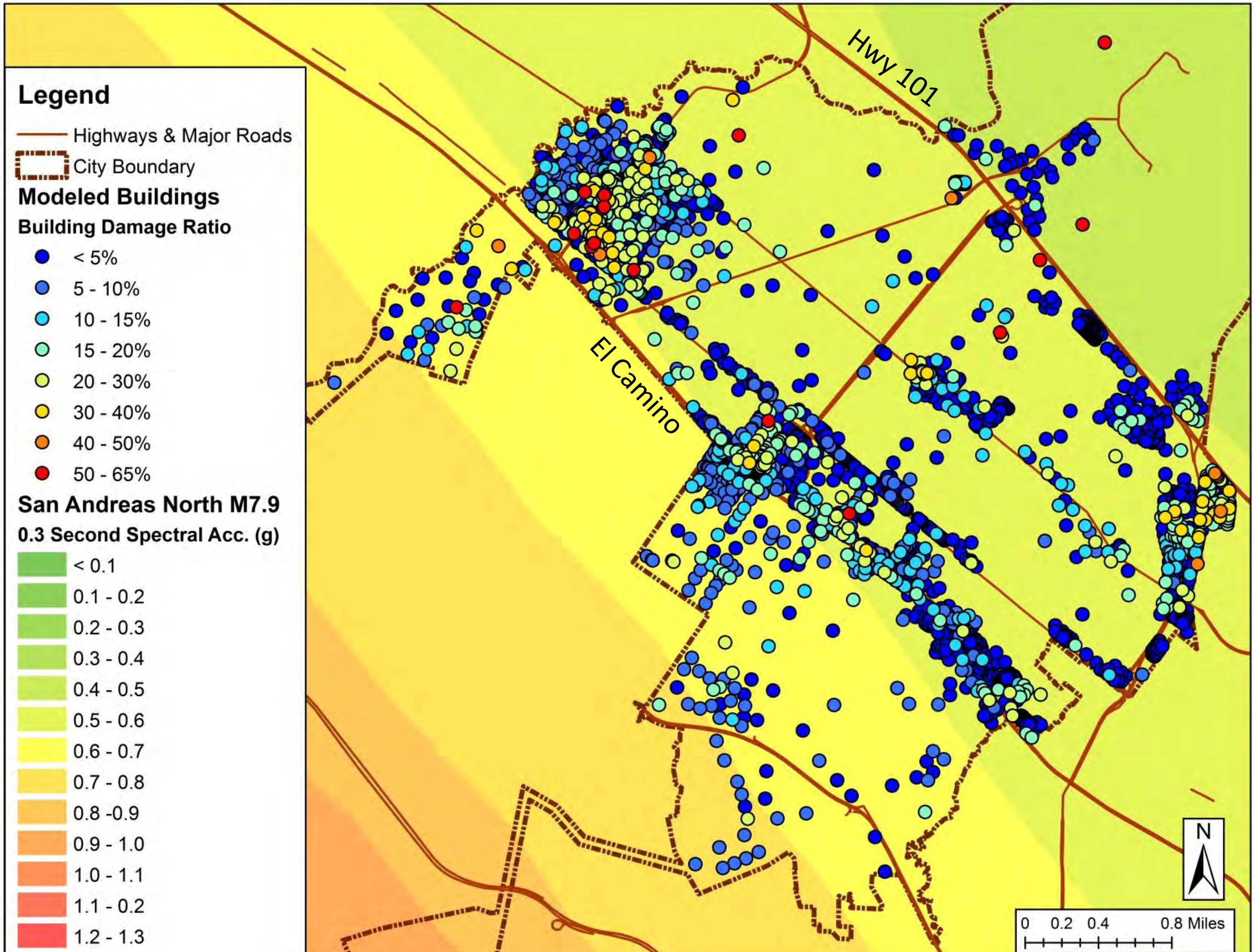
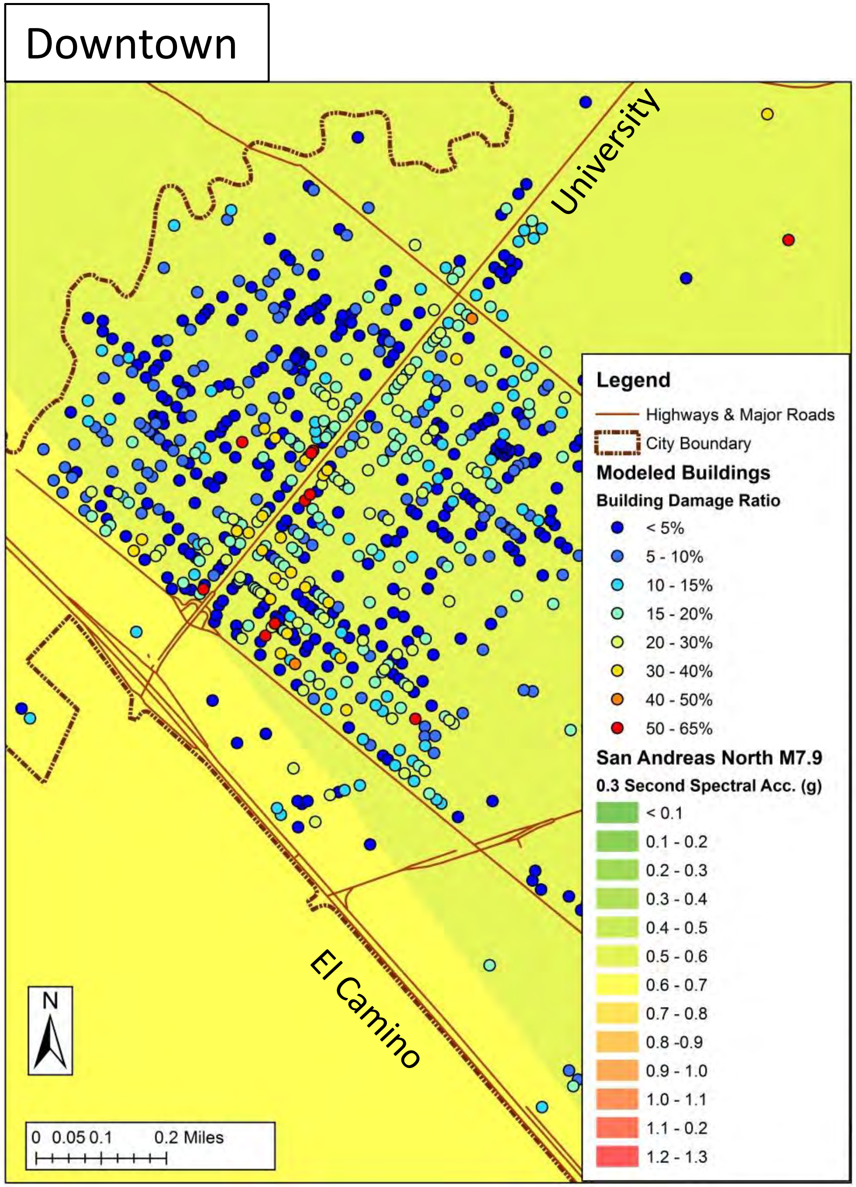
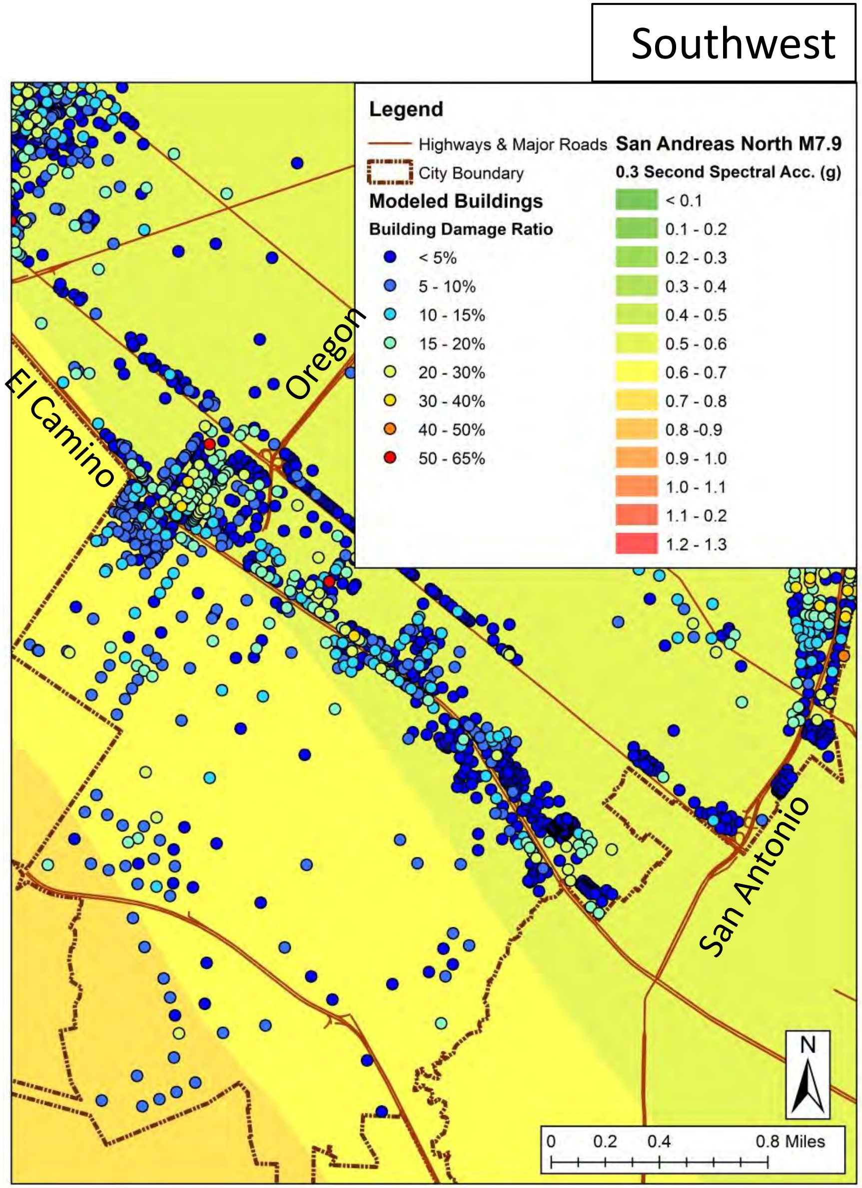
Building Damage Ratio

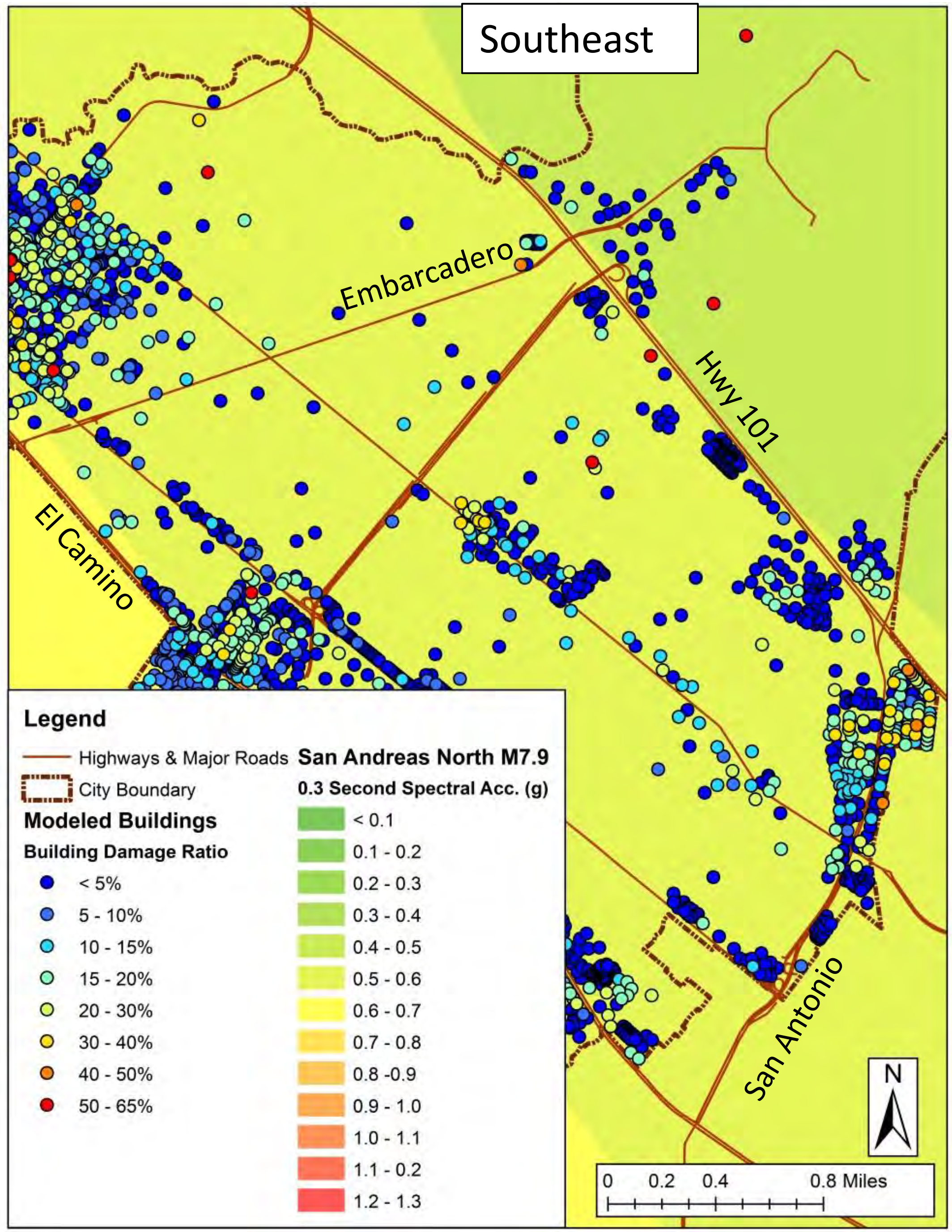


Building Damage Ratio





Building Damage Ratio



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What are the Worst Building Types?

Takeaways

- Depends on metric used
- Types with the largest $ losses ≠ types with the highest damage %

			San Andreas M7.9		
Building Type	Number of Buildings	Building Value ($M)	Estimated Building Damage ($M)	Average Building Damage Ratio	Number of Bldgs with Damage Ratio ≥ 20%
Concrete shear wall	320	4,059	477	14%	75
Concrete tilt-up	242	3,368	365	12%	32
Woodframe commercial/industrial	309	5,442	311	8%	9
Steel frame with masonry infill	2	3	1	38%	1
Unreinforced masonry bearing wall	9	15	4	29%	9
Concrete frame with masonry infill	10	208	30	26%	6
Concrete shear wall	320	4,059	477	14%	75
Concrete tilt-up	242	3,368	365	12%	32
Steel moment frame	68	958	119	19%	27

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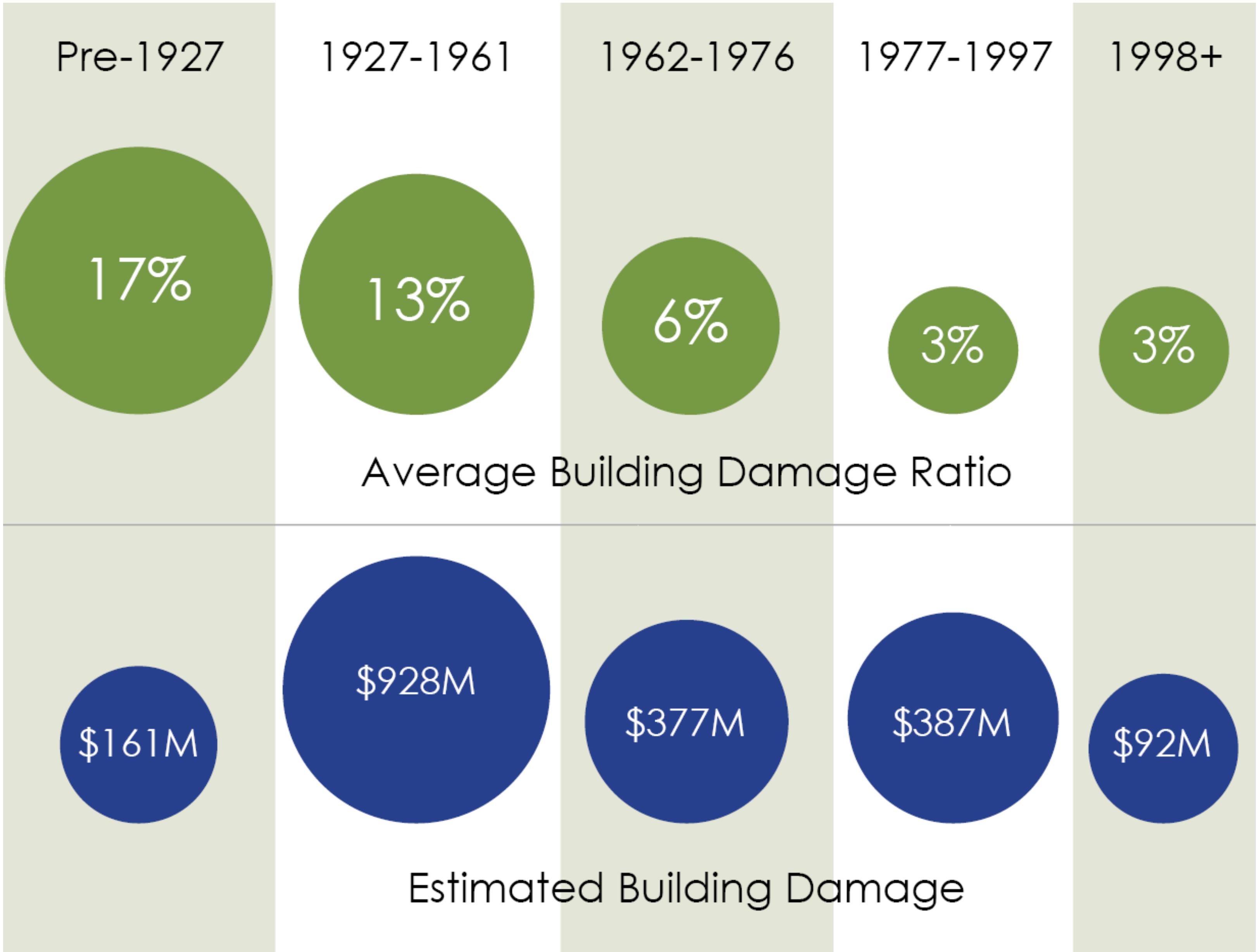
What are the Worst Occupancies?

			San Andreas M7.9			
Occupancy Type	Number of Buildings	Building Value ($M)	Estimated Building Damage ($1M)	Average Building Damage Ratio	Number of Bldgs with Damage Ratio ≥ 20%
Professional/Technical	677	8,051	**789**	12%	92
Hospital	18	4,542	**265**	8%	2
Schools/Libraries	17	1,057	**180**	10%	3
Theaters	2	7.8	222	**28%**	2
Colleges/Universities	2	5.7	140	**25%**	2
Construction	5	5.1	114	**26%**	3
Retail Trade	202	1,047	130	14%	**34**
Professional/Technical	677	8,051	790	12%	**92**
Entertainment and Recreation	156	740	844	14%	**37**

Takeaways

- Like building type, worst occupancy depends on metric used.
- Largest $ losses ≠ highest damage %

How Does Year Built Affect Losses?



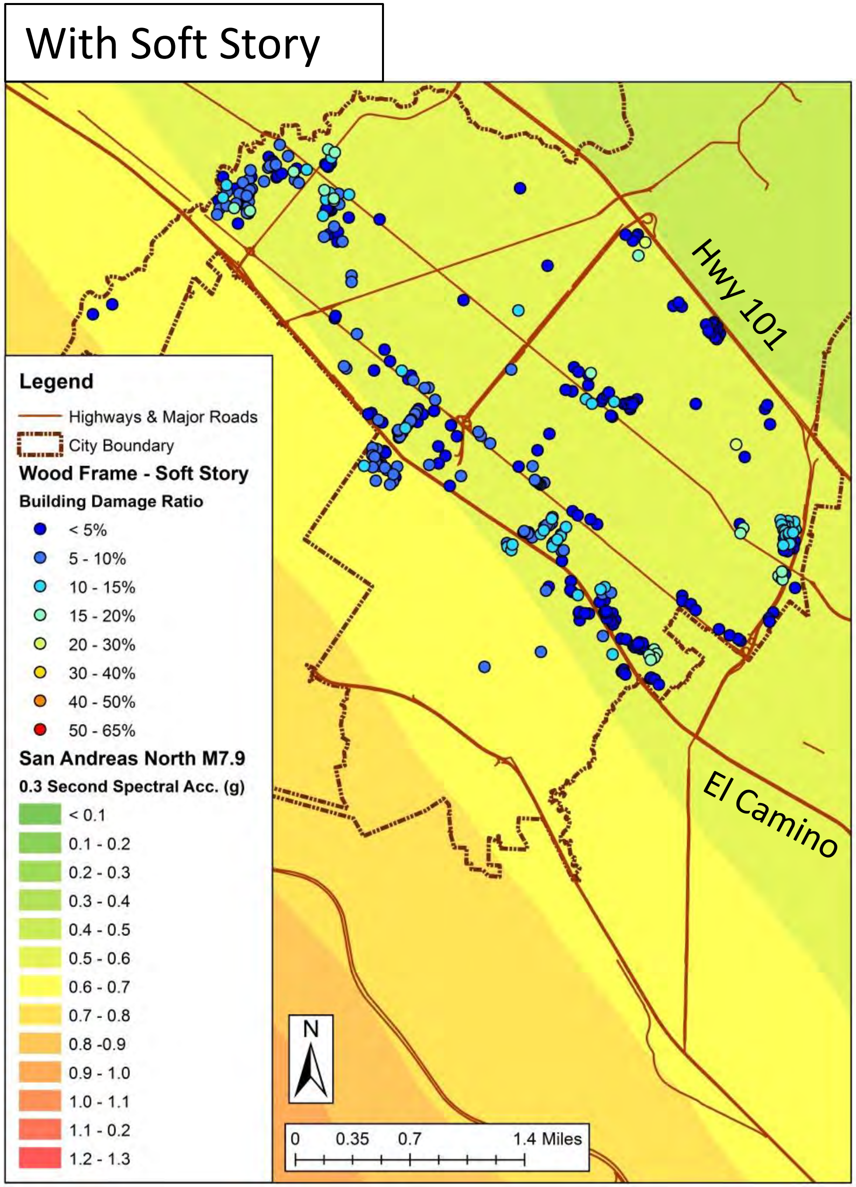
What is the Impact of a Soft Story?

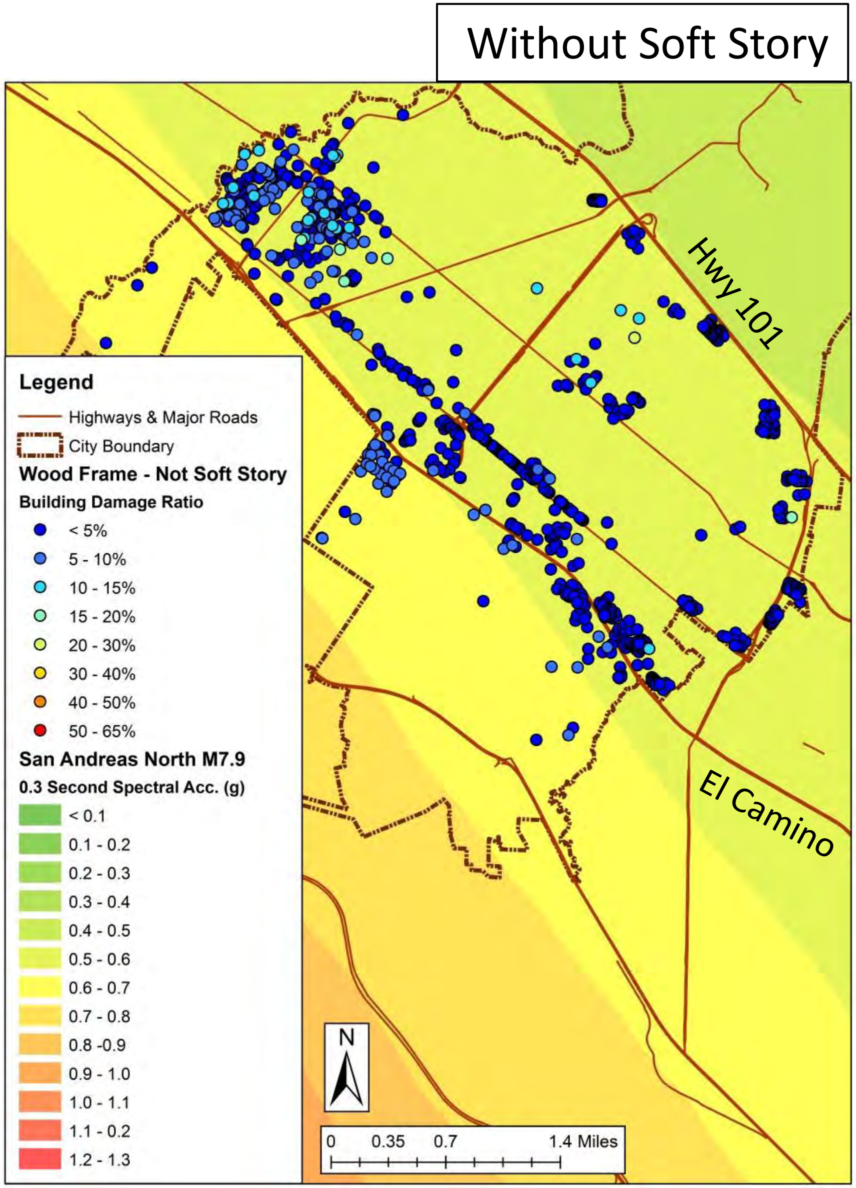
Building Type	Soft Story	Number of Buildings	Building Value ($M)	San Andreas M7.9 Estimated Building Damage ($M)	San Andreas M7.9 Average Building Damage Ratio	San Andreas M7.9 Number of Bldgs with Damage Ratio ≥ 20%
Concrete shear wall	No	270	3,537	384	13%	45
	Yes	50	522	93	20%	30
Woodframe larger residential	No	207	2,577	103	4%	1
	Yes	129	753	68	9%	2
Woodframe commercial/industrial	No	243	4,570	186	8%	0
	Yes	66	873	124	11%	9

<u>Takeaways</u>: Soft story…

- Approximately doubles the average damage ratio
- Significantly increases the % of buildings with large loss ratios

Light Wood Frame Building Damage





How Does Year Built Affect Steel Moment Frames?

			San Andreas M7.9		
Age Range	Number of Buildings	Building Value ($M)	Estimated Building Damage ($M)	Average Building Damage Ratio	Number of Bldgs with Damage Ratio ≥ 20%
Pre-1927	13	102	41	44%	13
1927-1961	19	79	17	26%	13
1962-1976	6	149	17	9%	0
1977-1997	15	514	40	9%	1
1998 and later	15	114	4	4%	0

Takeaway: Year built (and design code) makes a significant difference. Benchmark is post-Northridge changes in 1997 UBC.

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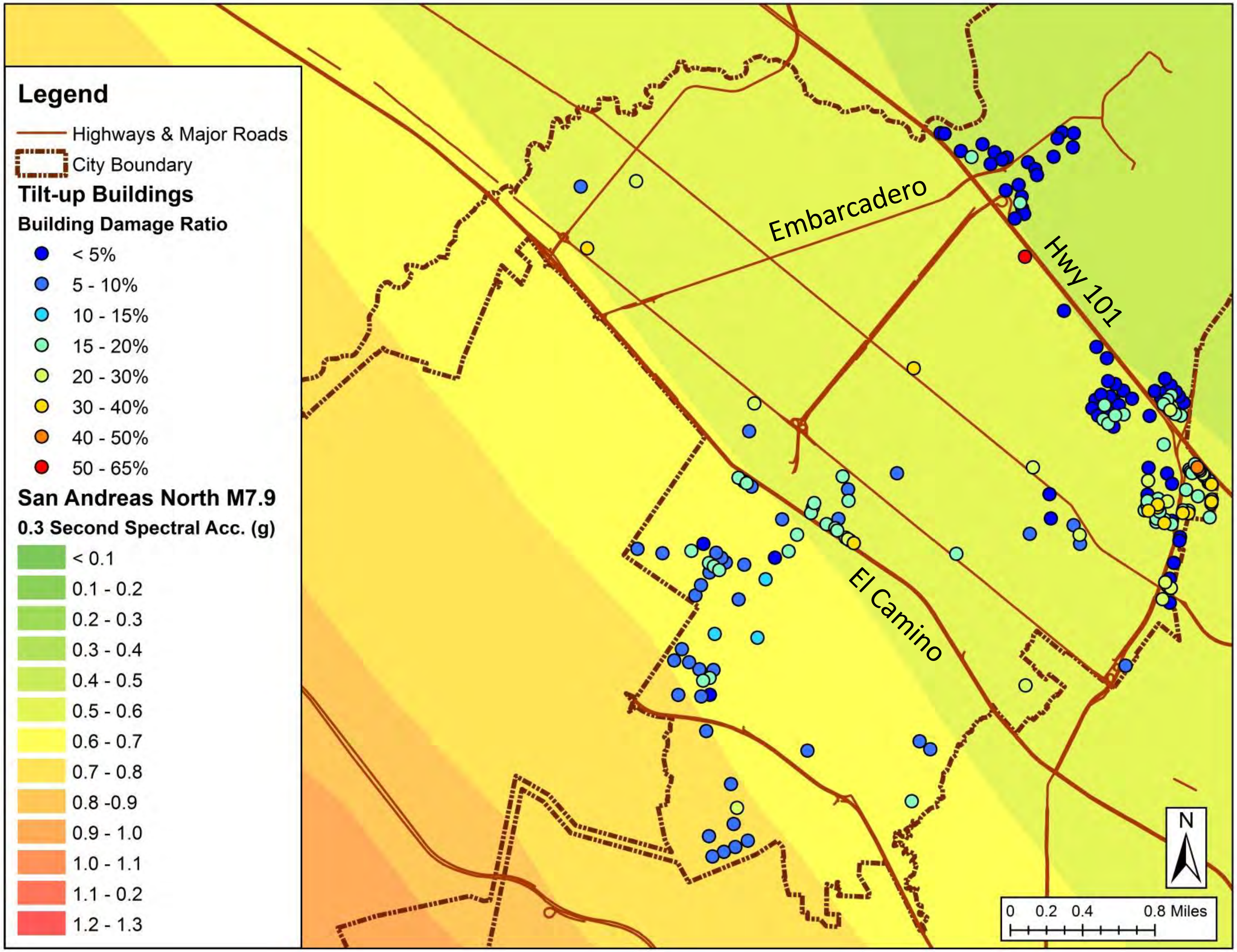
How Does Year Built Affect Tilt-Up Buildings?

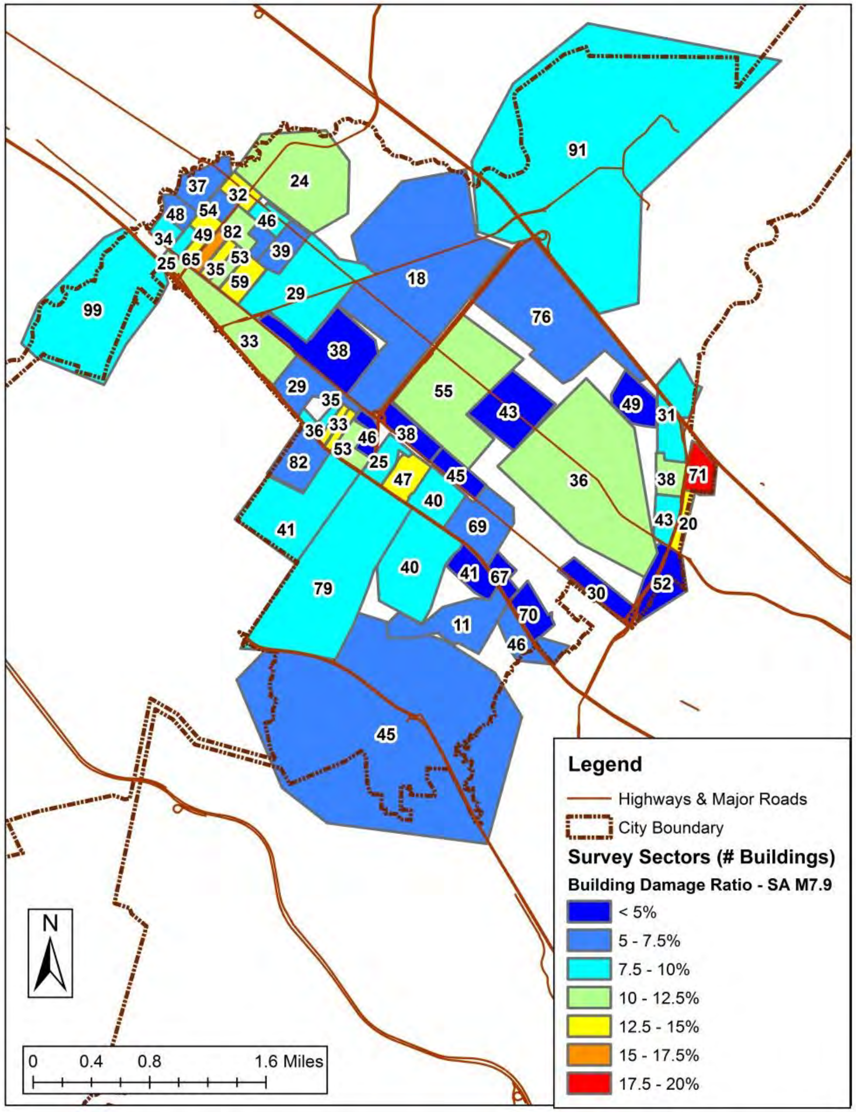
			San Andreas M7.9		
Age Range	**Number of Buildings**	**Building Value ($M)**	**Estimated Building Damage ($M)**	**Average Building Damage Ratio**	**Number of Bldgs with Damage Ratio ≥ 20%**
1927-1961	87	880	156	21%	24
1962-1976	94	1,543	110	7%	3
1977-1997	54	806	92	8%	5
1998 and later	7	140	6	4%	0

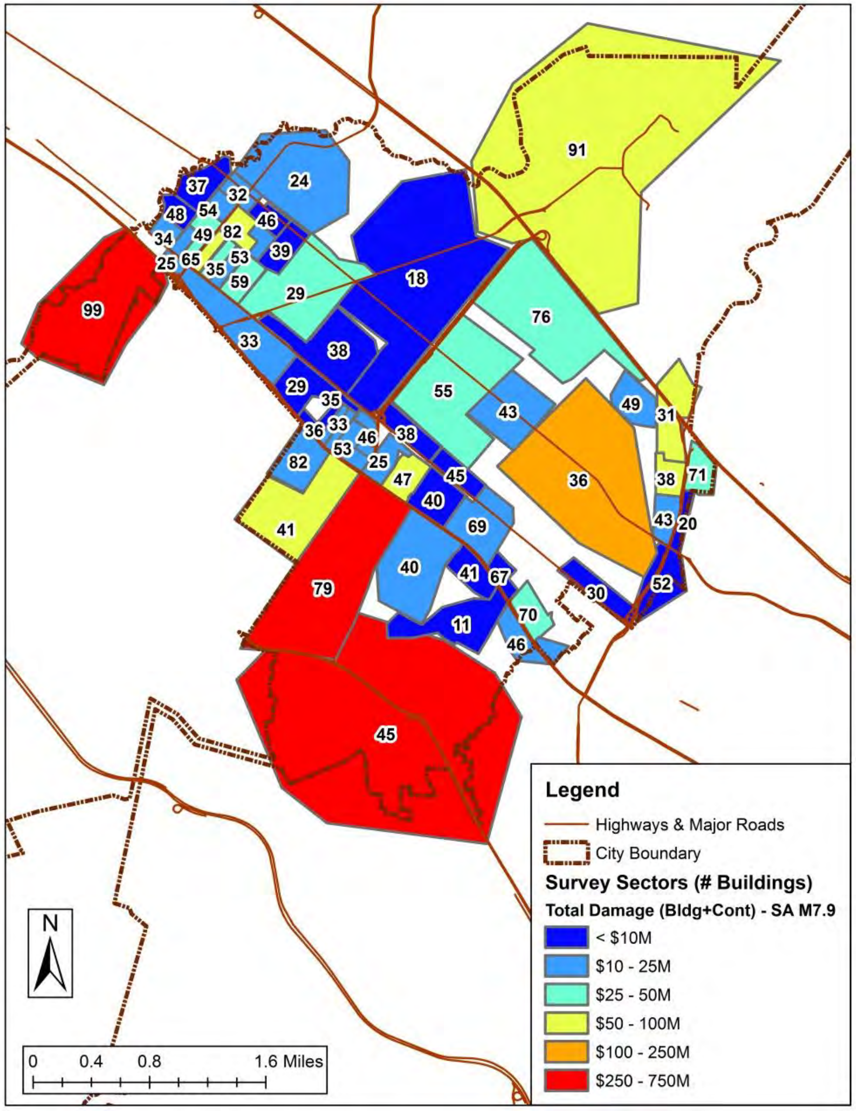
Takeaway: Year built (and design code) makes a significant difference. Benchmark is post-Northridge changes in 1997 UBC.

Tilt-up Building Damage



Building Damage by Survey Sector





What Benefit Do URM Retrofits Provide?

			San Andreas M7.9		
Retrofit Status	Number of Buildings	Building Value ($M)	Estimated Building Damage ($M)	Average Building Damage Ratio	Number of Bldgs with Damage Ratio ≥ 20%
Yes	20	105	4.5	4%	0
No	9	15	4.4	29%	9

<u>Takeaways</u>

- Retrofitting URMs makes a significant reduction in average damage and in the number with large damage ratios.
- There are few URM buildings compared to other building types.

Implications for Policy Options

- The estimated losses in a major event and potential reduction from retrofitting are significant.
- Addressing building types known to be potentially hazardous <u>and</u> with large numbers of buildings will lead to the greatest reduction in losses.
- Possible building types to consider:
  - Soft story wood frame buildings
  - Older concrete buildings
  - Older tilt-up buildings
  - Older steel moment frame buildings
- Requirements imposed on different building types impact different groups of owners, tenants, and occupants.

Options for Palo Alto Based on Assessment of Other Local Models

- Programs break down by targeted building types, requirements, priority tiers, timelines, and incentives
- Success is relative to goals
- Effectiveness data is limited, but we know some paths achieve more retrofit progress and momentum than others

Targeted Structural Systems, Year Built, and Other Characteristics

Structural Systems / Age— e.g., URM, soft-story, older concrete

Higher Occupancy / # Units — e.g., 5 or more residential units, 100+ persons

Location — e.g., state-determined Earthquake Fault Zones, historic or downtown districts

Uses — e.g., public schools, hospitals, essential services buildings

Palo Alto's Current Program Targets a Mix of Building Criteria and Location

- Three categories based on structure type, occupancy and age
- Relates to Central Business District

- Options for addressing buildings with other vulnerabilities or characteristics:
  – Older concrete
  – Soft-story residential
  – Other structural feature/use/occupancy combinations (e.g., private schools, façades)

Understanding and Taking Action on Older Concrete Building Risks

Concrete Coalition organization and volunteer inventory:

- 23 case study cities
- Estimated 16,000–17,000 pre-1980 concrete buildings in California high risk counties
- San Francisco building taxonomy study

Example Local Programs for Older Concrete

- City of Los Angeles Building Code Divisions 91 & 96:
  - (1994 - 1996) triggered upgrading on pre-1976 tilt-ups
  - (2014) mandatory evaluation and upgrade if needed for nonductile concrete
- City of Long Beach Chapter 18.71
  - Voluntary guidance
- City of Santa Monica Municipal Code 8.80
  - Mandatory evaluation and upgrade if needed for existing nonductile concrete buildings
- City of Burbank --
  - voluntary guidelines for older reinforced concrete and concrete frame buildings with masonry infill

2015 Los Angeles Ordinance

Policy development timeline:

- Concrete Coalition inventory effort
- LA Times freedom of information request to force Univ. of Calif. to release data, followed by featured article
- Great ShakeOut
- Mayor Garcetti create Seismic Advisory Task Force, headed by Lucy Jones (USGS)
- Resilience by Design report

Passed October 2015 Ordinance

- Mandatory screening (3 yrs), evaluation (10 yrs), and subsequent retrofit (25 yrs) of nonductile concrete
- Also included: mandatory evaluation and subsequent retrofit of soft-story

California Learners and Leaders in Soft-Story Programs

LEARNING LEADING

Increasing Requirements

Inventory Only	***Notify Only***	**Voluntary Retrofit**	***Mandatory Screening***	***Mandatory Evaluation***	***Mandatory Retrofit***
Santa Clara County San Jose	San Leandro Richmond Sebastopol		Oakland San Francisco	Berkeley Alameda Los Angeles	Fremont

In Development: Hayward

Compiled by S. Rabinovici, 2016.

Options for Policy Mechanisms and Requirements

- Packaging and phasing

Inventory Only	Notify Only	Voluntary Retrofit	"Sunshine" Approaches	Mandatory Screening	Mandatory Evaluation	Mandatory Retrofit
City staff, consultants, and/or a volunteer organization has created an **inventory** of one or more suspected hazard building types, but list is not officially released to the public or been acted upon.	An inventory exists and a policy has been established to **notify owners** if their property is on a suspected hazard building list.	Owners of properties on a **publically available list** are formally **encouraged to retrofit**, possibly by offering of technical assistance, financial help, or policy incentives.	Properties on a **publically available list** are subject to one or more methods of forced information sharing, such as **tenant notification**, **public signage**, **recorded notice** on the property title.	Owners of properties on a publically available list are required to **submit a form** within a fixed time window that is filled out by a licensed building professional.	Owners of properties on a publically available list are required **submit an evaluation** completed by a licensed engineer within a fixed time frame.	Owners of properties on a publically available list are **required to retrofit** by a certain date. This step may be implemented following a screening or evaluation phase.

Palo Alto's Current Program Relies on Voluntary Action and Planning Incentives

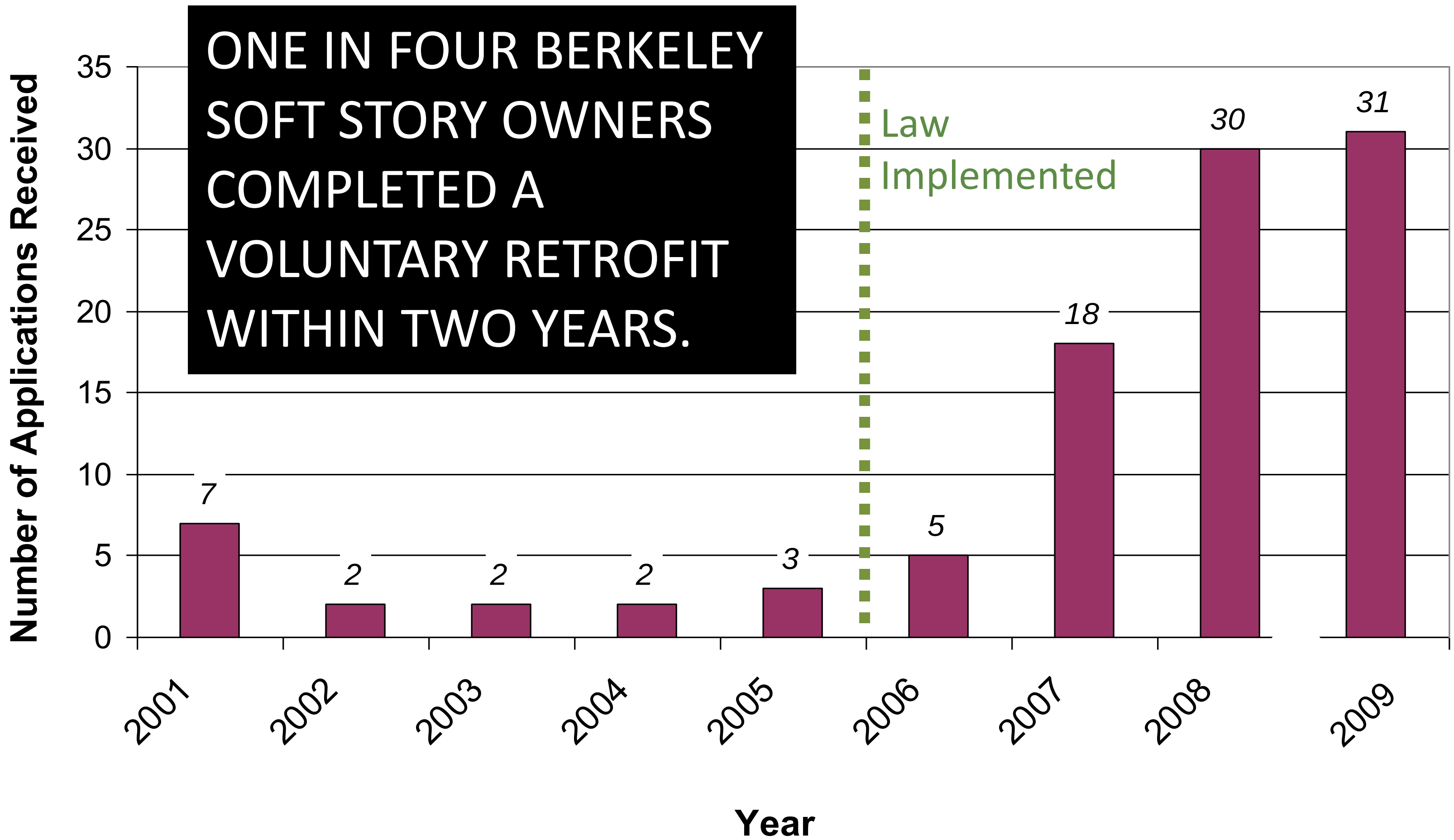
- Floor Area Bonus

- Options for addressing remaining properties on the existing list:
  - Mandate evaluation
  - Mandate retrofit
  - Ramp up voluntary program with added features (e.g., technical assistance, increase incentives, or sunshine measures)

City of Berkeley Soft-Story: 2005 – 2013 Mandatory Evaluation to Mandatory Retrofit

City Program	Inventory Method and Timing	Targeted Buildings	Deadline for Evaluation	Deadline for Permit	Deadline for Retrofit
Berkeley	1996 and 2003 (collaboration with UC Berkeley and EERI)	5 or more units, pre-1996	2 years (under 2005 law)	2 years	4 years

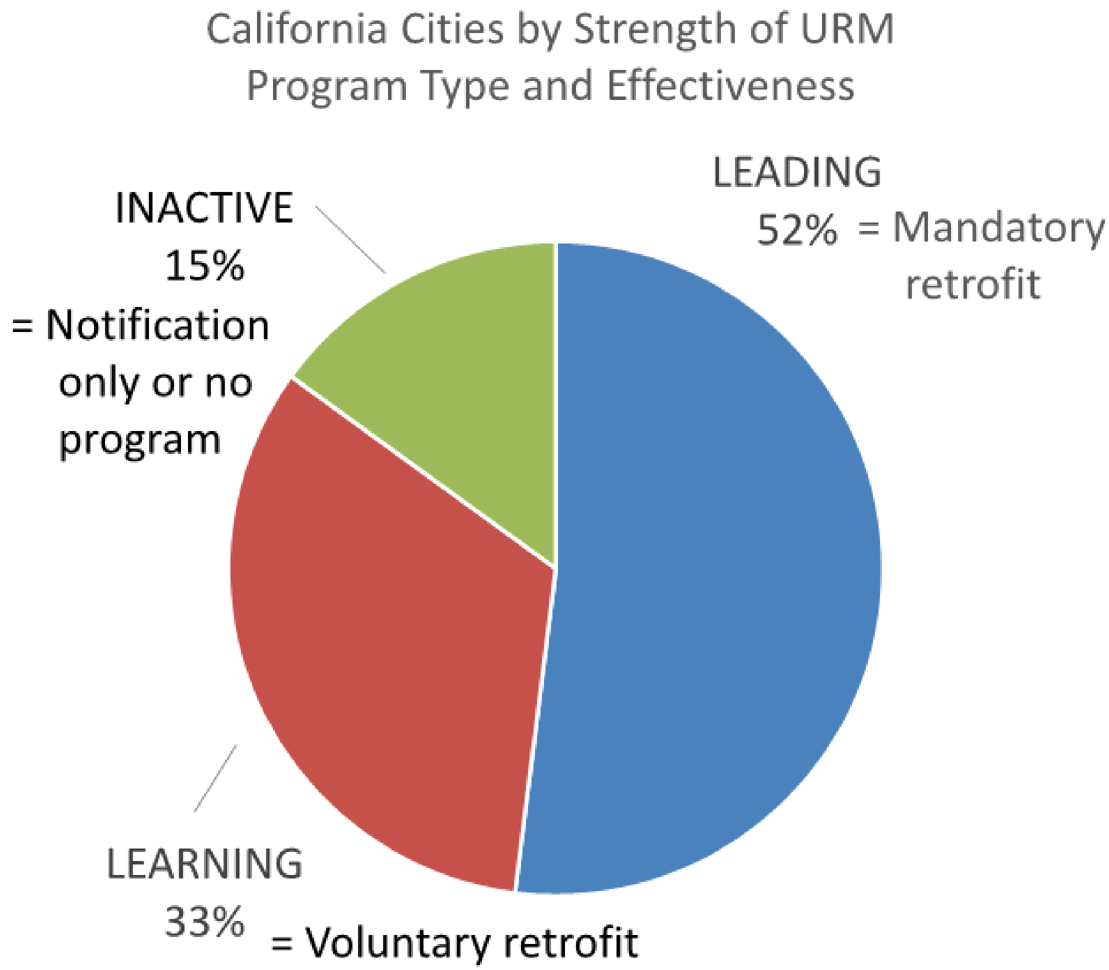
The Impact of Mandated Soft-Story Evaluations: Seven Fold Increase in Permit Application Rate



Note: Data collected April 2010, Source: D. Lambert, personal communication.

URM Progress Statewide (2006)

ON AVERAGE, THREE TIMES MORE BUILDINGS HAVE BEEN RETROFIT OR DEMOLISHED IN CITIES WITH MANDATORY PROGRAMS



Data Source: CSSC, 2006 (Table 3)

Prioritization and Pacing

- Among targeted buildings, sequence or timelines can be structured differently
  - Year built, number of stories, unit totals, occupancy, or combinations thereof
  - Puts most important and/or risky building first
- Most soft-story policies use this tactic
  - SF, Oakland, and LA have "tiers"
- Eases both owner compliance and program operations

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Palo Alto's Current Program Uses Categorization to Shape Goals & Timing

- Options for further leveraging prioritization and pacing:
  - Create graduated schedule to emphasize most important buildings first
  - Allow owners more time to comply for more costly and complex projects
  - Gradually reduce incentives for owners that take longer to comply

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"Sunshine" Measures: Searchable Lists, Signs, Tenants, and Notices

City of Alameda Soft Story List (3/2015)

1500	ALAMEDA	AVE	HOMEOWNERS ASSOCIATION
2128	ALAMEDA	AVE	AHMETSPAHIC MEHMED & DZEVAHIRA
1455	BAY	ST	KREISS NORMAN S
3215	BRIGGS	AVE	COMMON AREA OF TRACT 3365
3221	BRIGGS	AVE	LUCCHESE BRUNO J TR
3224	BRIGGS	AVE	MARTINEZ PETER E & ANGELITA C TRS
3225	BRIGGS	AVE	LUCCHESE BRUNO J TR
3228	BRIGGS	AVE	LAKEPARK LODGE PARTNERSHIP & MARIE HINTON FAM ETAL
3250	BRIGGS	AVE	MUSSER LORRAINE D TR & ASHBAKER ROBERT A & DIANE
301	BROADWAY		NOBLE COMMUNITY MANAGEMENT
470	BUENA VISTA	AVE	DER YIM N & QUAN K
520	BUENA VISTA	AVE	JAZMIN JOSE P & BETTY TRS
547	BUENA VISTA	AVE	MAHMOUDIAN M & MURRAY T C TRS EXEMPTIC
434	CENTRAL	AVE	MENDOZA GENARO
475	CENTRAL	AVE	KAHN MELVIN TR
600	CENTRAL	AVE	PEREZ HEIDI & DONALD PEREZ TRS & PEREZ HEIC
724	CENTRAL	AVE	SHAFFER E G TR TRUST I & E G TR NON EXEMPT
831	CENTRAL	AVE	HO ALBERT M & SERENA S
1704	CENTRAL	AVE	GOLDSTEIN RUTH B TR
1715	CENTRAL	AVE	ASRANI FAMILY LP
1732	CENTRAL	AVE	MAR WAYNE & HUANG NUAN Q TRS
1812	CENTRAL	AVE	SYCAMORE OF ALAMEDA HOA
1836	CENTRAL	AVE	HASSEN ABDEL K & FATIMA TRS
2026	CENTRAL	AVE	JAN RICHARD & NANCY
2037	CENTRAL	AVE	FOSTER EDWARD J TR
2043	CENTRAL	AVE	VETTERLI ELIZABETH TR & LUNDBORG WILDA M
2050	CENTRAL	AVE	CHOW LALIE K
2053	CENTRAL	AVE	JABER SAM & BILLIE J TRS
2101	CENTRAL	AVE	MAGNOLIA HOMEOWNERS ASSOCIATION
2115	CENTRAL	AVE	HOMEOWNERS ASSOC
2119	CENTRAL	AVE	GALETTO MARIO & ALBINA M
2253	CENTRAL	AVE	SASAKI ROBERT J TR
1515	CHESTNUT	ST	NGUYEN XUAN Q & DANG NGOC B
1531	CHESTNUT	ST	LEE MALCOLM P & SHU M

NOTICE

YOU ARE REQUIRED BY LAW

TO COMPLETE A SOFT STORY SCREENING FORM BY SEPTEMBER 15, 2014

Nearly 3000 buildings like yours have already returned their screening forms. Many owners have begun their required upgrades, while many are not required to retrofit at all. Act now to avoid penalties!

Palo Alto's Current Program Does Not Take Full Advantage of Sunshine

- Options for making more visible and increasing the costs of not retrofitting:
  - Make listing of buildings more accessible
  - Publicize list of buildings
  - Tenant notification
  - Community forums

- These options ALSO increase the benefits of retrofitting

Nudging and Easing the Path With Incentives

Financial Tools	Policy Tools
Bonds	Density or Intensity Bonuses
Grants	Exemptions for Non-Conformities
Loans	Zoning Incentives
Property-Assessed Financing Loan (PACE)	Condominium Conversion Assistance
Tax Credits	Exemptions or Relief from Standards or Non-Conforming Conditions
Real Estate Transfer Tax Rebates	Exemption from Future Retrofit Requirements
Waivers or Reductions of Building Department Fees	Transfer of Development Rights (TDR)
Pass Through of Retrofit Costs to Tenants	Expedite Permits, Inspections, and Reviews
Special District or Historic Designation Tax Reductions	

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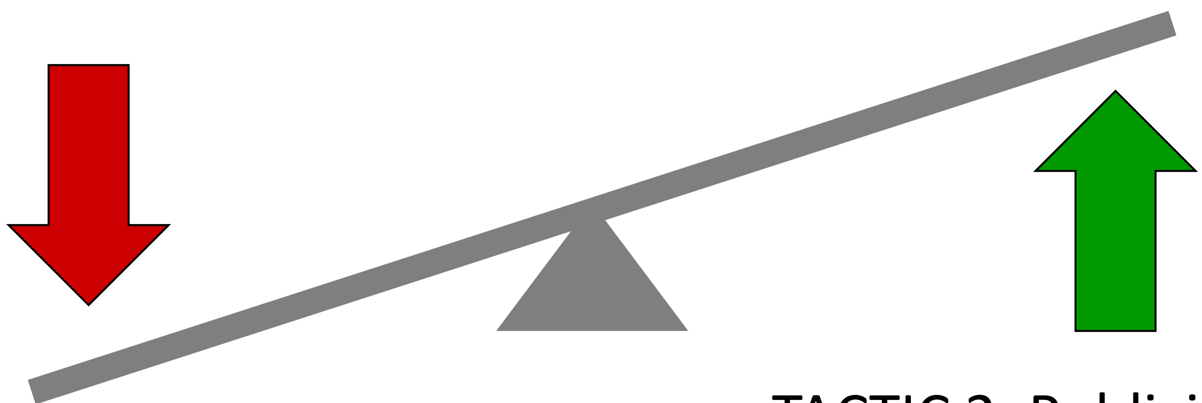
Strategically Combine Policy Features to Promote Risk Reduction

TACTIC 1: Publicize and increase the consequences of not retrofitting

PUBLIC SAFETY, LOSS AVOIDANCE, AND RESILIENCE BENEFITS FROM RETROFIT WORK



STATUS QUO

TACTIC 2: Publicize, ease the costs, increase the benefits of retrofitting

What's the Right "Policy Package" for Palo Alto Going Forward?

1. **Which buildings to target?**
   - Expand to one or more other types or same categories as now?
2. **Which requirements and features?**
   - Expand voluntary program measures, add mandatory screening or evaluation, and/or mandate retrofit
3. **How to motivate and sustain progress?**
   - Phases, tiers, timing, and enforcement
   - Offer a strategic range of incentives
   - Adequate program budget

The Advisory Group Process Moving Forward

Suggested pathway to reach recommendations for Council:

- Reach agreement on the most important sources of risk
- Define program goals and priorities based on implications for the community
- Evaluate policy options

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Meeting Wrap-Up and Follow-Ups

- Outcomes from today
- What will be added to the website
- Next steps
  - Completion of Task 3 report and issue
  - Conceptual retrofit
  - Loss estimate of retrofitted buildings
- Scope of next meeting on April 14
  - Review loss estimate of retrofitted buildings
  - Continue policy option discussion

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City of Palo Alto Seismic Risk Management Program

Rinconada Library
1213 Newell Rd.
Embarcadero Room

Monday, May 16, 2016 ☒ Discussion ☒ Action

Our proposed topics, objectives, distribution materials, agenda, and issues for the third Advisory Group session are described below.

MEETING DATE, TIME, AND LOCATION

- Date: Monday, May 16, 2016
- Time: 1pm – 4pm
- PLEASE NOTE DIFFERENT LOCATION: Rinconada Library (Embarcadero Room)
  1213 Newell Rd
  Palo Alto, CA 94303

MEETING OBJECTIVES

- Review loss estimation findings and retrofit cost/benefit results
- Introduce policy, incentive, and disclosure options for Palo Alto
- Advisory Group members discuss and compare potential policy directions

PRE-MEETING MATERIALS

- Minutes from AG3
- Agenda for AG4
- Discussion handout AG4
- Task 2 draft report – Review of state legislation and requirements
- Task 3 draft report – Local program best practices assessment

Notes:

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City of Palo Alto Seismic Risk Management Program

Project Team Meeting
Rinconada Library (Embarcadero Room)
1213 Newell Rd. Palo Alto, CA 94303

Monday, May 16, 2016 AGENDA

Time	Subject	Lead
1:00 pm	Welcome	George Hoyt / Bret Lizundia
1:05 pm	Project business Review/approve minutes from 3/17/16 AG3 meeting Quick recap of activities since last meeting Timeline status	
1:15 pm	Presentation of risk assessment results Comparison of loss estimates with and without retrofit Retrofit cost/benefit results Building types that reflect greatest potential for aggregate risk reduction	Bret Lizundia
2:00 pm	Presentation on policy, incentive, and disclosure options for Palo Alto Summary of six main policy options, including precedents and pros / cons of different policy features	Sharyl Rabinovici
2:25 pm	Stretch Break	
2:30 pm	Small group break-outs: Tables with 4-5 members each discuss options list for Palo Alto with an emphasis on: Policy mechanisms and targeted building types Disclosure measures Incentive options	Sharyl Rabinovici / Small Groups
3:10 pm	Reconvene to advance the conversation on preferred policy directions and identify issues needing attention Small groups report back Larger group discussion Anonymous straw poll and results	All / Bret Lizundia
4:00 pm	Adjourn	

Seismic Advisory Group
Meeting #4
May 16, 2016
1 – 4 pm
Rinconada Library

MEETING MINUTES – SEISMIC RISK MANAGEMENT ADVISORY GROUP

Attendance By:	Peter Pirnejad (PP), Development Services Director COPA George Hoyt (GH), Chief Building Official COPA Evon Ballash (EB), Assistant Building Official COPA Bud Starmer (Bud S), Building Inspection Supervisor COPA James Henrikson (JH), Fire Marshal COPA Meg Monroe (MM), Senior Planner COPA Bret Lizundia (BL), Principal, Rutherford+Chekene (R+C) Sharyl Rabinovic (SR), Sub Consultant to R+C Ken Joye, Venura NPC Rich Cody, Cody Brock Anil Babbar, CAA Chris Rojahn, ATC Tom Holzer, USGS Dana Brechwald, ABAG Teresa Marks, Hudson Pacific Blake Salzman, Allerion Consulting Group Roxy Rapp, Developer Ken Hayes, Hayes Group Annette Glanckopf, Community
Minutes Prepared By:	Evon Ballash
ITEMS	DISCUSSION
Introduction	General: ➢ Introduction by GH: The objectives of this meeting are to review the loss estimation findings; introduce policy, incentive and disclosure options; and then the advisory group will break out in small groups to discuss possible policy directions and options. ➢ Approval of Meeting #3 minutes was passed without comments. ➢ BL reviewed meeting agenda in more detail with the group. Goals for the meeting are to review the project progress, discuss plans for the sidewalk survey, review the first round of loss estimates from AG3 for unretrofitted buildings, show the retrofit schemes developed for buildings of interest, and summarize the second round of loss estimate that cover retrofitted buildings. The meeting will also discuss policy, incentive, and disclosure options and issues. Handouts have been provided for discussion in small groups. They cover Guiding Principles, potential program options, building types to be considered, types of disclosure measure options, incentive option types that includes financial and policy incentives. A list of Straw Poll Questions has also been distributed and will be used for the small group discussion and an anonymous poll.

MEETING MINUTES – SEISMIC RISK MANAGEMENT ADVISORY GROUP

Program Timeline	➢ The timeline and purpose of the Advisory Group was discussed. ➢ A general timeline for the project as well as the Advisory Group meetings was shared by BL. ➢ Findings and results will be presented to the Policy and Services Committee later in the summer. ➢ Advisory group program recommendations are to be presented to city council for review by October.
Inventory	➢ This project inventory excludes one and two family dwellings, public schools and OSPHD – regulated hospitals. It currently contains 2632 buildings. ➢ Under the current Palo Alto seismic retrofit ordinance from 1986 there 25 buildings remaining that have not yet been retrofitted or demolished. ➢ 615 additional building have been identified as potentially hazardous and may be considered in the expanded ordinance. ➢ The building types within this inventory that are considered a high priority for consideration in an updated City program include wood frame soft-story multi-family residential and commercial buildings, concrete tilt-up buildings, old concrete buildings including soft-stories, and steel moment frame structure (pre-Northridge).
Loss Estimates	➢ There are two scenarios considered: damage from earthquake with magnitude of 6.7 (M6.7) and with a magnitude of 7.9 (M7.9). ➢ The ratio of M7.9/M6.7 of buildings with a damage ratio ≥ 20% is 12:1 without retrofitting. Average ratio of M7.9/M6.7 for Total Losses (building damage plus content damage in dollars) without retrofitting is 2:1. Total losses for M7.9 are $2.4 billion. ➢ After retrofitting, the number of buildings with damage ratio ≥ 20% is significantly reduced. The losses for M7.9 event are $1.3 billion. ➢ Retrofitting reduces the expected damage in a M7.9 event by approximately $1.1 billion in building damage and content. ➢ For building types: the worst damage depended on the metrics used. Building types with the largest dollar amount losses were not necessarily buildings with the highest percentage of damage since there are different numbers and sizes of buildings in the

	different building types. The building types with the largest aggregate building damage dollar losses are concrete shear wall, concrete tilt-ups, and wood frame commercial/industrial buildings. ➢ For building occupancies: the worst occupancy for damage also depended on the metrics used. Occupancies with largest dollar amount damages were not necessarily the worst damaged. The occupancy types with the largest aggregate building damage dollar losses were Professional/ Technical, School/ Libraries and Retail occupancies. ➢ Older buildings performed worst on average than newer buildings. Retrofit improvements to older pre-1927 buildings and buildings built between 1927–1961 had the most benefit in total aggregate damage dollar loss reduction. ➢ For building damage by survey sector, one of the sectors wit h the greatest reduction in aggregate building damage dollar losses occurred along Page Mill Rd where there are a number of older commercial buildings. ➢ The ratio of average damage for soft story buildings without retrofitting compared to buildings without soft stories was doubled. Soft story buildings also significantly increased the percentage of buildings with large loss ratios. ➢ The benefits of retrofitting soft story buildings are significant
Retrofit Schemes	➢ The 12 most common building prototypes seen in Palo Alto were considered. ➢ Study Example Prototype: Wood frame larger residential with soft story prototype: • Infill steel moment frame along the first floor soft story level • provide new plywood shear walls in the perpendicular walls
Performance Expectations	➢ Unstrengthened building had significant damage after M7.9 with the risk of collapse on the ground floor and significant cracking of the stucco walls and interior partition damage. There were a higher percentage of red tagged structures compared to green and yellow tags. ➢ Rehabilitated structures for life safety concerns had less damage with a lower amount red tags and a higher number of green tags.

Retrofit Costs	➢ Hard costs include the contractor bid cost and design contingencies to conceptual retrofits. ➢ Soft costs include design fees for architect and engineers, testing and inspection costs, permit fees and owner change orders. ➢ Not included are hazmat abatement, occupants-in-place cost, accessibility upgrades, historic building costs, relocation/ interruption of tenants, program management, renovation costs, repair of existing conditions, financing costs, legal fees, etc. ➢ The 12 retrofit prototype buildings types were: 1. Woodframe Smaller Residential, 2 stories 2. Woodframe Larger Residential, 2 stories 3. Woodframe Larger Residential, 3 stories 4. Woodframe Commercial/ Industrial, 2 stories 5. Steel Moment Frame, 2 stories 6. Concrete Shear Wall, 1 story 7. Concrete Shear Wall, 2 stories 8. Concrete Tilt-up, 1 story 9. Concrete Tilt-up, 2 stories 10. Reinforced Masonry, 1 story 11. Reinforced Masonry, 2 stories 12. Unreinforced Masonry Bearing Wall, 1 story ➢ For the retrofit prototypes, the average retrofit costs ranged from \$6/s.f. to \$110/s.f.
Cost Benefits	Model Building Type: ➢ The average damage reduction from retrofitting ranged from \$4/s.f. to \$121/s.f. ➢ Steel frame building with masonry infill showed the highest retrofit benefit of \$121/s.f. ➢ The retrofit costs were on order with the damage reduction. Selected Building Types with Highest Benefit to Cost Ratio: ➢ Pre-1977 Woodframe Soft Story Buildings: 1. Inventory of 294 buildings 2. \$46/s.f. average damage loss avoided by retrofitting 3. Cost to retrofit \$4/s/f 4. Average loss avoided/average retrofit cost: 4:1 ➢ Pre-1998 Tilt-Up Buildings: 1. Poor connections of roof to walls 2. Intermediate and end roof bays collapses 3. Average loss avoided/average retrofit cost: 3:1

	➢ Pre-1977 Concrete Soft Story Buildings: 1. Inventory of 37 buildings 2. Average loss avoided/average retrofit cost: 3:1 ➢ Pre-1998 Steel Moment Frame Buildings: 1. Average loss avoided/average retrofit cost: 11:1 (high) 2. Low cost retrofits with steel brace frames.
Policy Mechanisms	Range of Policies Approaches: ➢ Inventory Only: create a list of hazard building types for the public ➢ Notify Only: the inventory list is used to notify property owners ➢ Voluntary Retrofit: owners on the public inventory list are encouraged to retrofit. ➢ Disclosure Measure: publically available lists are disclosed to tenants, public signage, recorded notice. ➢ Mandatory Screening: owners on the public inventory are required to submit a form by a licensed professional ➢ Mandatory Evaluation: owners on the public inventory are required to submit an evaluation by a licensed professional ➢ Mandatory Retrofit: owners on the public inventory are required to retrofit by a certain date. Bundled Options with Increasing Regulatory Strength: ➢ Option 1: Status Quo, do nothing. The cities of Albany, Alameda and Richmond have chosen this path. ➢ Option 2: Add more building type requirements with voluntary retrofit. ➢ Option 3: Add more building types with voluntary retrofit plus disclosure. ➢ Option 4: Add more building types with some triggered mandatory measures. ➢ Option 5: Add more building types with some mandates with fixed timelines. ➢ Option 6: Add more building types with more mandates with timelines. This option was used by Los Angeles and San Francisco. ➢ Bud S noted that Town & Country Shopping Center has completed extensive retrofit. The cost of retrofit is exempt from property tax increases for improvements.
Disclosure Methods	➢ Bundle 1: Basic Transparency, inventory lists and information are readily available for owners on websites.

	➢ Bundle 2: Community Awareness: public inventory lists are focused for tenants and citizens, such as tenant notification forms to be signed and on file with the city. San Francisco runs retrofit fairs, similar to a trade show with vendors and regulatory agencies. ➢ Bundle 3: Onsite signage on buildings with seismic hazards. Example signs can be multi-lingual. Also includes building rating systems. ➢ Examples of website disclosure lists can be found with the City of Alameda, Berkeley. ➢ USRC (U.S. Resiliency Council) provides a rating system of buildings for safety, damage and recovery.
Incentives	Financial Incentives: ➢ Type 1: Basic Help 1. Provide fee waivers or reductions of building permit fees. ➢ Type 2: Project Facilitation: 1. Property-Assessed Financing Loan, PACE, subsidized loan that is paid off through tax increments over 20 years. ➢ Type 3: Deeper Financial Assistance: 1. Real estate transfer tax rebates 2. Special district or historical designation tax reduction 3. Tax credits 4. Grants 5. Special purpose bonds. Policy Incentives: ➢ Type 1: Basic Help 1. Exemption from future retrofit requirements 2. Expedited building permits and inspections ➢ Type 2: Project Facilitation 1. Exemptions or relief from standards or non-conforming conditions 2. Zoning relief, e.g. set-backs, parking 3. Density or intensity bonuses, e.g. increase F.A.R. Floor Area Ratios 4. Transfer of Development Rights
Small Group Breakout	➢ The advisory group participants were split into 4 groups and asked to discuss the merits and drawbacks of the various policy options, disclosure methods and incentive options. At the end of the discussion, participants are asked to complete an anonymous straw poll survey.

MEETING MINUTES – SEISMIC RISK MANAGEMENT ADVISORY GROUP

Large Group Discussion	Group A Comments: ➢ Discussed policy options of owner evaluation of soft story residential multi-family buildings on a 1-2 year lease. Tenant notices, building evaluations and retrofits could be on timeline as triggers may not be applicable or desirable. ➢ Commercial building tenants have longer leases of 5 years and are not readily vacant to retrofit, so a timeline may not be feasible. Possibly a trigger by building sale could be used. ➢ Incentives to allow lease termination to facilitate retrofit work and TDR/FAR expiration. Group B Comments: ➢ Concerned about repercussions of rental increases for retrofit work. ➢ Concerned that short term triggers may compromised quality. ➢ Loss estimation for individual properties could be beneficial. ➢ Incentive to retrofit was already high for owners. ➢ Quality of life matters and there may be resistance to zoning relief. ➢ Residents care if buildings are safe and that people are informed with signage. Group C Comments: ➢ Discussed concerns of residents separately from business owners ➢ Residents favor signage on buildings and sunset triggers for incentives ➢ Business owner finds sunset triggers were a disincentive and considers FAR to be a valuable incentive tool for large commercial buildings. ➢ Favors bundles 1 & 2 for disclosure measures, seems to be more realistic, but signage might be too much. ➢ Signage could kick in after a certain time period if no retrofit action occurs. Group D Comments: ➢ Felt that soft story retrofits were the "best bang for the buck" value wise and easier to retrofit without disturbing occupants. ➢ Include older tilt-up building type, with feasible retrofits by improving roof ledger connections. ➢ Provide incentives and mandates for older URM buildings that have not yet been retrofitted to get them safe. Liability concerns on these 25 URM buildings may need to ramp up with notifications. ➢ Favors Type 2: Project Facilitation using policy incentives, financial incentives may not be as critical in Palo Alto. ➢ Parking incentives for retrofitting to be transferrable.

MEETING MINUTES – SEISMIC RISK MANAGEMENT ADVISORY GROUP

Straw Poll Results	Policy Options; ➢ Option 5 received the most votes with 9, which covered increased scope, some categories voluntary and some categories mandatory with enforcement by a fixed timeline. ➢ Option 3 received the next highest votes of 4, and supported increased scope, voluntary retrofit and some disclosure measures. ➢ Option 1: Status Quo received one vote ➢ Option 6: Increase scope with mandatory measures received one vote. Building Types: ➢ Soft Story was almost unanimous in all combinations, except for one vote ➢ Combinations of all types were favored by all. Disclosure Measures: ➢ Combination of the various bundles was chosen by all ➢ Signage received less robust support. It may be desirable to implement this with voluntary programs and/or after the owner has not progress in retrofitting. Incentives: ➢ Type 2: Project Facilitation tied for the most votes with 7 ➢ Type 4: Combination of all types received 7 votes ➢ Type 3: Deep Financial Assistance received 1 vote Level of Interest: ➢ High interest was selected for all
Action Items	➢ Create a consensus from the advisory group to make recommendations to the city council ➢ Next meeting in 4 - 5 weeks (mid to late June). Send out doodle pool to members.

City of Palo Alto

Seismic Risk Management Program

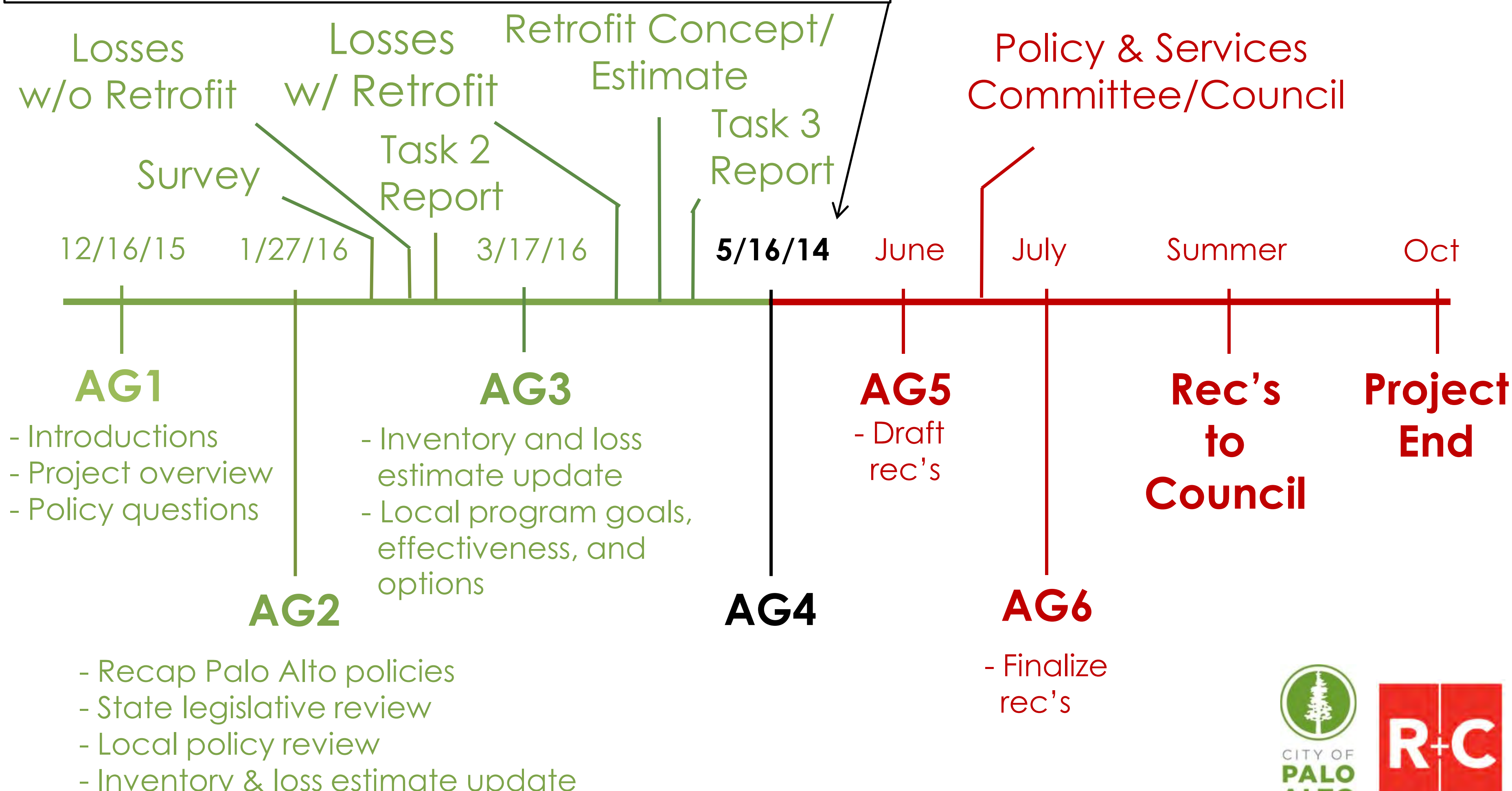
Advisory Group Meeting #4
May 16, 2016

Before Meeting
- AG3 minutes
- AG4 agenda & handouts
- Task 2 report
- Task 3 report

At Meeting
- Review loss estimation findings & cost/benefit results
- Introduce policy, incentive, and disclosure options
- Discuss potential policies

Purpose of Advisory Group

To review and discuss implications of the project's technical findings and provide input about community concerns, priorities, and preferences.



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Project and Advisory Group Process Status

- Review of minutes from 3/17/16 AG3 meeting
- Seismic Risk Management Program Website: http://www.cityofpaloalto.org/gov/depts/ds/srmag.asp
  - Added content includes presentation slides and minutes from last meeting

Guiding Principles

- **Palo Alto faces significant losses.**
- **Potential benefits from retrofitting are also significant.**
- **Addressing known potentially hazardous building types that are present in large numbers maximizes risk reduction.**

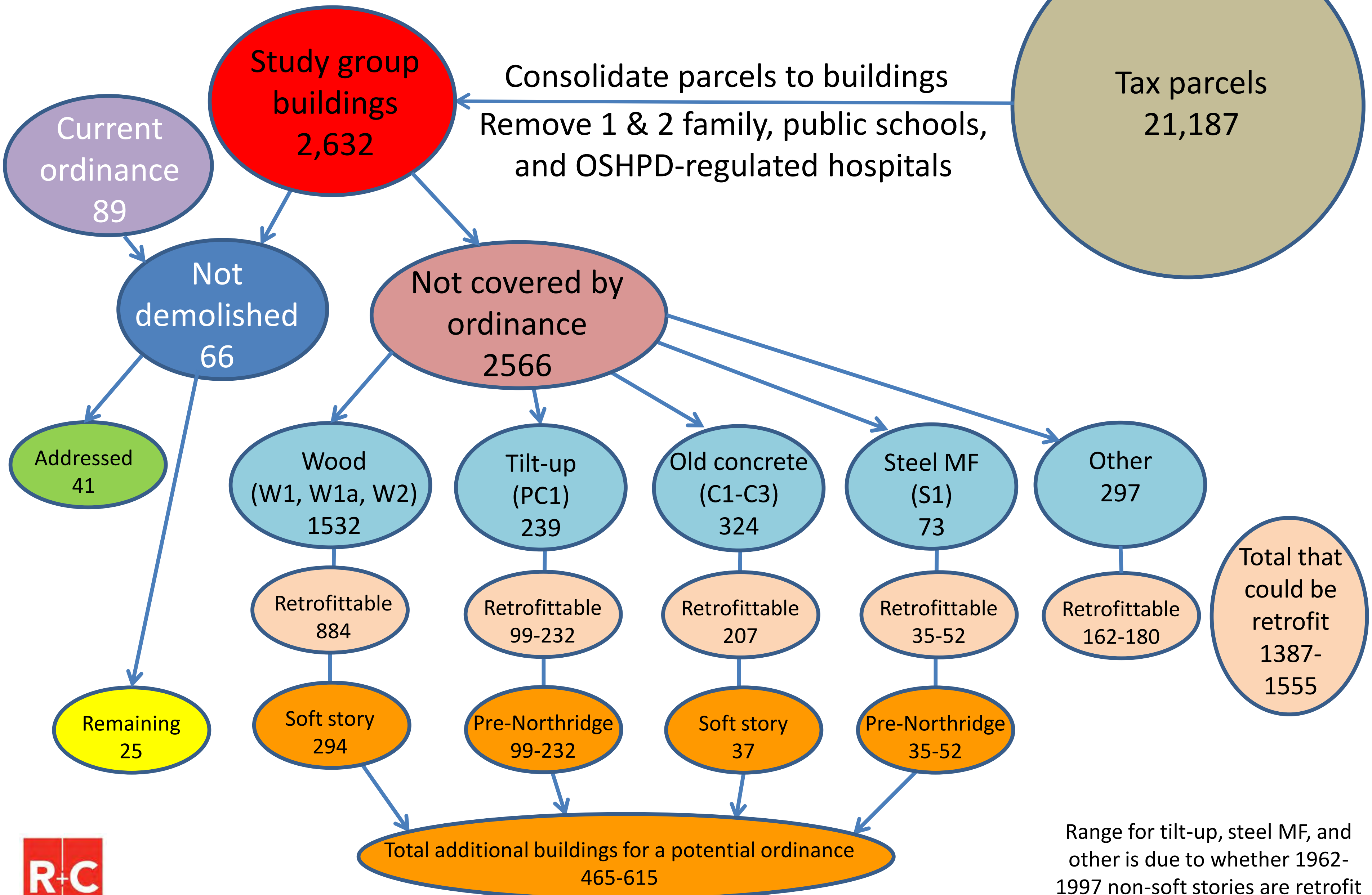
- A range of policy approaches can be combined into a program package.
- A range of incentives can help ease the process.

How Many Buildings are We Talking About? (the Short Version)

- Covered by current ordinance, but not yet retrofit or demolished:
  25

- Additional buildings that are potentially hazardous and recommended for a possible expanded ordinance:
  615

The Longer Version



Range for tilt-up, steel MF, and other is due to whether 1962-1997 non-soft stories are retrofit

What is the Total Exposure?

- Number of buildings:
  2,632
- Total replacement value of buildings:
  $18.9B
- Total value of contents:
  $17.3B

What are the Major Building Types?

Model Building Type	Description	Number of Buildings	Aggregate Building Value ($M)
C2	Concrete shear wall	318	4,082
PC1	Concrete tilt-up	242	3,368
W1A	Woodframe larger residential	331	3,232
W2	Woodframe commercial/industrial	307	2,369
S2	Steel braced frame	50	1,391
W1	Woodframe smaller residential	898	1,278
S1	Steel moment frame	75	1,242
RM1	Reinforced masonry, wood floor	285	1,209
RM2	Reinforced masonry, concrete floor	30	211
S3	Steel light metal frame	41	177
PC2	Precast concrete frame	5	125
C1	Concrete moment frame	18	117
S4	Steel frame with concrete shear walls	13	72
URM	Unreinforced masonry bearing wall	9	15
C3	Concrete frame with masonry infill	8	8
S5	Steel frame with masonry infill	2	3
Totals		**2,632**	**18,899**

Loss Estimates

- Two scenarios (M6.7 and M7.9)

- Last meeting:
  - Initial run: Losses without new retrofit

- Today:
  - Updated the initial run to exclude hospitals not regulated by Palo Alto
  - Developed conceptual retrofits with cost estimates
  - Losses with new retrofit
  - Losses avoided by retrofitting

What are the Total Losses <u>Without</u> New Retrofitting?

Earthquake Scenario	Building Value ($B)	Content Value ($B)	Estimated Building Damage ($B)	Average Building Damage Ratio	Number of Bldgs with Damage Ratio ≥ 20%	Estimated Content Damage ($B)	Average Content Damage Ratio	Total Building & Content Damage ($B)
M7.9	18.9	17.3	1.7	9%	224	0.7	4%	2.4
M6.7	18.9	17.3	0.8	4%	19	0.4	2%	1.2
Ratio of M7.9 / M6.7			**2**	**2**	**12**	**2**	**2**	**2**

<u>Takeaways</u>:

- Ratio for $ loss and average % damage is about 2,
  but is about 12 for number of buildings with over 20% loss.
- Losses in M7.9 are $2.4B.

What are the Total Losses With New Retrofitting?

Earthquake Scenario	Building Value ($B)	Content Value ($B)	Estimated Building Damage ($B)	Average Building Damage Ratio	Number of Bldgs with Damage Ratio ≥ 20%	Estimated Content Damage ($B)	Average Content Damage Ratio	Total Building & Content Damage ($B)
M7.9	18.9	17.3	0.9	5%	6	0.5	3%	1.3
M6.7	18.9	17.3	0.5	3%	0	0.3	2%	0.8
Ratio of M7.9 / M6.7			**2**	**2**	**---**	**2**	**2**	**2**

Takeaways:

- Ratio for $ loss and average % damage is about 2, and the number of buildings with over 20% loss is *dramatically reduced* (e.g. in M7.9 224 without retrofit vs. 6 with retrofit)
- M7.9 losses are $1.3B.

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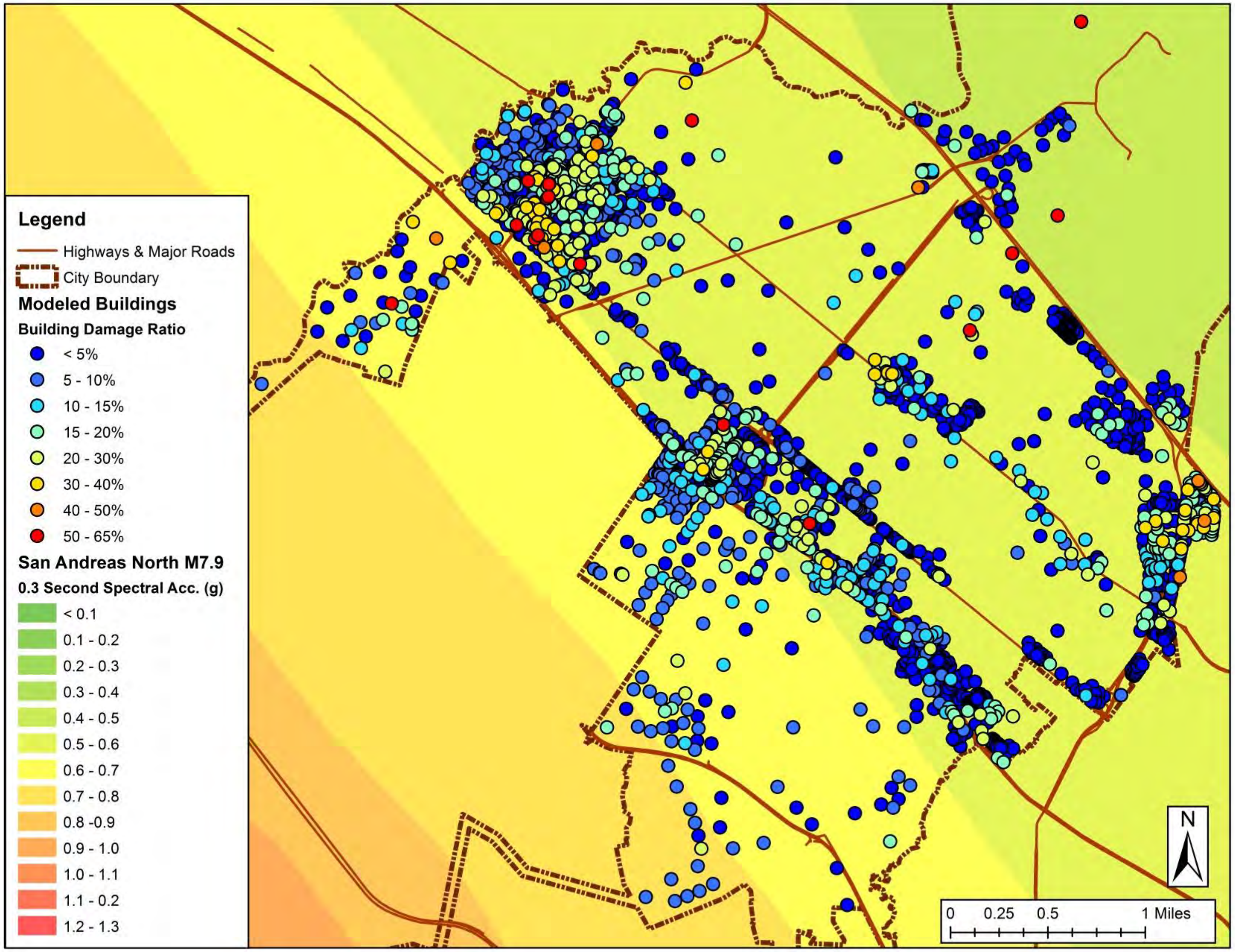
What is the Improvement due to Retrofitting?

Improvement = Reduction in damage
= Losses <u>without</u> retrofit – losses <u>with</u> retrofit

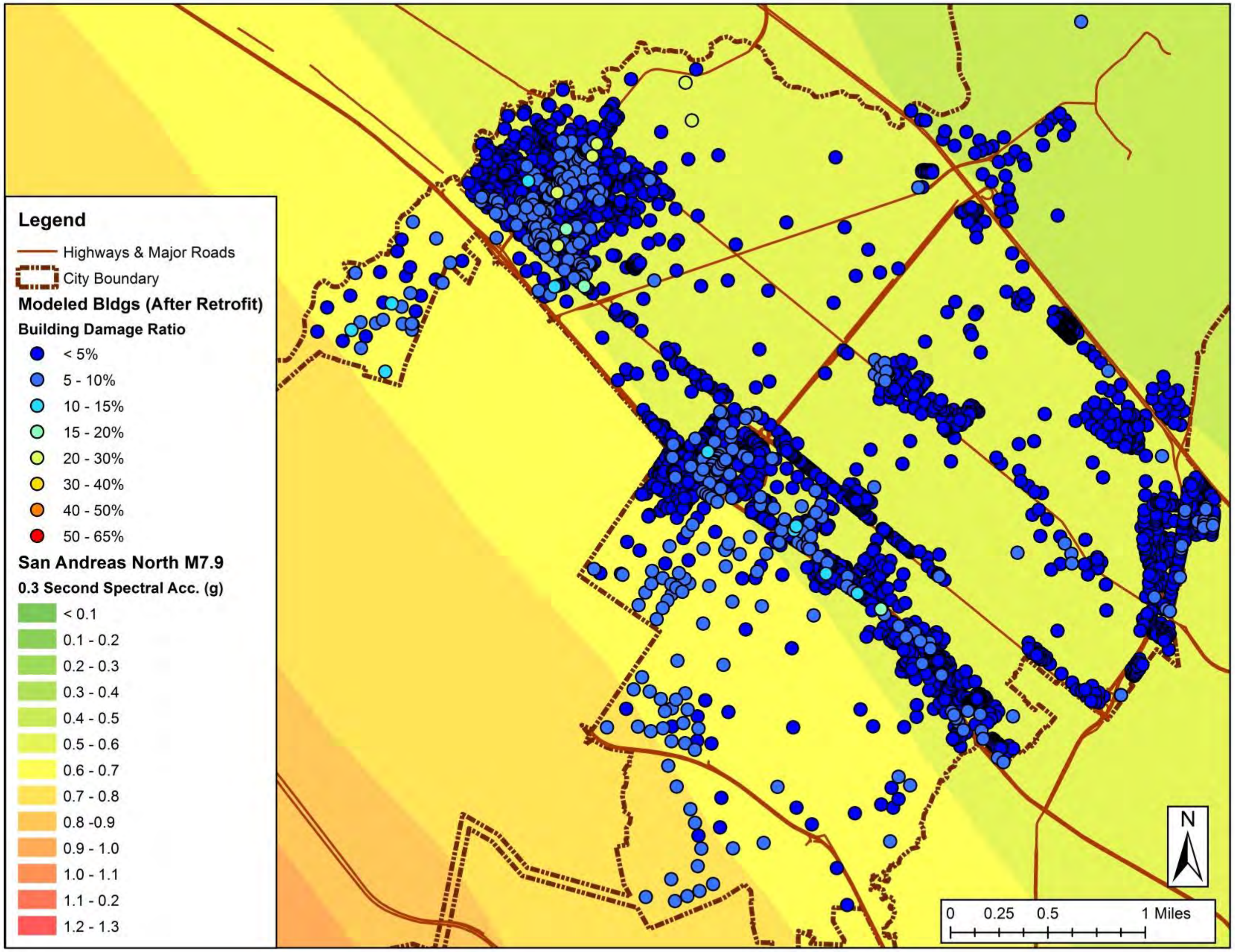
Earthquake Scenario	Building Value ($B)	Content Value ($B)	Building Damage Reduction ($B)	Building Damage Reduction (%)	Content Damage Reduction ($B)	Content Damage Reduction (%)	Total Building & Content Damage Reduction ($B)
M7.9	18.9	17.3	0.8	47%	0.2	33%	**1.0**
M6.7	18.9	17.3	0.3	36%	0.1	19%	0.4
Ratio of M7.9 / M6.7			**3**	**1**	**2**	**2**	**3**

<u>Takeaway</u>: Retrofitting reduces the expected damage in a M7.9 event by about $1 billion in building and content damage.

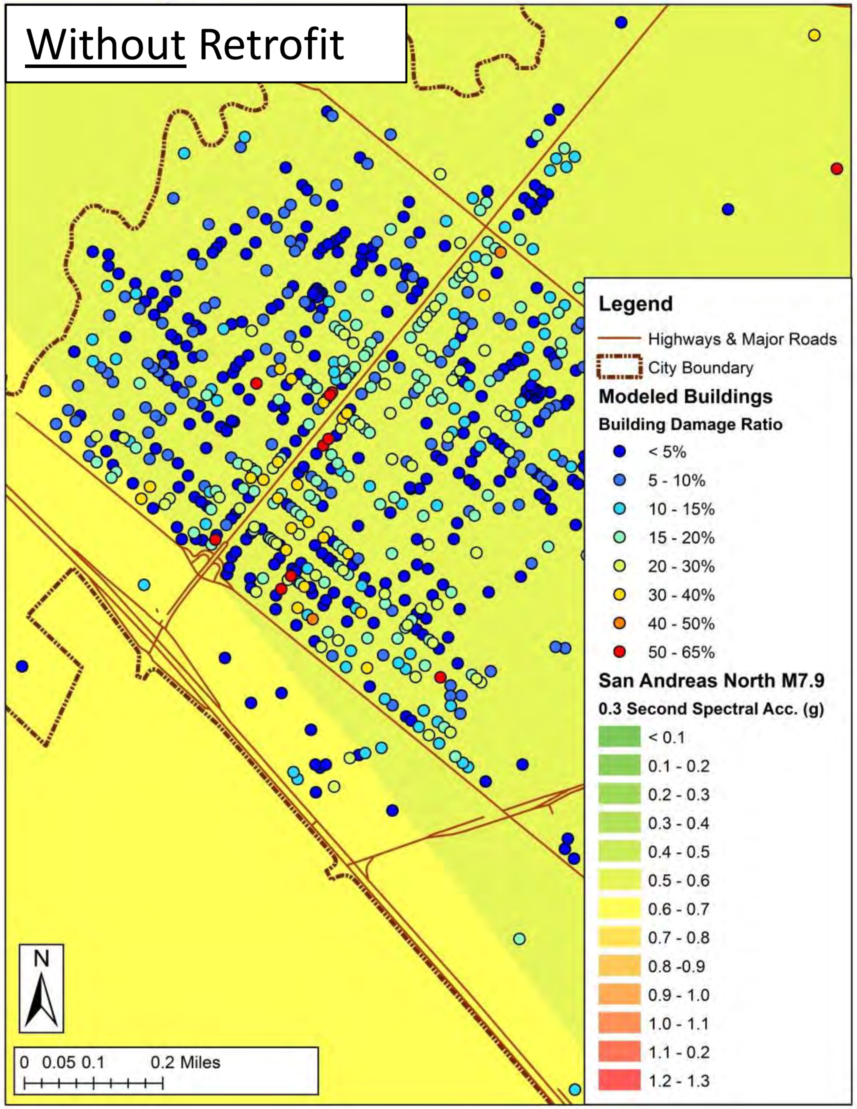
Building Damage Ratio – Without New Retrofit

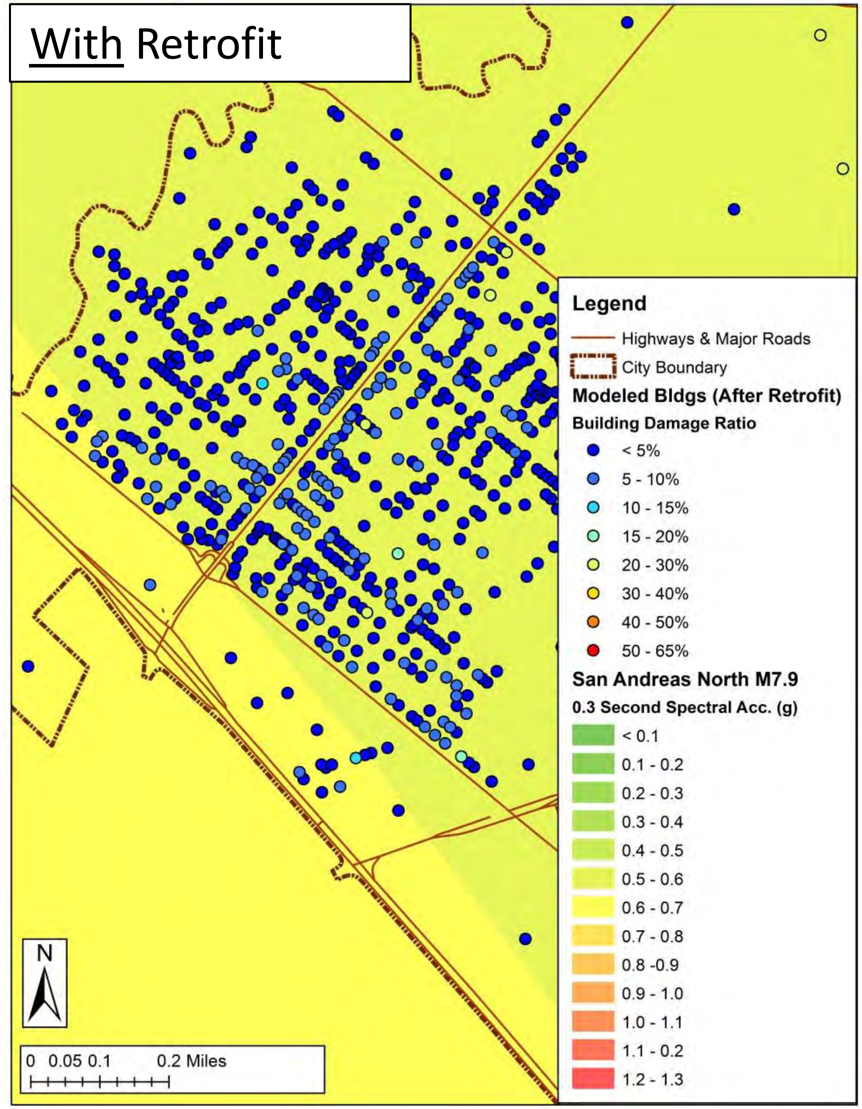


Building Damage Ratio – <u>With</u> New Retrofit



Building Damage Ratio - Downtown





What are the Worst Building Types?

			San Andreas M7.9		
Building Type	Number of Buildings	Building Value ($M)	Estimated Building Damage ($M)	Average Building Damage Ratio	Number of Bldgs with Damage Ratio ≥ 20%
Concrete shear wall	318	4,082	**477**	14%	75
Concrete tilt-up	242	3,368	**365**	12%	32
Woodframe commerical/industrial	307	2,369	**216**	9%	9
Steel frame with masonry infill	2	3	1	**38%**	1
Unreinforced masonry bearing wall	9	15	4	**29%**	9
Concrete frame with masonry infill	8	8	2	**29%**	6
Concrete shear wall	318	4,082	477	14%	**75**
Concrete tilt-up	242	3,368	365	12%	**32**
Steel moment frame	75	1,242	130	18%	**27**

Takeaways

- Depends on metric used
- Largest $ losses ≠ types with the highest damage %

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What are the Worst Occupancies?

Occupancy Type	Number of Buildings	Building Value ($M)	San Andreas M7.9 Estimated Building Damage ($M)	San Andreas M7.9 Average Building Damage Ratio	San Andreas M7.9 Number of Bldgs with Damage Ratio ≥ 20%
Professional/Technical	676	8,047	**789**	12%	92
Schools/Libraries	18	1,146	**184**	10%	3
Retail Trade	199	1,037	**129**	14%	31

Theaters	2	8	2	**28%**	2
Construction	5	5	1	**26%**	3
Colleges/Universities	2	6	1	**25%**	2

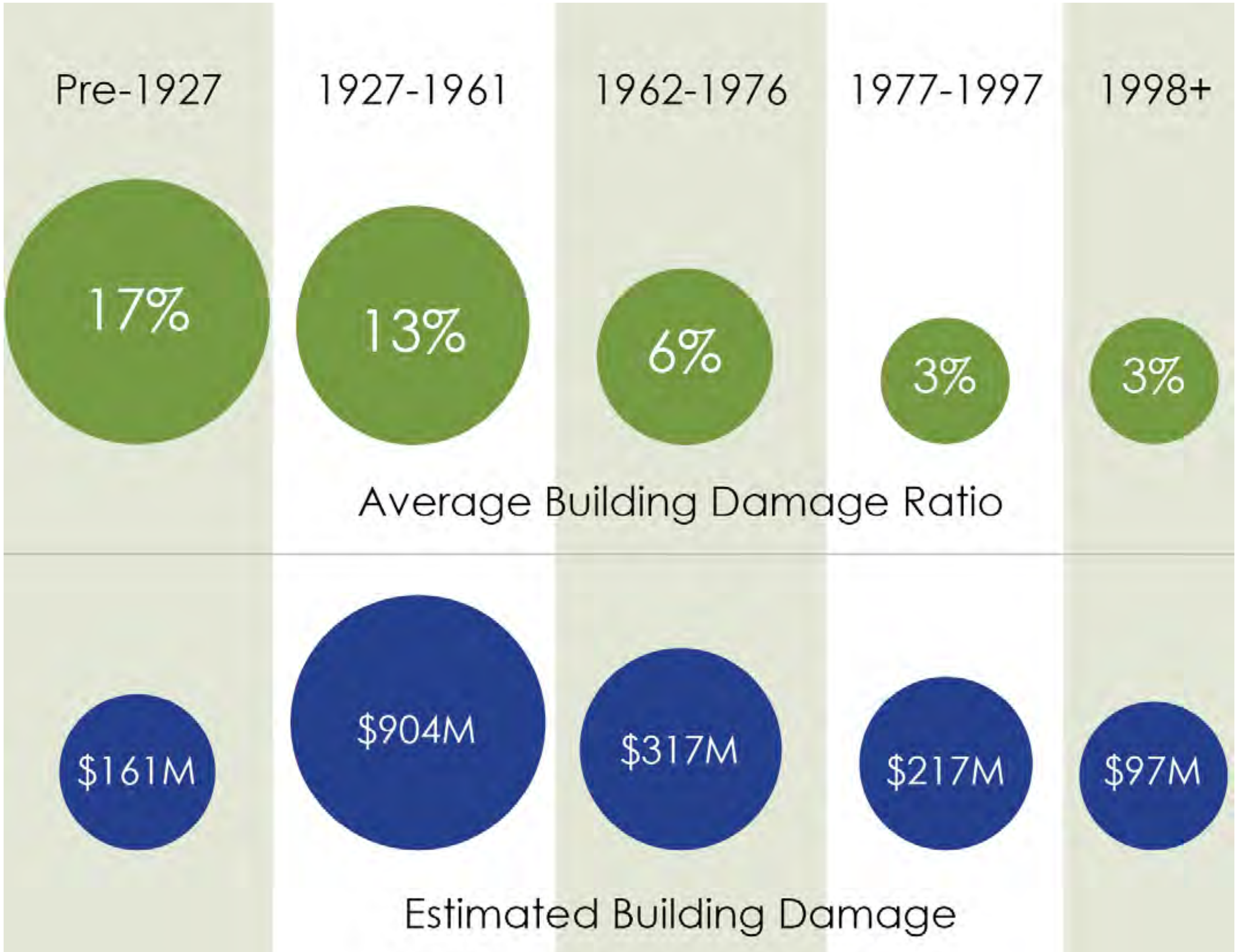
Professional/Technical	676	8,047	789	12%	**92**
Entertainment and Recreation	155	641	81	14%	**37**
Retail Trade	199	1,037	129	14%	**33**

Takeaways

- Like building type, worst occupancy depends on metric used.
- Similarly, largest $ losses ≠ highest damage %.

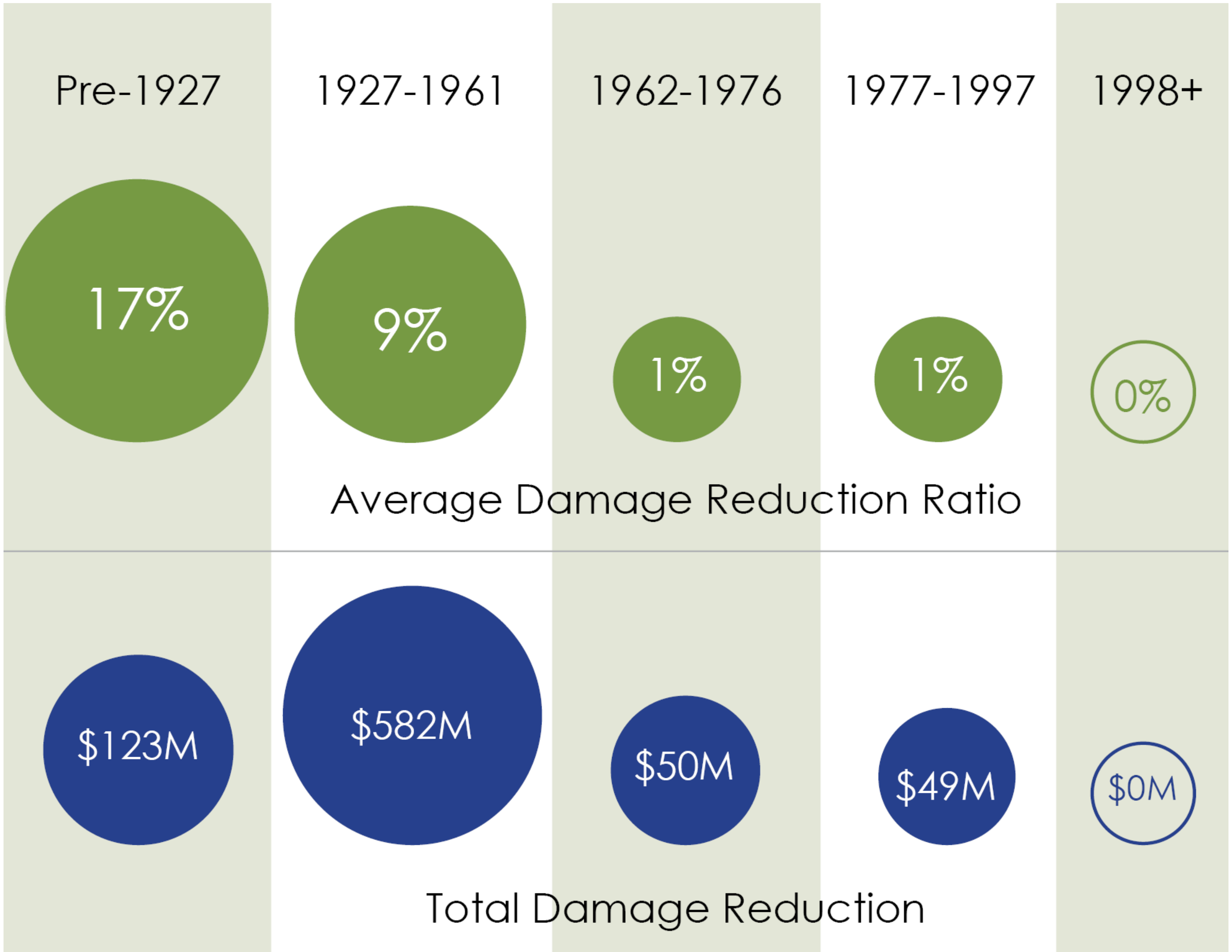
How Does Year Built Affect Losses?

Before Retrofit | San Andreas M7.9 Earthquake

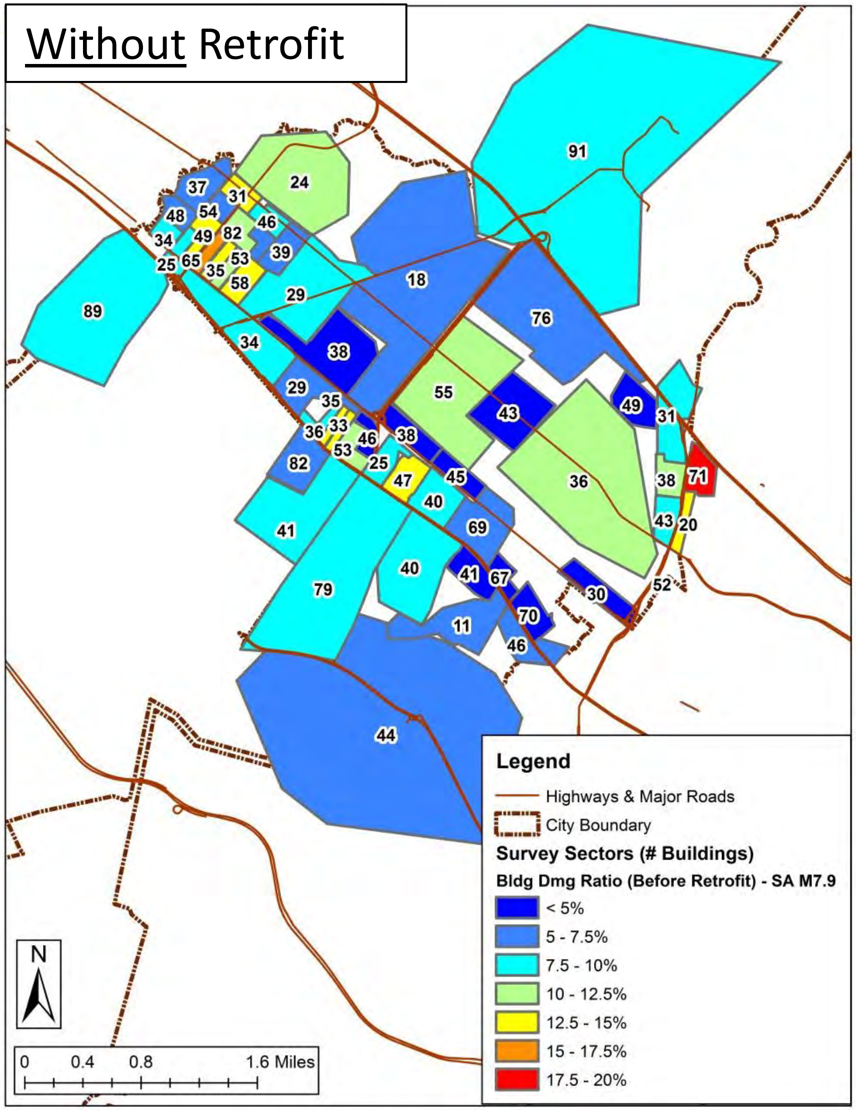


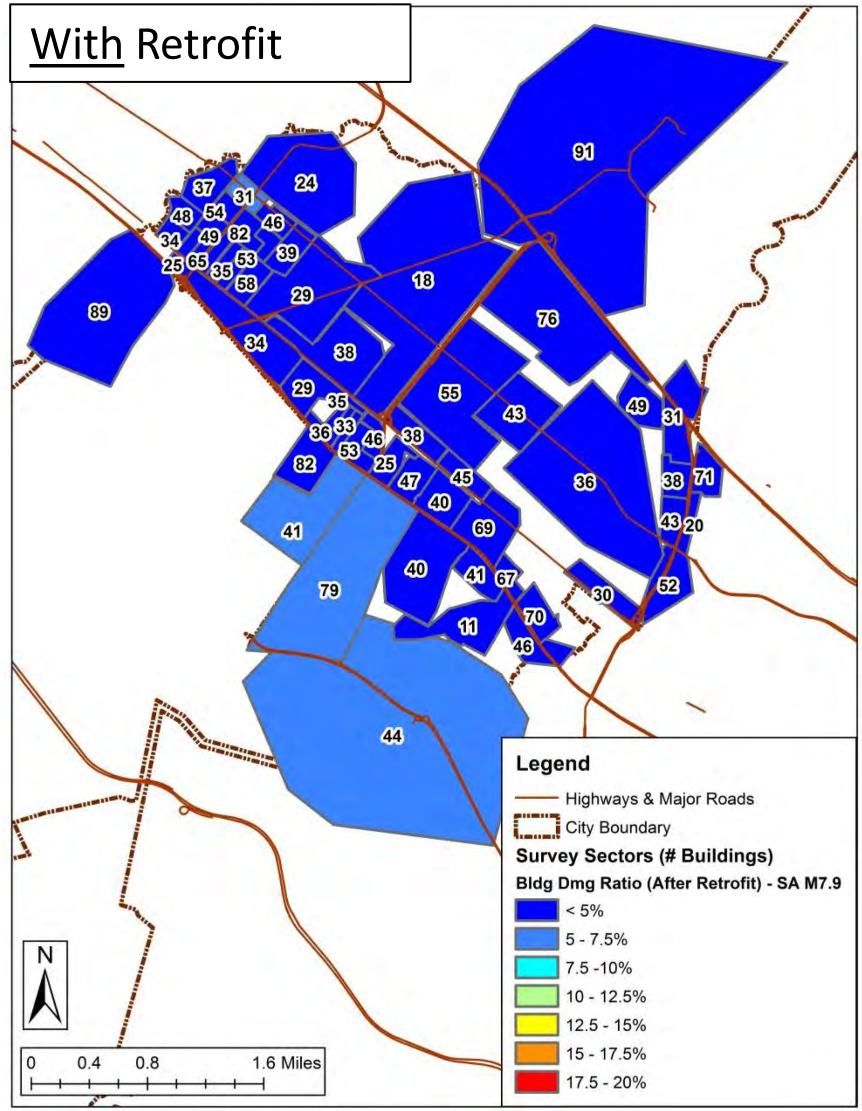
Which Age Group Benefits Most?

After Retrofit | San Andreas M7.9 Earthquake

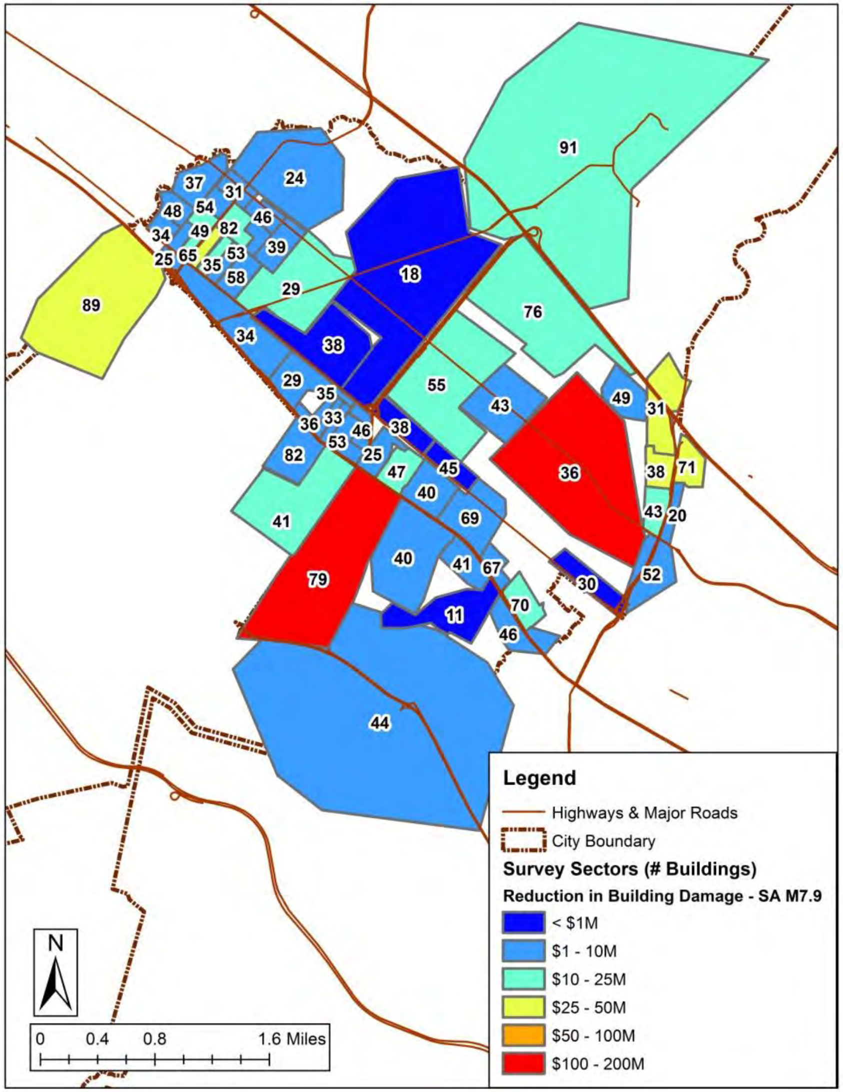


Building Damage Ratio by Survey Sector





Building Damage Reduction by Survey Sector



What is the Impact of a Soft Story?

Building Type	Soft Story	Number of Buildings	Building Value ($M)	San Andreas M7.9			
				Estimated Building Damage ($M)	Average Building Damage Ratio	Number of Bldgs with Damage Ratio ≥ 20%	% of Bldgs with Damage Ratio ≥ 20%
Concrete shear wall	No	269	3,565	384	13%	45	17%
	Yes	49	517	93	20%	30	61%
Woodframe larger residential	No	206	2,551	103	4%	1	0.5%
	Yes	125	681	65	9%	2	2%
Woodframe commercial/industrial	No	240	1,492	92	8%	0	0%
	Yes	67	877	124	11%	9	13%

Takeaways: Soft story…

- Approximately doubles the average damage ratio
- Significantly increases the % of buildings with large loss ratios

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What is the Benefit of Retrofitting a Soft Story Building?

Building Type	Soft Story	Number of Buildings	Building Value ($M)	San Andreas M7.9			
				Total Building & Content Damage Before Retrofit ($M)	Total Building & Content Damage After Retrofit ($M)	Losses Avoided ($M)	Losses Avoided / Building Value (%)
Concrete shear wall	No	269	3,565	544	296	248	7%
	Yes	49	517	131	42	89	17%
Woodframe larger residential	No	206	2,551	135	121	14	1%
	Yes	125	681	78	31	47	7%
Woodframe commercial/industrial	No	240	1,492	143	101	42	3%
	Yes	67	877	165	46	119	14%

Takeaway: Retrofitting a soft story provides significantly more benefit in the ratio of losses avoided.

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Conceptual Retrofits

- 12 building prototypes, covering the most common types in Palo Alto

- For each prototype
  - Written description and sketch of building & retrofit scope by R+C, with typical retrofit details from FEMA 547
  - Estimate by cost subconsultant Vanir Construction Management

Example Prototype: Woodframe Larger Residential

Source: "Practical Solutions for Improving the Seismic Performance of Buildings with Tuckunder Parking," by Rutherford + Chekene, for the City of San Jose, May 2000

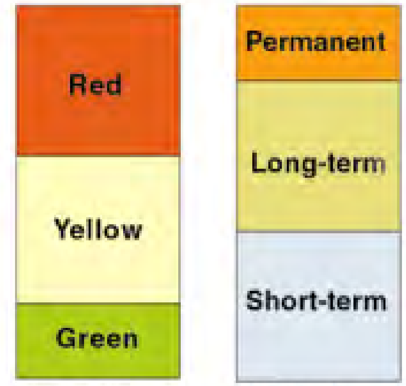
Retrofitting Techniques

Source: Rutherford + Chekene, 2000

Performance Expectations

Unstrengthened Building

- Ground story at risk of collapse
- Significant stucco cracking/plywood shear wall damage
- Significant interior partition damage

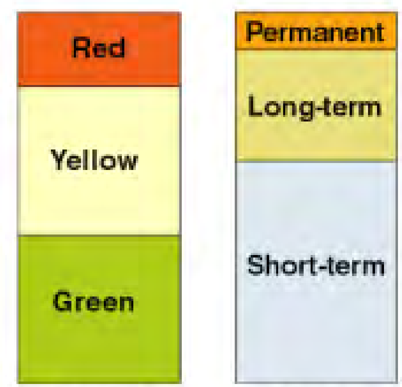


Distribution of Emergency City Tagging

Distribution of Displacement of Occupants

Life Safety Rehabilitation

- Potential residual movement at ground story
- At upper stories, damage is similar to that in the unstrengthened building

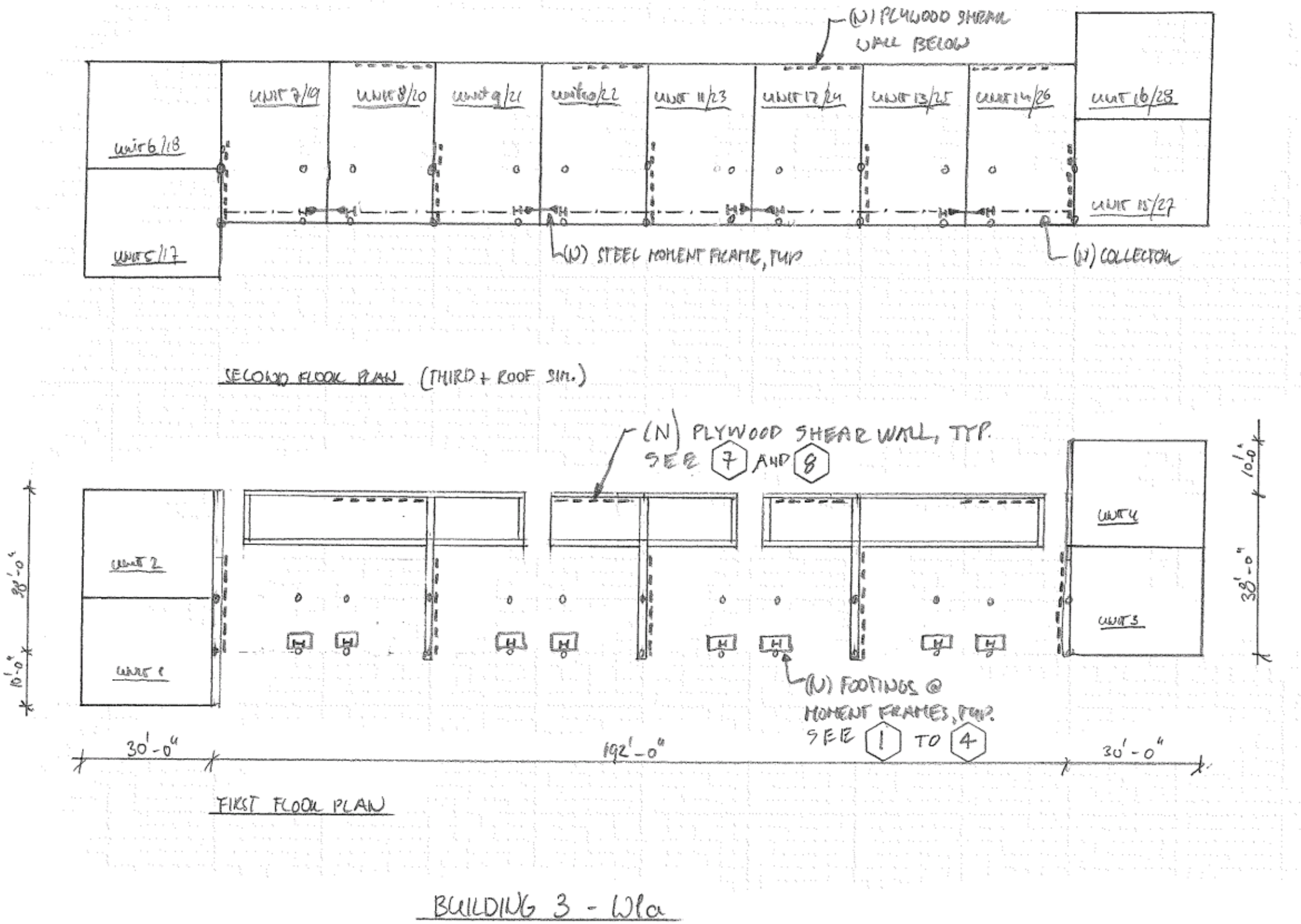


Distribution of Emergency City Tagging

Distribution of Displacement of Occupants

Source: Rutherford + Chekene, 2000

Building Prototype 3 in Palo Alto



Retrofit Costs Include

- Hard cost
  - Cost the owner pays the contractor (the bid cost)
  - Design contingency as these are conceptual retrofits
- Soft costs
  - Architect and engineer design fees
  - Testing and inspection costs
  - Permit fees
  - Owner change order contingency

Retrofit Costs Do Not Include

- Hazardous material abatement costs
- Occupants-in-place costs
- Accessibility costs
- Historic building costs
- Relocation/interruption costs
- Project management costs
- Renovation costs
- Financing costs
- Repair of existing conditions
- Legal fees

Conceptual Retrofit Prototype Costs

Retrofit Prototype	Model Building Type	Description	Stories	Square Feet	Use for Model Building Types*	Use for Square Feet	Average Retrofit Cost ($/SF)
1	W1	Woodframe smaller residential	2	5,320	W1	All	12
2	W1A	Woodframe larger residential	2	9,500	W1A	< 15,000	11
3	W1A	Woodframe larger residential	3	30,000	W1A	≥ 15,000	6
4	W2	Woodframe commercial/industrial	2	10,000	W2	All	14
5	S1	Steel moment frame	2	43,900	S1, S2, S3	All	10
6	C2	Concrete shear wall	1	5,000	C1, C2, S4, PC2	<10,000	50
7	C2	Concrete shear wall	2	17,280	C1, C2, S4, PC2	≥ 10,000	40
8	PC1	Concrete tilt-up	1	18,435	PC1	<25,000	29
9	PC1	Concrete tilt-up	2	38,400	PC1	≥ 25,000	21
10	RM1	Reinforced masonry, wood floor	1	2,750	RM1, RM2	< 5,000	74
11	RM1	Reinforced masonry, wood floor	2	8,150	RM1, RM2	≥ 5,000	46
12	URM	Unreinforced masonry bearing wall	1	5,000	URM, S5, C3	All	110

*Legend for other Model Building Types			
S2	Steel braced frame	C1	Concrete moment frame
S3	Steel light metal frame	C3	Concrete frame with masonry infill
S4	Steel frame with concrete shear walls	PC2	Precast concrete frame
S5	Steel frame with masonry infill	RM2	Reinforced masonry, concrete floor

Comparison of Benefits and Costs by Model Building Type

				San Andreas M7.9				
Model Building Type	**Description**	**Number of Buildings**	**Total Square Feet (1,000)**	**M7.9 Total Building + Content Damage ($1,000)**	**Average Damage ($/SF)**	**Total Damage Reduction ($1,000)**	**Average Damage Reduction ($/SF)**	**Retrofit Cost ($/SF)**
W1	Woodframe smaller residential	898	3,821	61,331	16	13,775	4	12
W1A	Woodframe larger residential	331	8,403	212,815	25	61,317	7	6-11
W2	Woodframe commercial/industrial	307	6,209	307,644	50	160,155	26	14
S1	Steel moment frame	75	3,005	187,779	62	76,150	25	10
S2	Steel braced frame	50	3,116	136,321	44	24,222	8	10
S3	Steel light metal frame	41	533	57,332	108	38,163	72	10
S4	Steel frame with concrete shear walls	13	162	16,435	101	11,118	69	40-50
S5	Steel frame with masonry infill	2	6	1,414	247	695	121	110
C1	Concrete moment frame	18	325	17,773	55	8,045	25	40-50
C2	Concrete shear wall	318	9,699	674,916	70	336,574	35	40-50
C3	Concrete frame with masonry infill	8	26	3,099	120	865	34	110
PC1	Concrete tilt-up	242	8,054	545,020	68	218,491	27	21-29
PC2	Precast concrete frame	5	334	7,064	21	0	0	21-29
RM1	Reinforced masonry, wood floor	285	2,806	165,421	59	87,697	31	46-74
RM2	Reinforced masonry, concrete floor	30	574	19,913	35	3,727	6	46-74
URM	Unreinforced masonry bearing wall	9	274	6,259	23	5,216	19	110
Totals		**2,632**	**47,346**	**2,420,538**	51	**1,046,210**	22	

<u>Takeaways</u>:

- Average damage and damage reduction vary by building type.
- Retrofit costs are on the order of the damage reduction.

Comparison of Benefits and Costs by Selected Model Building Type, Date and Characteristics

Description	Number of Buildings	Total SF (1,000)	M7.9 EQ Total Building + Content Losses ($M)	Average Loss/Bldg ($/SF)	M7.9 EQ Total Building + Content Losses Avoided ($M)	Average Loss Avoided by Retrofit ($/SF)	Total Retrofit Cost ($M)	Average Cost to Retrofit ($/SF)	(Average Loss Avoided)/ (Average Retrofit Cost)
Pre-1977 woodframe soft story (W1, W1a, W2)	294	3,690	244	**66**	172	46	43	12	4
Pre-1998 tilt-up (PC1)	99	3,078	327	**106**	218	71	71	23	3
Pre-1977 concrete soft story (C1, C2, C3)	37	842	125	**149**	91	108	35	42	3
Pre-1998 steel moment frame (S1)	35	690	105	**152**	76	110	7	10	11
All buildings	**2,632**	**47,346**	**2,421**	**51**	**1,066**	**23**			

Takeaway:

- The selected building types with their deficiencies have a higher benefit-to-cost ratio than the average types and a substantial number of buildings.

Guiding Principles

- Palo Alto faces significant losses.
- Potential benefits from retrofitting are also significant.
- Addressing known potentially hazardous building types that are present in large numbers maximizes risk reduction.

- **A range of policy approaches can be combined into a program package.**
- **A range of incentives can help ease the process.**

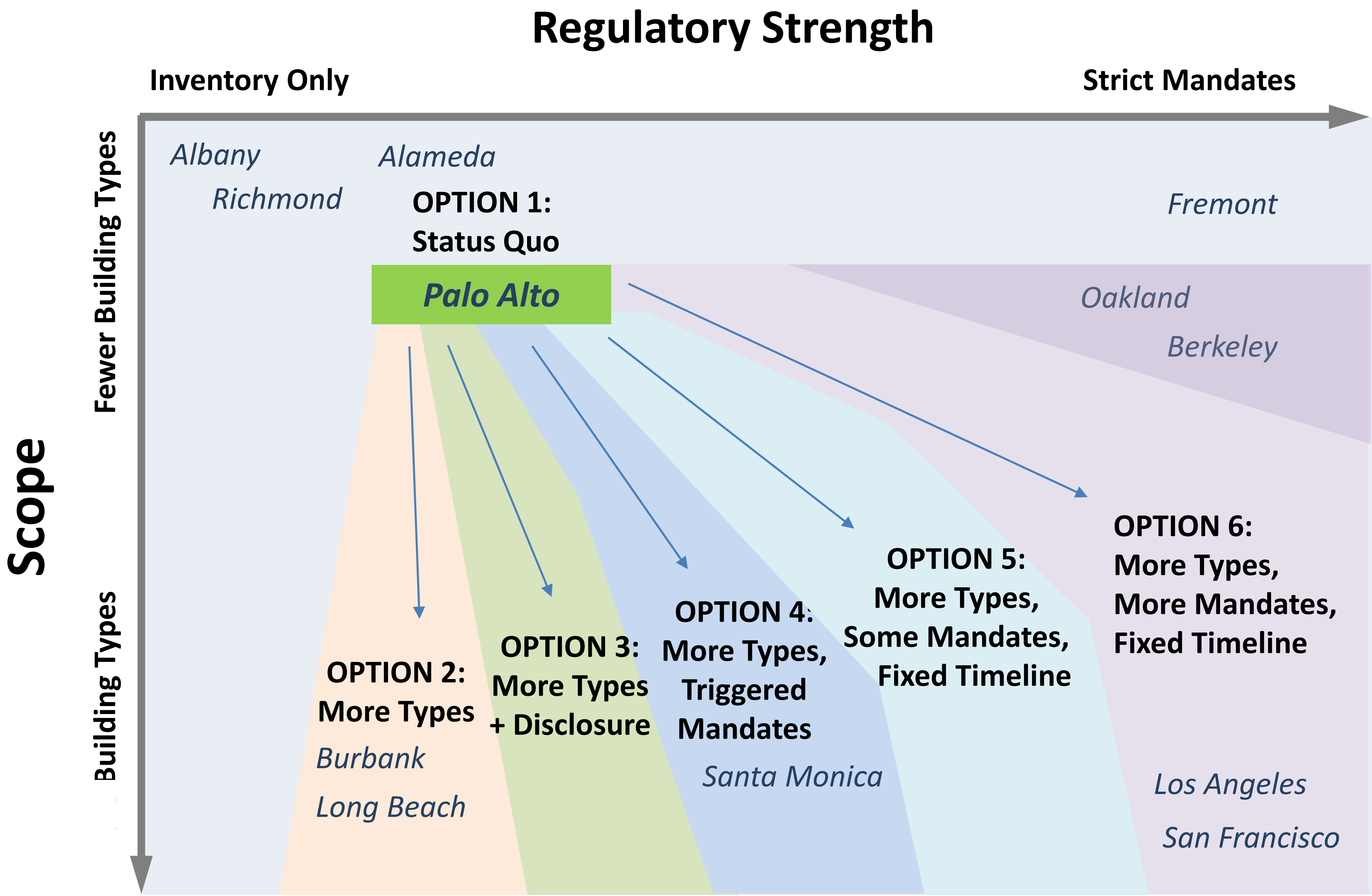
Alternative Policy Mechanisms and Requirements

Inventory Only	Notify Only	Voluntary Retrofit	Disclosure Measures	Mandatory Screening	Mandatory Evaluation	Mandatory Retrofit
City staff, consultants, and/or a volunteer organization has created an **inventory** of one or more suspected hazard building types, but list is not officially released to the public or been acted upon.	An inventory exists and a policy has been established to **notify owners** if their property is on a suspected hazard building list.	Owners of properties on a **publically available list** are formally **encouraged to retrofit**, possibly by offering of technical assistance, financial help, or policy incentives.	Properties on a **publically available list** are subject to one or more methods of forced information sharing, such as **tenant notification**, **public signage**, **recorded notice** on the property title.	Owners of properties on a publically available list are required to **submit a form** within a fixed time window that is filled out by a licensed building professional.	Owners of properties on a publically available list are required **submit an evaluation** completed by a licensed engineer within a fixed time frame.	Owners of properties on a publically available list are **required to retrofit** by a certain date. This step may be implemented following a screening or evaluation phase.

Comparison of Policy Options for Palo Alto

Options	Current 3 Categories	Soft Story Wood Frame	Older Concrete	Older Tilt-Up	Older Steel Moment Frame	Mechanism	Timeline
1: Status Quo	✓					Voluntary Retrofit	Elapsed
2: Same Program, More Types	✓	?	?	?	?	Voluntary Retrofit	None
3: Same Program, More Types, + Disclosure	✓	?	?	?	?	Voluntary Retrofit plus Disclosure	None
4: More Types, Some Triggered Mandates	✓	?	?	?	?	Some mandatory measures	Triggered Events
5: More Types Some Fixed Timeline Mandates	✓	?	?	?	?	Some mandatory measures	Fixed Timeline
6: More Mandates, All on Fixed Timeline	✓	?	?	?	?	More mandatory measures	Fixed Timeline

Which Direction is Best for Palo Alto?



Status of Palo Alto's New Inventory

- ✓ Digital data on all buildings of interest
- ✓ Walking survey to collect further data for about half those buildings, clustered by sectors to improve sample rigor
- Palo Alto can now go one of two routes:
  - Detailed field effort on remaining of buildings to develop a comprehensive inventory list
  - Use generic "building of interest" criteria then have owners go through an extra screening phase

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Key Additional Considerations

- Potential disclosure measures
- Types and sizes of incentives to offer
- Potential to integrate with other disaster-related programs or initiate an overall community resilience effort
    - e.g., post-disaster rehabilitation ordinances or re-occupancy program

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Disclosure Measures Vary in Strategy, Ease of Implementation, and Effectiveness

Easier to Implement

More Difficult to Implement

DISCLOSURE MEASURES
Make the list more prominent on city website
Include compliance status on the city website
Record notice on title
Require tenant notification
Community events (e.g., forums, retrofit fairs)
Distribute educational materials
Require signage until retrofit is completed
Require signage in perpetuity
Encouraging or requiring use of building rating systems

Bundle 1—Basic Transparency

- Building owner-focused
- Some upfront and ongoing IT costs
- Promotes information access

Bundle 2—Community Awareness

- Tenant- and citizen- focused
- Some upfront and ongoing enforcement costs
- Empowers informed decisions

Bundle 3—Signage

- Onsite-focused
- Some ongoing enforcement costs
- May draw public attention
- Owners fear more stigma than may actually occur

City Websites and Online Lists Vary in Sophistication, Content, and Format

City of Alameda Soft-Story List Includes Owner Names

City of Alameda Soft Story List (3/2015)

1500	ALAMEDA	AVE	HOMEOWNERS ASSOCIATION
2128	ALAMEDA	AVE	AHMETSPAHIC MEHMED & DZEVAHIRA
1455	BAY	ST	KREISS NORMAN S
3215	BRIGGS	AVE	COMMON AREA OF TRACT 3365
3221	BRIGGS	AVE	LUCCHESE BRUNO J TR
3224	BRIGGS	AVE	MARTINEZ PETER E & ANGELITA C TRS
3225	BRIGGS	AVE	LUCCHESE BRUNO J TR
3228	BRIGGS	AVE	LAKEPARK LODGE PARTNERSHIP & MARIE HINTON FAM ETAL
3250	BRIGGS	AVE	MUSSER LORRAINE D TR & ASHBAKER ROBERT A & DIANE
301	BROADWAY		NOBLE COMMUNITY MANAGEMENT
470	BUENA VISTA	AVE	DER YIM N & QUAN K
520	BUENA VISTA	AVE	JAZMIN JOSE P & BETTY TRS
547	BUENA VISTA	AVE	MAHMOUDIAN M & MURRAY T C TRS EXEMPTION TRUST ETAL
434	CENTRAL	AVE	MENDOZA GENARO
475	CENTRAL	AVE	KAHN MELVIN TR
600	CENTRAL	AVE	PEREZ HEIDI & DONALD PEREZ TRS & PEREZ HEIDI ETAL
724	CENTRAL	AVE	SHAFFER E G TR TRUST I & E G TR NON EXEMPT TR II
831	CENTRAL	AVE	HO ALBERT M & SERENA S
1704	CENTRAL	AVE	GOLDSTEIN RUTH B TR
1715	CENTRAL	AVE	ASRANI FAMILY LP
1732	CENTRAL	AVE	MAR WAYNE & HUANG NUAN Q TRS
1812	CENTRAL	AVE	SYCAMORE OF ALAMEDA HOA
1836	CENTRAL	AVE	HASSEN ABDEL K & FATIMA TRS
2026	CENTRAL	AVE	JAN RICHARD & NANCY
2037	CENTRAL	AVE	FOSTER EDWARD J TR
2043	CENTRAL	AVE	VETTERLI ELIZABETH TR & LUNDBORG WILDA M TR
2050	CENTRAL	AVE	CHOW LALIE K
2053	CENTRAL	AVE	JABER SAM & BILLIE J TRS
2101	CENTRAL	AVE	MAGNOLIA HOMEOWNERS ASSOCIATION
2115	CENTRAL	AVE	HOMEOWNERS ASSOC
2119	CENTRAL	AVE	GALETTO MARIO & ALBINA M
2253	CENTRAL	AVE	SASAKI ROBERT J TR
1515	CHESTNUT	ST	NGUYEN XUAN Q & DANG NGOC B
1531	CHESTNUT	ST	LEE MALCOLM P & SHU M

Displayed or Downloadable PDFs

Unreinforced Masonry Buildings in Berkeley

	Number	Street
1	2552	MLK
2	1335	San Pablo
3	2072	San Pablo
4	2601	San Pablo
5	2815	Seventh
6	2609	Shattuck
7	1110	University
8	1734	University

As of September 29, 2015

Options for Informing the Community

- Tenant Notification is required in the ordinances of most Bay Area soft-story wood frame programs

Appendix A

Notice to Tenants re: Soft Story Building

This is to notify you that the building at ________________________________, Berkeley, California is on the City of Berkeley's Inventory of Soft Story Potentially Hazardous Buildings and may constitute a severe threat to life safety in the event of an earthquake of moderate to high magnitude.

This notice is required by the Berkeley Municipal Code (BMC) Chapter 19.39.050. This chapter also requires that the building be analyzed by a civil or structural engineer to determine its seismic vulnerability.

For purposes of the program, Soft Story Buildings are those buildings constructed prior to 1997, containing at least five residential units and typically having tuck-under parking or a storefront on the first floor.

If you have any questions about the law, please contact Daniel Lambert, the project manager:

- by phone at (510) 981-7406,
- by e-mail at dlambert@ci.berkeley.ca.us,
- by mail at 2118 Milvia Street, Berkeley, CA 94704.

For questions about this particular building, please contact:

____

(Name of owner or manager and how to contact)

____

(signature of owner) (date) (print name)

Proof of service *(Return signed copy to Building Mitigation Manager, 2118 Milvia Street, Berkeley, CA 94704)*

On ____________, 2001 I delivered the above notice by:

- ☐ Placing it in the mail of the United States Postal Service addressed as follows:

____.

- ☐ Personally delivering it to:

____________________ at ____________________.

____________________ __________

(signature of server) (date)

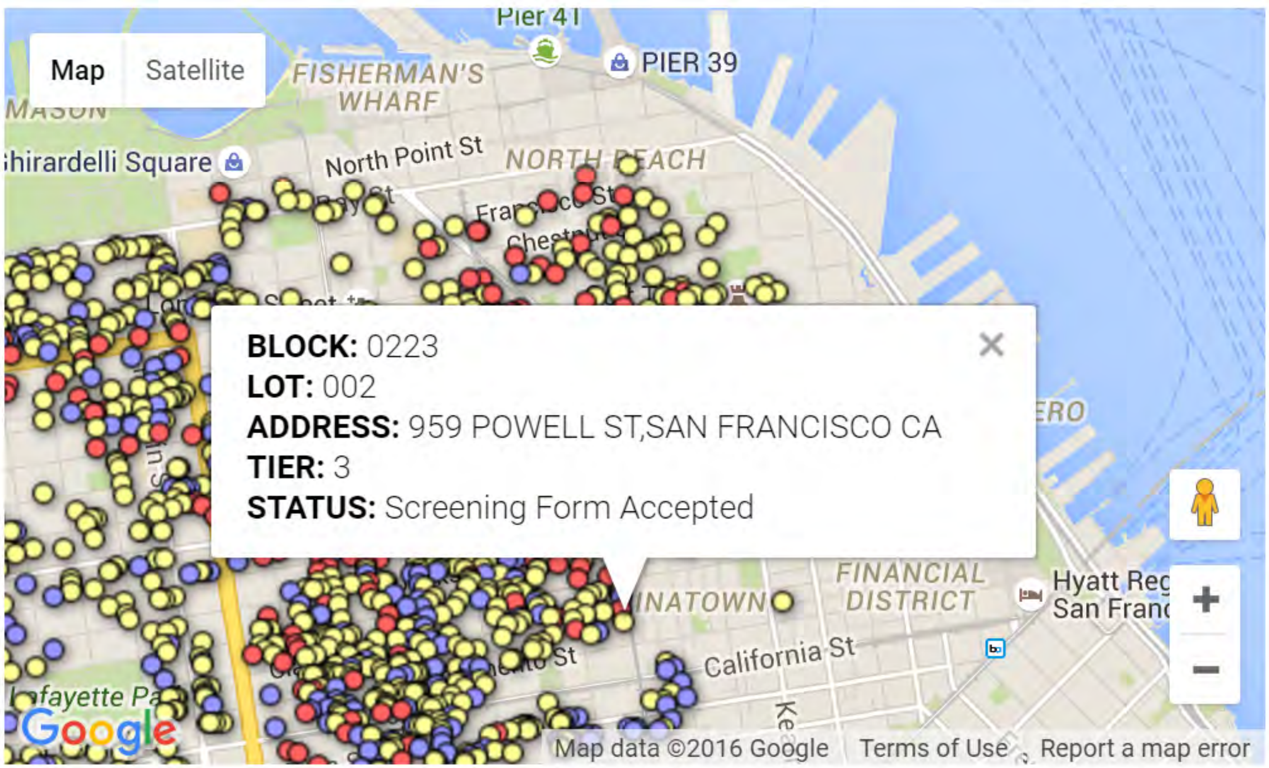
____

(print name)

City of San Francisco Soft-Story Wood Frame Program Online Searchable Map

- Compliance status updated weekly

Click on any point on the map to find out information on the property address, compliance tier and current status. You may also view the data here and filter the information by tier or status.



Retrofit Fairs

City of San Francisco Retrofit Fairs – 2014 and 2016

- Trade show style event at Bill Graham auditorium
- One-stop-shop for both ordinance compliance and service providers
- Open to the public

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Broader Community Education Events

City of Berkeley Preparedness Fair – April 2016

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Signage Examples

Example Required URM Building Sign

City of Berkeley Required Sign for Wood Frame Soft-Story

City of San Francisco Non-Compliance Sign for Wood Frame Soft-Story

DO NOT REMOVE UNDER PENALTY OF LAW! DO NOT REMOVE UNDER PENALTY OF LAW! DO NOT REMOVE UNDER PENALTY OF LAW!

The San Francisco Department of Building Inspection - Tom Hui, S.E., C.B.O., Director
SFBC Section 3405B.6.1

EARTHQUAKE WARNING!

This Building is in Violation of the Requirements of the San Francisco Building Code Regarding Earthquake Safety.

The owner(s) of this building have not complied with the Mandatory Soft Story Retrofit Program, as required by SFBC Chapter 34B. Please contact the Department of Building Inspection at *softstory@sfgov.org* or **(415) 558-6699** or **www.sfdbi.org/softstory**.

地震警告!

這棟樓宇違反三藩市建築條例有關地震安全的要求。

根據三藩市建築條例第34B章，本棟樓宇業主未遵守軟層建築物防震加固計劃強制規定。請立即與樓宇檢查部連絡，電郵: softstory@sfgov.org，電話: (415) 558-6699 或網址: www.sfdbi.org/softstory。

¡ADVERTENCIA DEL TERREMOTO!

Este edificio está en la violación de los requisitos del Código de construcción de San Francisco en cuanto a la seguridad del terremoto.

El propietario o los propietarios de este edificio no ha(n) cumplido con el Programa Obligatorio de Acondicionamiento de Pisos (Mandatory Soft Story Retrofit Program), según lo requiere el Código de Edificios de San Francisco Capítulo 34B (SFBC Chapter 34B). Favor comunicarse con el Departamento de Inspección de Edificios (Department of Building Inspection) a: *softstory@sfgov.org* o (415) 558-6699 o www.sfdbi.org/softstory.

DO NOT REMOVE UNDER PENALTY OF LAW! DO NOT REMOVE UNDER PENALTY OF LAW! DO NOT REMOVE UNDER PENALTY OF LAW!

City Involvement in Use of Building Rating Systems

- Similar strategy to US GBC LEED
- City of Los Angeles pledged to implement for its own buildings

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Disclosure Measure Considerations

- Makes building characteristics more visible and understandable
- Transparency, public's right to know
- Increases the downsides of not retrofitting (esp. in voluntary programs)
- Increases the benefits of retrofitting
- Relatively low cost to city
- Some initial resistance re: stigmatizing

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Incentives Options: Basic Help

Easier to Implement

More Difficult to Implement

FINANCIAL INCENTIVES (direct money)	POLICY INCENTIVES (indirect or in-kind)
Type 1: Basic Help Waivers or reductions of building department fees	Exemption from future retrofit requirements Expedited permits, inspections, and reviews

Incentives: Facilitate Projects

Easier to Implement

More Difficult to Implement

FINANCIAL INCENTIVES (direct money)	POLICY INCENTIVES (indirect or in-kind)
Property-Assessed Financing Loan (PACE*)	Exemptions or relief from standards or non-conforming conditions
Other subsidized or special term loans	Technical assistance for owners on navigating financing, compliance, and project management issues
	Zoning relief (e.g., setbacks, parking)
	Density or intensity bonuses (e.g., FAR)
	Transfer of Development Rights (TDR)

Type 2: Project Facilitation

* PACE = Property Assessed Clean Energy

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PACE = **P**roperty **A**ssessed **C**lean **E**nergy, Now Available for Seismic

- AllianceNRG: https://www.alliancenrg.com/retail/
- Cities statewide can opt in (Berkeley, San Francisco)
- 100% loan paid off through tax increments over 20 years
- Backed by Deutche Bank
- Do owners really need it?

Incentives: Help Pay for Projects

Easier to Implement

FINANCIAL INCENTIVES (direct money)	POLICY INCENTIVES (indirect or in-kind)
Real estate transfer tax rebates Special district or historic designation tax reductions Tax credits Grants General obligation or special purpose bonds **Type 3: Deeper Financial Assistance**	

Incentive Options for Palo Alto

Easier to Implement

More Difficult to Implement

FINANCIAL INCENTIVES	POLICY INCENTIVES
Waivers or reductions of building department fees **Type 1: Basic Help**	Exemption from future retrofit requirements Expedited permits, inspections, and reviews
Property-Assessed Financing Loan (PACE*) Other subsidized or special term loans	Exemptions or relief from standards or non-conforming conditions Technical assistance for owners on navigating financing, compliance, and project management issues Zoning relief (e.g., setbacks, parking) Density or intensity bonuses (e.g., FAR) Transfer of Development Rights (TDR) **Type 2: Project Facilitation**
Real estate transfer tax rebates Special district or historic designation tax reductions Tax credits Grants General obligation or special purpose bonds **Type 3: Deeper Financial Assistance**	

* PACE = Property Assessed Clean Energy

Policy Incentive Considerations

- Can relieve design challenges in what may be complex projects
- Potential to compensate for project cost through increased revenues or resale value
- Helps owners navigate unfamiliar terrain and overcome barriers
- Shows a spirit of compromise
- Can be difficult to implement for all parties

5 Minute Stretch Break

Small Group Activity

- About four per group
- 25 minutes
- Choose a scribe
- Discuss the five handout questions
- Project Team members are a resource
- Volunteer from each reports back to the larger group

Discussion Questions: Program Scope and Requirements

1. Which of the six policy options do you most favor at this time?

2. Which building types do you think Palo Alto should address?
   - Top priorities
   - Approximate timeframes

Discussion Questions: Program Features

3. Which disclosure measures do you most favor?

4. Which incentives do you most favor?

Discussion Questions: Looking to the Future

5. How in favor are you of recommending that Palo Alto address other disaster and broader community resilience issues?

Straw Poll Results

Meeting Wrap-Up and Follow-Ups

- Outcomes from today
- What will be added to the website
- Next steps

CITY OF
PALO
ALTO

City of Palo Alto Seismic Risk Management Program

Advisory Committee Member
Rinconada Library (Embarcadero Room)
1213 Newell Rd. Palo Alto, CA 94303

Monday, June 27, 2016 AGENDA

MEETING OBJECTIVES

- Advisory Group members discuss and compare details regarding the two most promising policy directions
- Prepare list of points of agreement, further discussion needed, and plan for final report

AGENDA

Time	Subject	Lead
1:00 pm	Welcome	George Hoyt / Bret Lizundia
1:05 pm	Project business and meeting overview • Review/approve minutes from 5/17/16 AG4 meeting • Quick recap of ongoing activities and timeline • Review meeting agenda and outcomes	
1:15 pm	Policy options overview and large group discussion: • Building categories that reflect greatest potential for aggregate risk reduction • Preferred requirements for each • Potential subcategories or priority tiers • Appropriate timelines	Bret Lizundia
2:30 pm	Stretch Break	
2:40 pm	Large group discussion of additional policy features: • Highest potential disclosure measures • Highest potential incentive measures	Sharyl Rabinovici
3:30 pm	Meeting Wrap-Up • Generate lists of draft conclusions and issues requiring further discussion • Next steps	All / Bret Lizundia
4:00 pm	Adjourn	

Seismic Advisory Group
Meeting #5
June 27, 2016
1 – 4 pm
Rinconada Library

MEETING MINUTES – SEISMIC RISK MANAGEMENT ADVISORY GROUP

Attendance By:	George Hoyt (GH), Chief Building Official COPA Evon Ballash (EB), Assistant Building Official COPA James Henrikson (JH), Fire Marshal COPA Meg Monroe (MM), Senior Planner COPA Bret Lizundia (BL), Principal, Rutherford+Chekene (R+C) Sharyl Rabinovic (SR), Sub Consultant to R+C Rich Cody (RC), Cody Brock Tom Holzer, USGS Teresa Marks, Hudson Pacific Roxy Rapp (RR), Developer Ken Hayes (KH), Hayes Group Annette Glanckopf, Community Doug Hohbach (DH), Hohbach – Lewin Jessica Epstein, Silvar, Policy
Minutes Prepared By:	Evon Ballash
ITEMS	DISCUSSION
Introduction/Project Timeline	General: ➢ Introduction by GH/BL: This is the last work session before that final advisory meeting. The objectives of this meeting are to review the previous straw poll results and policy framework handout; refine policy options; and identify conclusions, points of agreement, and issues warranting further attention. Eventually, the Advisory Group effort will develop recommendations for the City Council. ➢ The Meeting #4 minutes were approved without comment. ➢ BL reviewed timeline of the Advisory Group up to AG4. Draft recommendations will be developed following the meeting, with completion at the final AG6 meeting. There will not be a Policy and Services review meeting. Rather, recommendations go directly to the City Council in November or December. Following the meeting, a 12/5/16 date for presentation to the City Council was established.
Guiding Principles	➢ Palo Alto faces significant losses. ➢ Potential benefits from retrofitting are also significant. ➢ Addressing known potentially hazardous building types that are present in large numbers in Palo Alto maximizes risk reduction. ➢ Range of policy approaches can be considered for building types that pose a worse than average risk and lend themselves to available ordinances with engineering techniques adoptable to retrofit.

Parameters for Comparing Different Building Types to Target	➢ Review the number of affected buildings including multi-family residential units and commercial. ➢ The impacted areas are distributed all over town. There are no areas of high concern. ➢ Broad implications for collapse prevention, losses avoided, the retrofit costs incurred, and the average loss avoided/retrofit cost ratio
Potential Further Study	➢ Areas not covered in this study but that might be considered by the City in the future include: • Historic buildings in each building type category and whether they should have special requirements in an updated ordinance. • Parking implications: the loss of parking spaces caused by retrofitting, either temporarily during construction or permanently. • Small businesses that are impacted by seismic retrofits, loss of business, as well as improvements in speed of recovery. • Renter impacts: displacement during construction, rental rate increases, vacancy rates.
Policy Framework	➢ Six possible package options: 1. Status quo 2. Add more building types to the scope, but retrofit remains voluntary 3. Add more disclosure measures 4. Add triggered mandates, such as when a building is sold or undergoes substantial renovation 5. Add mandated, fixed timelines for selected building types 6. More building types, mandates, fixed timelines, everything included (e.g., S.F., L.A.) ➢ Straw poll strongly favored Option #5, with some for Option #3 and none for Option #1. ➢ Option #3 discussion: Complete the URM retrofit program; address the soft-story wood frame buildings. ➢ Will tenants be displaced for soft-story retrofits? BL: Retrofit ordinances focus on the soft-story deficiency at the ground floor parking level. As a result, most of the retrofit work can be done at the ground story without affecting the living areas above. There will be some noise and dust, and temporary loss of parking. There is less amount of disruption to occupants with

	this building category than other building categories. ➢ There is Advisory Group support for enhancing disclosure measures and incentives.
Topics Discussed	➢ Which building type categories to add to the program. ➢ The extent of mandatory requirements for each new category. ➢ Whether residential (multi-family) or non-residential buildings should have different requirements. ➢ General timelines for retrofitting. Second handout shows a Comparison of Selected Categories: ➢ Column 4 "Number of Housing Units" was added to address questions and concerns from the Advisory Group Category IV: Soft-Story Woodframe (SSWF) Buildings: ➢ Inventory of 294 buildings and 2001 housing units. ➢ Includes building types W1 (smaller residential), W1a (larger multi-family residential), and W2 (commercial). ➢ Large losses of $244M for M7.9 earthquake event ➢ Loss avoided if retrofitted was $172M. ➢ The average loss avoided divided by the average retrofit cost was 4:1 and is considered comparatively high. Category V: Pre-1988 Tilt-up Buildings: ➢ Inventory of 99 buildings with no housing units. ➢ Located mostly in south Palo Alto ➢ Harder to retrofit than the woodframe buildings. ➢ Losses of $327M with loss avoided if retrofitted of $218M ➢ Average loss avoided / average cost ratio is 3:1. Category VI: Pre-1977 Concrete Soft-Story Buildings: ➢ Inventory of 37 buildings and 42 housing units. ➢ Losses of $125M with loss avoided if retrofitted of $108M ➢ Average loss avoided / average cost ratio is 3:1. Category VII: Pre-1998 steel moment frame ➢ Inventory of 35 buildings and 85 housing units. ➢ Losses of $105M with loss avoided if retrofitted of $76M ➢ Highest average loss avoided / average retrofit cost ratio of 11:1 due to loss retrofit cost assumed. Actual ratio likely to be lower. Category VIII: Other pre-1977 concrete buildings: ➢ This category was added, in part because the City of L.A. has

	an ordinance. ➢ Which buildings are the worst performers in this overall category can be difficult to quickly identify and is currently the subject of on-going study. ➢ 25 year timeline to retrofit in L.A. BL recommends only Categories IV – VII be considered at this time.
Policy Discussion	Due to meeting time, only the soft-story wood frame buildings were discussed in detail. Other potential building categories will be discussed at the final meeting. ➢ Type IV: SSWF buildings ➢ Usage: Residential vs. non-residential ➢ Size: Area, number of occupants or units. ➢ W1- inventory of 175 units. How many are 50 units or less? BL approximately 20%. ➢ 1st step: Notification from Building Department that the building has been identified as a potential soft-story woodframe building. ➢ 2nd step: Short, inexpensive screening form completed by a design professional to confirm the building is in fact a soft story and woodframe structure and thus subject to the ordinance. ➢ 3rd step: Structural evaluation to determine if structure is o.k. ➢ The International Existing Building Code (IEBC) standard can be used for evaluation as well as retrofit. Current version is the 2015 IEBC. Other possibilities are ASCE 41-13 or FEMA P-807. All three are permitted in San Francisco as part of their soft-story wood frame ordinance. ➢ SR: $2,000 - $5,000 estimated cost for seismic evaluation in Berkeley. It was cheaper to develop plans for mandatory retrofit than a structural evaluation and retrofit plan. ➢ There was concern for tenant displacement and cost pass-through for retrofits. Renter impacts include: will they have to move-out, e.g. ave cost/s.f. and number unit $10/unit over 10 year, could be written as an ordinance. What about SSWF and URM building that already have been voluntarily retrofitted after the retrofit ordinance has been passed: ➢ How to address past partial retrofit conditions and what is fair. ➢ Would a structural evaluation by the owner provided to the building department be sufficient? ➢ Ordinance should define retrofit scope. Rating System through USRC, U.S. Resiliency Council ➢ Following an evaluation, the building receives a rating related to several seismic risk metrics ➢ Non-profit organization, similar to USGBC, LEED. ➢ Possibility of influencing market for rental rates, insurance premiums lowered, etc.

MEETING MINUTES – SEISMIC RISK MANAGEMENT ADVISORY GROUP

BL/KH ask Advisory Group: How many are in favor of woodframe soft-story retrofits?

- 11 in favor.
- 0 oppose.
- 1 abstains.

Advisory Group Discussion:

- PACE program is available to help finance retrofits and there is some interest.
- SSWF buildings should have mandatory retrofit.
- Loss of life concern has compelling concerns for mandates to retrofit.
- Population of Palo Alto is approximately 67,000. 5 -10% of the population could be displaced from SSWF.
- Risk to life is smaller in SSWF buildings
- Cost of displacement is much higher in SSWF
- Loss of housing stock in post-earthquake event, usually the most affordable units are impacted, due to lower quality construction.
- Will the cost of retrofit be fair to landlords or will it impose an undue burden?
- Level of incentives can help to level the playing field.
- RR comments that structural evaluation will inform the owner and tenants the building's risks and may help the city to justify more action to be taken.
- Structural report may not have influence on insurance companies.
- If a rating system is available, this may affect bank lenders.
- GH comments that the Building Division currently has a Class 1 ISO rating in part because of the existing seismic mitigation ordinance.
- SR comments that currently there is no insurance benefit for retrofits.
- The City of Berkeley ordinance requires a seismic evaluation and a cost estimate.
- DH advocated use of mandatory triggers, such as when there is a change of use, a sale or a substantial renovation that costs more than 50% of the replacement cost of the building
- BL explained San Francisco had a cumulative cost trigger where all previous renovation work was included as well. The Advisory Group did not support this due to the difficulty of enforcement and administration.

Advisory Group non-staff members were polled: "How many agree on mandatory SSWF retrofit?" and "How many support mandatory triggers?" There were 7 non-staff members present. One consistently

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<tr><td></td><td>abstained, leaving 6 “voting.” Synthesis of results is as follows:

Option 3 (mandatory evaluation, voluntary retrofit, disclosure, incentives): 6 support at least doing this.
Option 4 (mandatory evaluation, retrofits triggered on sale or substantial renovation): 4 support going this far, 2 prefer not stay at Option 3
Option 5 (mandatory evaluation and retrofit): 2 of the remaining 4 support going this; the other 2 do not
Option 6: zero.

Discussion on polled results:

Mandatory triggers were useful in past ordinance.
Advisory Group suggests mandatory retrofits on low hanging fruit, i.e., building types that have the lowest average cost to retrofit
SR comments that triggers are a stop-gap measure to a mandatory retrofit. A mandatory evaluation with a trigger would be an intermediate measure.
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<tr><td>Disclosure Measures</td><td>
Bundle 1—Basic Transparency: Inventory lists and information are readily available for owners on websites.

A pdf list that is downloadable from city website
Interactive and/or searchable map
Monthly updates on pdf list
Only the property address should be shown, rather than the owner’s name
List SSWF on deed and title search
Post list after mandatory screening
Staff time concern to support and maintain posting

Bundle 2—Community Awareness: Public inventory lists are focused on tenants and citizens, such as tenant notification forms to be signed and on file with the city.

Obtaining signatures is difficult. The Advisory Group does not support this.
Passive notification at time of rental lease signing may be simpler

Bundle 3: Onsite signage on buildings with seismic hazards. Example signs can be multi-lingual. Also includes building rating systems.

Advisory Group preferences on disclosure measures:

Notice on title: low interest
Tenant notification: strong interest for passive only approach
Community events, involvement, and awareness: good support,
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	should repeat every few years ➢ Required signage following building evaluation, implement only later if retrofit is not undertaken: low to moderate interest. Benefits are less clear.
Incentives	➢ Who will these measures help: residential or commercial owners? ➢ Use housing inventory list element, for preferred density sites to increase FAR, if community benefits are provided. ➢ What about SSWF that are condominium developments that need financial help or multi-family buildings with low-equity owners? ➢ PACE loans are paid through real estate taxes. Most banks will not allow transferrable PACE loans for refinancing. ➢ More incentives are needed on a shorter timeline. Advisory Group preferences on incentives: ➢ Fee waiver or expedited review for SSWF and to include residential and commercial: high interest. ➢ FAR bonuses that are transferrable: high interest for residential ➢ Parking bonus for when dimensional changes reduces density: low interest ➢ PACE – like loan program: sounds good, but there was low interest on the 8% rate.
Meeting Wrap-Up	➢ SR: We obtained enough information from AG4 and AG5 meetings to develop draft language for recommendations ➢ RC: Needs more buy-in from Advisory Group in the next meeting that decisions will be made. ➢ BL: The final AG6 meeting will focus on discussing the approach to be take with the remaining building categories

City of Palo Alto

Seismic Risk Management Program

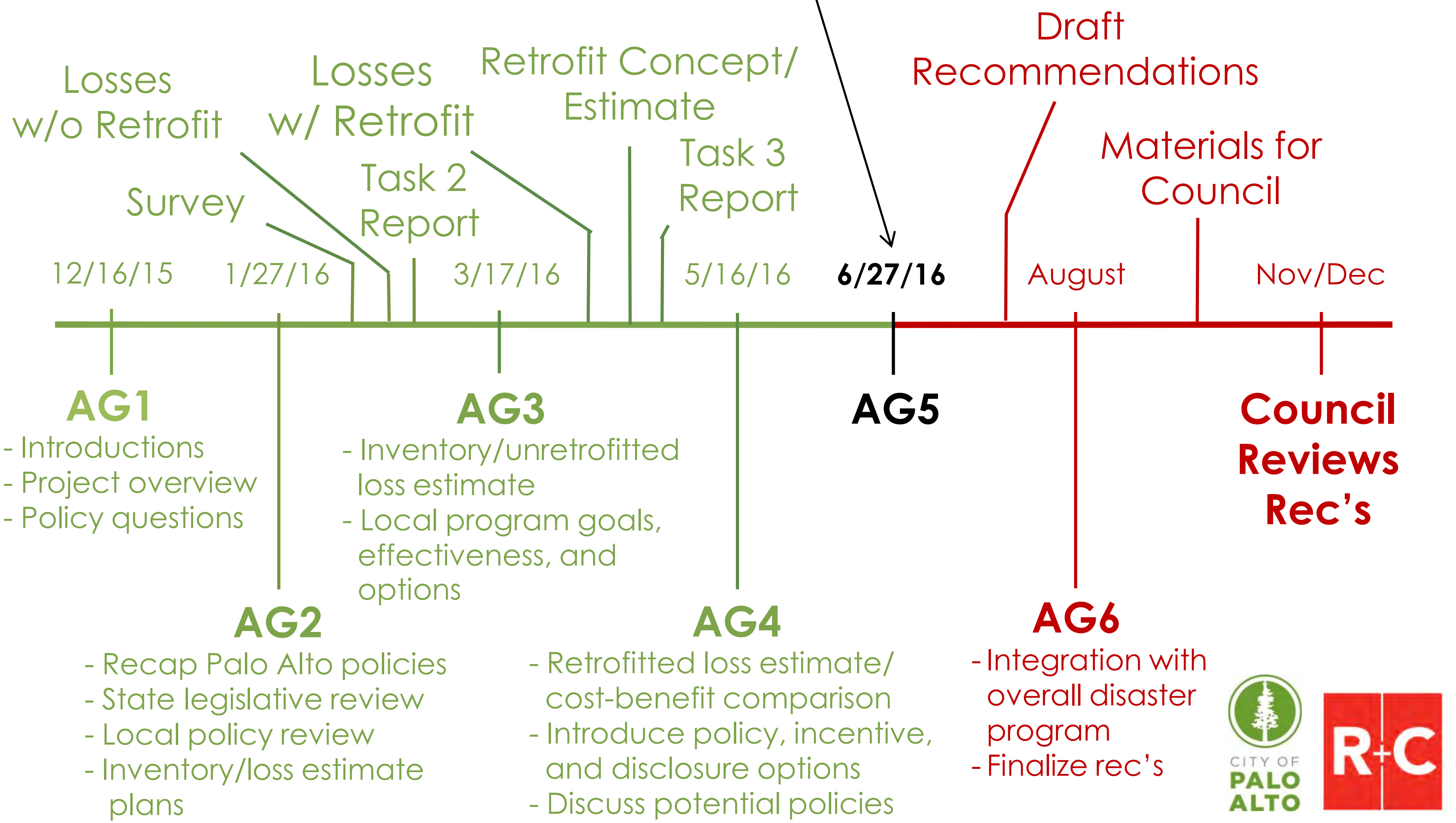
Advisory Group Meeting #5
June 27, 2016

Before Meeting
- AG4 minutes and straw poll results
- AG5 handout

At Meeting
- Refine policy options
- Identify conclusions, points of agreement, and issues warranting further attention

Purpose of Advisory Group

To review and discuss implications of the project's technical findings and provide input about community concerns, priorities, and preferences.



CITY OF PALO ALTO

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Project and Advisory Group Process Status

- Review of minutes from 5/16/16 AG4 meeting
- Seismic Risk Management Program Website: http://www.cityofpaloalto.org/gov/depts/ds/srmag.asp
  - Added content includes presentation slides and minutes from last meeting plus Task 3 report on local program best practices

Guiding Principles

- **Palo Alto faces significant losses.**
- **Potential benefits from retrofitting are also significant.**
- **Addressing known potentially hazardous building types that are present in large numbers maximizes risk reduction.**

- A range of policy approaches can be combined into a program package.
- A range of disclosure measures and incentives can help stimulate and ease the process.

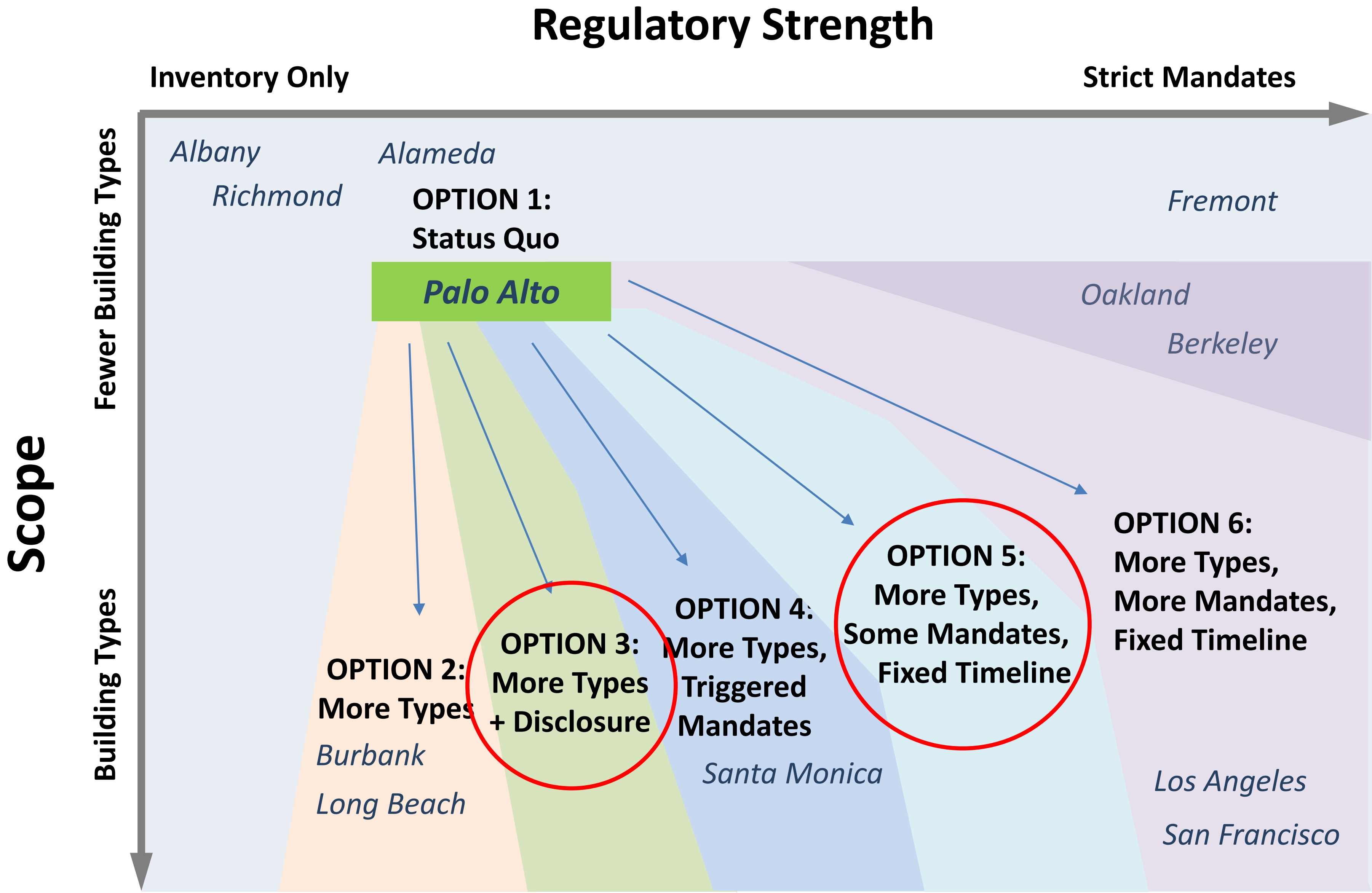
Parameters for Comparing Different Building Types to Target

- Number of affected buildings, residential units, commercial tenants
- Impacted locations in community
- Broad implications for:
  - Collapse prevention
  - Losses avoided
  - Retrofit costs incurred
  - Average loss avoided/retrofit cost ratio

Potential Further Study

- Implications for:
  - Parking
  - Historic preservation and aesthetics
  - Small business losses, recovery, and retention
  - Business recovery and retention
  - Renter impacts—rental rates, vacancy
  - Resident recovery and retention

Possible Directions for Palo Alto



Narrowing in on a Recommended Direction

- Little to no support for the status quo
- Support existed for:
  - Resolving buildings already in program, particularly URM buildings
  - Addressing more building types, particularly soft story woodframe
  - Including some mandatory requirements
  - Utilizing a variety of disclosure measures and incentives

Still Needing Discussion

- Which building types (categories) to add to the program
- Extent of mandatory requirements for each new category
- Possibly different requirements for residential vs. non-residential
- Appropriate timelines
- Which disclosure and incentive measures to focus on

Policy Option 3: Beyond Soft Story Woodframe, Which Categories Also Warrant Voluntary Measures? (p. 5 in Handout)

Category	Approx. Number	Building Type	Date of Construction	Occupants	Mandatory or Voluntary	Deadlines for Report/ Construction (years)	Disclosure	Incentives
Current Program (Potential Revision in *Italics*)								
I	10	URM	NA	Over 6 (and over 1900 sf)	Voluntary	Report: Expired Const: Not Req.	*Website listing, notice on title tenant notification, community events, distribute educational materials*	FAR bonus/ TDR *Waiver on fees, exemption from future requirements, expedited permit/ review, parking bonus/TDR*
II	4	Any	Before 1935	Over 100	Voluntary	Report: Expired Const: Not Req.		
III	9	Any	Before 8/1/76	Over 300	Voluntary	Report: Expired Const: Not Req.		
Expanded Program								
IV	294	Soft story woodframe	Before 1977	Any	Voluntary	Report: 4 Const: Not Req	Same as above?	Same as above?
V	99	Tilt-up	Before 1998	Any	Voluntary	Report: 6 Const: Not Req.	Ditto	Ditto
VI	37	Soft story concrete	Before 1977	Any	Voluntary	Report: 8 Const: Not Req	Ditto	Ditto
VII	35	Steel moment frame	Before 1998	Any	Voluntary	Report: 10 Const: Not Req.	Ditto	Ditto
VIII	TBD	Other older nonductile concrete	Before 1977	Any	Voluntary	Report: 25 Const: Not Req.	Ditto	Ditto

Policy Option 5: Which Additional Categories Warrant Mandatory or Voluntary Measures? (p. 6 in Handout)

Category	Approx. Number	Building Type	Date of Construction	Occupants	Mandatory or Voluntary	Deadlines for Report/ Construction (years)	Disclosure	Incentives
Current Program (Revisions in *Red*)								
I	10	URM	NA	Over 6 (and over 1900 sf)	*Mandatory*	Report: Expired *Const: 6*	*Website listing, notice on title, tenant notification, community events, distribute educational materials*	FAR bonus/ TDR *Waiver on fees, exemption from future requirements, expedited permit/ review, parking bonus/TDR*
II	4	Any	Before 1935	Over 100	Voluntary	Report: Expired Const: Not Req.		
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IV	294	Soft story woodframe	Before 1977	Any	Mandatory	Report: 4 Const: 10	Same as above?	Same as above?
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VIII	TBD	Other older nonductile concrete	Before 1977	Any	Voluntary	Report: 25 Const: Not Req.	Ditto	Ditto

Comparison of Selected Categories

Category	Description	Number of Buildings	Number of Housing Units	Total SF (1,000)	M7.9 EQ Total Building + Content Losses ($M)	M7.9 EQ Total Building + Content Losses Avoided ($M)	Average Loss Avoided by Retrofit ($/SF)	Average Cost to Retrofit ($/SF)	(Average Loss Avoided)/ (Average Retrofit Cost)
IV	Pre-1977 woodframe soft story (W1=175, W1a=77, W2=42)	294	2,201	3,690	244	172	46	12	4
V	Pre-1998 tilt-up (PC1)	99	0	3,078	327	218	71	23	3
VI	Pre-1977 concrete soft story (C1=3, C2=33, C3=1)	37	42	842	125	91	108	42	3
VII	Pre-1998 steel moment frame (S1)	35	85	690	105	76	110	10	11
VIII	Other pre-1977 concrete buildings (C1=4, C2=159, C3=7)	170	131	5,137	448	245	48	42	1
	All buildings	**2,632**	13,422	**47,346**	**2,421**	**1,066**	**23**	**25**	**1**

Takeaways:

- Categories IV-VII have higher benefit-to-cost ratios than the average types and a substantial number of buildings.
- Category VIII, without a focus on nonductile characteristics, has an average benefit-to-cost ratio.

Which Building Categories to Target

- Issues for each potential category:
  - Whether to add the category to the current ordinance scope
  - Whether the category should be mandatory or voluntary
  - Whether the category characteristics should be refined/defined by
    - Usage (such as residential vs. non-residential)
    - Size (such as square footage, occupants, or units)

R+C

Which Building Categories to Target

- IV: Pre-1977 woodframe soft story
- V: Pre-1998 tilt-up
- VI: Pre-1977 concrete soft story
- VII: Pre-1998 steel moment frame
- VIII: Other pre-1998 concrete

Which Building Categories to Target

- Should comprehensive upgrades be required for past partial retrofits of buildings in mandatory category?
  - Example: URM building with parapet strengthening and roof-to-wall ties, but no other retrofit work like out-of-plane wall bracing, in-plane wall strengthening, or diaphragm strengthening.

Policy Option 3: What Are Appropriate Timelines for Additional Voluntary Measures?

Category	Approx. Number	Building Type	Date of Construction	Occupants	Mandatory or Voluntary	Deadlines for Report/ Construction (years)	Disclosure	Incentives
Current Program (Potential Revision in *Italics*)								
I	10	URM	NA	Over 6 (and over 1900 sf)	Voluntary	Report: Expired Const.: Not Req.	*Website listing, notice on title tenant notification, community events, distribute educational materials*	FAR bonus/ TDR *Waiver on fees, exemption from future requirements, expedited permit/ review, parking bonus/TDR*
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Expanded Program								
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VIII	TBD	Other older nonductile concrete	Before 1977	Any	Voluntary	Report: 25 Const.: Not Req.	Ditto	Ditto

Policy Option 5: What Are Appropriate Timelines for Mandatory Measures?

Category	Approx. Number	Building Type	Date of Construction	Occupants	Mandatory or Voluntary	Deadlines for Report/ Construction (years)	Disclosure	Incentives
Current Program (Revisions in *Red*)								
I	10	URM	NA	Over 6 (and over 1900 sf)	*Mandatory*	Report: Expired *Const: 6*	*Website listing, notice on title, tenant notification, community events, distribute educational materials*	FAR bonus/ TDR *Waiver on fees, exemption from future requirements, expedited permit/ review, parking bonus/TDR*
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Timeline Possibilities

- Compliance milestones:
  - Submit a screening form
  - Submit an evaluation report
  - Submit drawings for permit
  - Complete the work
- Often several subcategories or priority tiers are set up with phased timelines
  - # units, use, # stories, soil conditions
  - Higher risk to life usually is done first

Approaches to Soft Story Woodframe

Jurisdiction	# of Soft-story Buildings	Program Type	Targeted Building Characteristics	Priorities or Tiers	Deadline for Evaluation	Deadline for Permit	Deadline for Completion
Los Angeles	unknown	Mandatory Evaluation leading to mandatory retrofit	Pre-1978 wood-frame structures with soft, weak or open front first floor conditions with two or more stories and five or more units. Only enforcement is prioritized by tiers	Priority I - Buildings containing 16 or more dwelling units	1 year	2 years	7 years
				Priority II - Buildings with three stories or more, containing fewer than 16 dwelling units			
				Priority III - Buildings not falling within the definition of Priority I or II			
San Francisco	2,800	Mandatory evaluation leading to mandatory retrofit	Wood frame construction with five or more residential units and two or more stories with permit for construction submitted prior to January 1, 1978 and five or more units	Tier I - educational, assembly, or residential care facility uses	1.5 years	2.5 years	4.5 years
				Tier II - 15 or more dwelling units	2.5 years	3.5 years	5.5 years
				Tier III - Any building not falling within another tier	3.5 years	4.5 years	6.5 years
				Tier IV - ground floor commercial uses	4.5 years	5.5 years	7.5 years

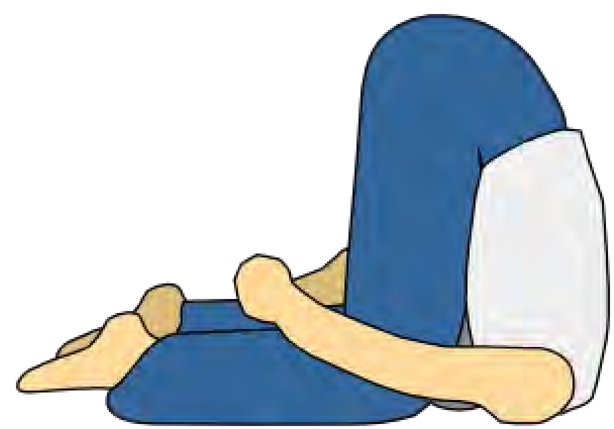
Approaches to Soft Story Woodframe

Jurisdiction	# of Soft-story Buildings	Program Type	Targeted Building Characteristics	Priorities or Tiers	Deadline for Evaluation	Deadline for Permit	Deadline for Completion
Oakland	1,380	Mandatory Screening (passed 2009) leading to mandatory retrofit	Pre-1985 multi-family wood frame structures with five or more units	n/a			
Berkeley	310 (at time of 2005 ordinance)	Mandatory evaluation law (2005) leading to mandatory retrofit (2014)	Multi-family wood frame structures with five or more units	n/a	2 years (under previous soft-story evaluation ordinance)	2 years	4 years
Alameda	70	Mandatory evaluation	Five or more units	n/a	2 years		
Fremont	22	Mandatory retrofit	Apartment house with more than ten units or more than two stories	Group 1 - Apartment house with more than ten units or more than two stories	n/a	2 years	4 years
				Group II - Apartment house with ten or less units and fewer than three stories high	n/a	2.5 years	5 years

Existing Approaches to Older Concrete

Jurisdiction	# Older Concrete Buildings	Program Type	Targeted Building Characteristics	Deadlines		
				Screening	Evaluation	Completion
Los Angeles	~1500	*Fixed timeline* mandatory evaluation leading to mandatory retrofit	Pre-1976 tilt-ups and nonductile concrete	3 years	10 years	25 years
Santa Monica	~173	*Triggered* mandatory evaluation leading to mandatory retrofit	Pre-1978 nonductile concrete	n/a	275 days	1 to 4 years depending on priority tiers
Long Beach	~396	*Voluntary* guidance	Nonductile concrete	n/a		
Burbank	~132	*Voluntary* guidance	Commercial pre-1977 reinforced concrete and concrete frame buildings with masonry infill	n/a		

10 Minute Stretch Break



Disclosure Measures Vary in Strategy, Ease of Implementation, and Effectiveness

Easier to Implement

More Difficult to Implement

DISCLOSURE MEASURES
Make the list more prominent on city website
Include compliance status on the city website
Record notice on title
Require tenant notification
Community events (e.g., forums, retrofit fairs)
Distribute educational materials
Require signage until retrofit is completed
Require signage in perpetuity
Encouraging or requiring use of building rating systems

Bundle 1—Basic Transparency

- Building owner-focused
- Some upfront and ongoing IT costs
- Promotes information access

Bundle 2—Community Awareness

- Tenant- and citizen- focused
- Some upfront and ongoing enforcement costs
- Empowers informed decisions

Bundle 3—Signage

- Onsite-focused
- Some ongoing enforcement costs
- May draw public attention
- Owners fear more stigma than may actually occur

Possible Directions for Use of Disclosure

- Strong support for transparency and community awareness measures
- Support for requiring signage was lower and contingent on type of program, type of building, content, and timing

Disclosure Measure Questions

- Notice on title
- Tenant notification
- Community events and public education?
- Require signage?
  - If so, when? (e.g., only for voluntary categories after a period of time without retrofit)
- Rating system

Incentive Options for Palo Alto

Easier to Implement

More Difficult to Implement

FINANCIAL INCENTIVES

- Waivers or reductions of building department fees

Type 1: Basic Help

- Property-Assessed Financing Loan (PACE*)
- Other subsidized or special term loans

- Real estate transfer tax rebates
- Special district or historic designation tax reductions
- Tax credits
- Grants
- General obligation or special purpose bonds

Type 3: Deeper Financial Assistance

POLICY INCENTIVES

- Exemption from future retrofit requirements
- Expedited permits, inspections, and reviews

- Exemptions or relief from standards or non-conforming conditions
- Technical assistance for owners on navigating financing, compliance, and project management issues
- Zoning relief (e.g., setbacks, parking)
- Density or intensity bonuses (e.g., FAR)
- Transfer of Development Rights (TDR)

Type 2: Project Facilitation

* PACE = Property Assessed Clean Energy

Possible Directions on Incentives

- Basic assistance viewed favorably but not as especially helpful
- Little support for major bond initiative or special districting
- Strongest interest was in project facilitation measures, particularly *policy* incentives
  - Zoning relief, transfer of development rights, floor area bonus

Which Incentive Measures Would Be Most Feasible and Effective?

- Fee waiver or expedited review
- Floor Area Ratio (FAR) bonus
- Parking bonus
- Transfer of development rights (TDR)
- Need for PACE-like loan program

Meeting Wrap-Up and Follow-Ups

- Outcomes from today
- Next steps

Comparison of Selected Categories

Category	Description	Number of Buildings	Number of Housing Units	Total SF (1,000)	M7.9 EQ Total Building + Content Losses ($M)	M7.9 EQ Total Building + Content Losses Avoided ($M)	Average Loss Avoided by Retrofit ($/SF)	Average Cost to Retrofit ($/SF)	(Average Loss Avoided)/ (Average Retrofit Cost)
IV	Pre-1977 woodframe soft story (W1=175, W1a=77, W2=42)	294	2,201	3,690	244	172	46	12	4
V	Pre-1998 tilt-up (PC1)	99	0	3,078	327	218	71	23	3
VI	Pre-1977 concrete soft story (C1=3, C2=33, C3=1)	37	42	842	125	91	108	42	3
VII	Pre-1998 steel moment frame (S1)	35	85	690	105	76	110	10	11
VIII	Other pre-1977 concrete buildings (C1=4, C2=159, C3=7)	170	131	5,137	448	245	48	42	1
	All buildings	**2,632**	13,422	**47,346**	**2,421**	**1,066**	**23**	**25**	**1**

Takeaways:

- Categories IV-VII have higher benefit-to-cost ratios than the average types and a substantial number of buildings.
- Category VIII, without a focus on nonductile characteristics, has an average benefit-to-cost ratio.

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City of Palo Alto Seismic Risk Management Program

Rinconada Library
1213 Newell Rd.
Embarcadero Room

Monday, August 15, 2016	☒ Discussion ☒ Action

Our proposed topics, objectives, distribution materials, agenda, and issues for the third Advisory Group session are described below.

MEETING DATE, TIME, AND LOCATION

- Date: Monday, August 15, 2016
- Time: 1pm – 4pm
- Rinconada Library (Embarcadero Room)
  1213 Newell Rd
  Palo Alto, CA 94303

MEETING OBJECTIVES

- Advisory Group members discuss status report summary on work to date
- Complete Advisory Group review of remaining building types

PRE-MEETING MATERIALS

- Minutes from AG5
- Agenda for AG6
- Updated version of the status summary report handout AG6

Notes:

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City of Palo Alto Seismic Risk Management Program

Advisory Committee Meeting
Rinconada Library (Embarcadero Room)
1213 Newell Rd. Palo Alto, CA 94303

Monday, August 15, 2016 AGENDA

AGENDA

Time	Subject	Lead
1:00 pm	Welcome	George Hoyt/ Bret Lizundia
1:05 pm	Project business and meeting overview • Review/approve minutes from 6/27/16 AG5 meeting • Quick recap of ongoing activities and timeline • Review meeting agenda and outcomes	
1:15 pm	Large group discussion of the meeting handout • Review of handout purpose and contents • Advisory Group comments and recommendations • Handout questions	Bret Lizundia/ Sharyl Rabinovici
2:00 pm	Large group discussion of remaining building categories, within the framework developed to date, including approach, timelines, and incentives • Category V: Tilt-up	Bret Lizundia/ Sharyl Rabinovici
2:30 pm	Stretch Break	
2:40 pm	Large group discussion of remaining building categories, within the framework developed to date, including approach, timelines, and incentives • Category VI and VIII: Soft story concrete and other older nonductile concrete • Category VII: Steel moment frames	Bret Lizundia/ Sharyl Rabinovici
3:20 pm	Meeting wrap-up • Summarize conclusions from meeting and regarding final update of the Advisory Group handout • Next steps for the project	Bret Lizundia
4:00 pm	Adjourn and thank you	George Hoyt

Seismic Advisory Group
Meeting #6
Aug 15, 2016
1 – 4 pm
Rinconada Library

MEETING MINUTES – SEISMIC RISK MANAGEMENT ADVISORY GROUP

Attendance By:	George Hoyt (GH), Chief Building Official COPA Evon Ballash (EB), Assistant Building Official COPA Meg Monroe (MM), Senior Planner COPA Nathan Rainey (NR), OES Coordinator COPA Bret Lizundia (BL), Principal, Rutherford+Chekene (R+C) Sharyl Rabinovici (SR), Subconsultant to R+C Anil Babbar (AB), CAA Dana Brechwald (DB), ABAG Rich Cody (RC), Cody Brock Doug Hohbach (DH), Hohbach – Lewin Tom Holzer (TH), USGS Teresa Marks (TM), Hudson Pacific Roxy Rapp (RR), Developer
Minutes Prepared By:	Evon Ballash
ITEMS	DISCUSSION
Introduction	General: ➢ Introduction by GH/BL: This is the last advisory meeting. The objectives of this meeting are to discuss the Seismic Risk Management Advisory Group (SRMAG) draft status report summary and complete the Advisory Group review of the remaining building types. ➢ Meeting #5 minutes were approved without comments.
Program Timeline	➢ The timeline and purpose of the Advisory Group was discussed. ➢ After this meeting, the SRMAG draft report summary will be updated for review by the SRMAG. ➢ The SRMAG report summary will be included in the documents the City Council receives for their Dec. 5th meeting. ➢ Council packet is due six (6) weeks prior to the meeting. ➢ The packet will be available to the public and the SRMAG 1-2 weeks prior on the website. ➢ This meeting will discuss: Draft report summary Policy options for tilt-up buildings, soft story concrete buildings and other non-ductile concrete buildings, and older steel moment frame buildings.
Guiding Principles	➢ Possible directions: Consensus was to go beyond the status quo: Options 3, 4, 5: Had the most preference Definitions: Option 3: Voluntary measures Option 4: Triggered measures e.g., at the time of sale or when there is a substantial renovation

	Option 5: Mandatory measures with timelines for survey report start and complete work. ➢ RR: What are the relative risks to life for URM, soft-story wood frame (SSWF), and tilt-up? ➢ BL: URM buildings are the most risky building type both from the threat to life safety and to property damage. Certain subsets of wood frame buildings have increased risk, e.g. SSWF where there is significantly increased risk of damage or collapse at the weak and flexible ground story. In older tilt-up buildings, the primary concern is inadequate connections between the roof and floor diaphragms and the concrete wall which can lead to the walls falling outward and partial collapse.
Large Group Discussion on Building Categories, Timelines and Incentives	➢ SR: Incentives for policy and financial: Type 1: Basic help Type 2: COPA to could consider using PACE loans; there is mixed data on desirability of TDR or FAR bonuses. High interest as motivation for voluntary measures; this would ease the burden of mandatory measures. ➢ RR: Concerned that mandatory or retrofit without incentives would not be successful or well received by developers and contractors. ➢ SR: Work on a matrix of building types with incentives to reduce risk. ➢ GH: Would prefer at a minimum that a mandatory seismic evaluation is required for all potentially hazardous building types. ➢ TM: Prefers a menu of incentives for multi-family and commercial instead of a matrix. ➢ GH: An incentive could be exemptions or relief from standard or non-conforming conditions from a planning perspective. ➢ DB: Brings up San Francisco Chronicle newspaper article on the progress of San Francisco's mandatory soft-story wood frame ordinance where converting ground story parking to occupied space was noted as an important development and incentive. ➢ BL: This could be done in Palo Alto as well. ➢ RC: Focus on owners of SSWF to encourage them to retrofit. ➢ RC: Also focus on those who don't care or can't afford retrofitting without some form of assistance or incentive. ➢ DH: URM retrofitting should be mandatory, and SSWF may have softer language. ➢ DH: TDR or FAR would be very productive, but stay within the same occupancy and building types. City Council may not be favorable to increase in commercial density. ➢ BL: What is the approximate market value of TDR? Group suggested that if a property has a $1000/sf value for the land

	and building, with the land at $400/sf and the building at $600/sf, that the TDR might be half of the building value or $300/sf. ➢ DH: Consider a trigger threshold of say 50% of market value. Thus, if the renovation were more than $250/sf for a building with a replacement cost of $500/sf, it would exceed the substantial renovation trigger. ➢ RR: URM commercial buildings will not attract Class A tenants ➢ TM: Parking relief is not attractive to renters and tenants. ➢ BL: Loss estimate in the project scope only considers property damage. If an estimate were to monetize loss of life and loss of use, then the benefit-to-cost ratio would increase. ➢ RR: Those owners that have not retrofitted that receive the most benefits will not be well received by the community. ➢ SR: 1:5 homeowners think that their insurance covers earthquake damage. ➢ BL: PML (Probable Maximum Loss) evaluations are used in the banking world. When the PML loss is greater than 20% of replacement value, it may be difficult to get a loan. ➢ RR: Landlord incentives would be lower insurance and better tenants. ➢ RC: Absentee owners may not be aware of incentives. The voluntary program may not be as effective. ➢ RR: Voluntary program is only effective for the progressive owners with interest in renovation. ➢ RR: There are many owners in Palo Alto who inherited property and they just want to keep the property as it is and maintain the current rent stream. ➢ SR: City of Berkeley had a 2-phase retrofit program: 1st phase: voluntary with more incentives 2nd phase: mandatory with less incentives ➢ TM: This sounds promising. ➢ BL: This is similar to Option 5 with declining incentives. ➢ RC: Should come up with a cost range for seismic evaluations. ➢ SR: In Berkeley, a $2,000 – $12,000 range for soft-story engineering evaluation was reported. It was often found to be cost effective to combine the evaluation with the final retrofit design.

MEETING MINUTES – SEISMIC RISK MANAGEMENT ADVISORY GROUP

Large Group Discussion on Category V: Tilt-Up Buildings	➢ BL: Tilt-up buildings include approximately 100 buildings in Palo Alto. Many are located east of Highway 101 or just west of 101 and north of San Antonio Road, and are mostly commercial buildings with offices. The focus is on older buildings that include pre-1998 construction. There was significant damage in San Fernando Valley in Northridge earthquake and the building code was upgraded in 1997 to improve performance, particularly with the connections between the perimeter walls and the roof and floors. The tilt-up building category contains a large overall square footage value. ➢ DH: Are the 2-3 story tilt-ups as dangerous as the one-story tilt-ups that were damaged in the San Fernando and Northridge Earthquakes? ➢ BL: Good question. Details of the floor-to-wall connections in these multi-story tilt-ups would be a key feature of an engineering seismic evaluation. ➢ RC: Tilt-up buildings can be retrofitted with the building occupied.RC: Foresees 50% of new owners retrofitting tilt-up buildings. A common scenario is taking a warehouse and converting it to a start-up, where the occupant density increases. Thus, while the building hazard is similar, the risk to life safety has increased. ➢ TM: Tilt-up buildings should have mandatory screening with voluntary measures. ➢ BL: Substantial could be a trigger, such as Option 4.DH: Without triggers, owners may not be fully aware of inherent risks. Previously, the building code had a cost trigger that was 50% of the replacement cost. The Engineering News Record (ENR) cost was used, and for Palo Alto it is too low. ➢ BL: Group consensus is there is strong interest in retrofitting tilt-ups because there is a large overall square footage in the category, the retrofit cost is comparatively low, there is substantial renovation work that could be leveraged, and exposure is increasing as a result of the conversions.
Large Group Discussion on Category VI: Soft Story Concrete Buildings	➢ BL: The concrete soft-story building category focuses on older (pre-1977) buildings before certain detailing provisions were added to the code and that have a weak or flexible ground story which can have an increased likelihood of collapse. The category includes 42 housing units. These buildings can be expensive and not so easy to retrofit. Substantial retrofit requires the building to be vacant. ➢ GH: Building Official's perspective would want mandatory screening and evaluation. ➢ SR: It is important to recognize the difference between screening and an engineering evaluation and the different associated costs.

	➢ BL: Screening can be a one-page form to be confirmed and/or completed by typically an architect or engineer for a nominal cost. An engineering evaluation would be more detailed, and can vary significantly depending on the type of building and the scope of services. It may include document review, finish removal to investigate building details, material testing, and calculations to standards such as the International Existing Building Code (IEBC) or ASCE 41. ➢ RR: Planning review is the most difficult and time consuming to approve, "Time is money". ➢ RR: Provide expedited planning review for building permits as an incentive.
Large Group Discussion on Category VII: Steel Moment Frame Buildings	➢ BL: Category VII: Pre-1998 steel moment frame buildings had unforeseen serious damage in the Northridge Earthquake. As a result, there were code changes to the 1997 building codes to address these concerns. These buildings have the highest benefit to cost ratio for seismic retrofitting. There are approximately 85 residential units in the estimated 35 buildings. However, these buildings are difficult to screen as the structural beam and column framing members are under fire-proofing coatings and gypsum board coverings. These buildings are generally one to five stories in height. ➢ DB: Good candidate for voluntary retrofit due to the high benefit-to-cost ratio and relative ease to retrofit.
Large Group Discussion on Category VIII: Other Older Non-Ductile Concrete Buildings	➢ BL: Category VIII: Older Pre-1977 concrete buildings. New information shows that the performance for many of these buildings may be better than expected. Due to the lack of inexpensive analytical methods for reliably identifying the worst of these buildings, inclusion of this building category in an updated ordinance is not recommended at this time. Such buildings could be included in the future when such analytical methods have been developed in the engineering community. ➢ Advisory Group concurred.
Meeting Wrap-Up	➢ BL: Based on discussions, mandatory retrofit is preferred for remaining URMs, there is high interest in retrofitting SSWF and relatively high interest in retrofitting tilt-up buildings particularly those undergoing conversions, there is some interest in retrofitting soft story concrete buildings and older steel moment frames. Incentives are desired. ➢ SR: An update of the SRMAG memo will incorporate Advisory Group input and be issued for review after the meeting. ➢ SR: The City may wish to include an Advisory Group member as a speaker during the presentation to Council on December 5.

City of Palo Alto

Seismic Risk Management Program

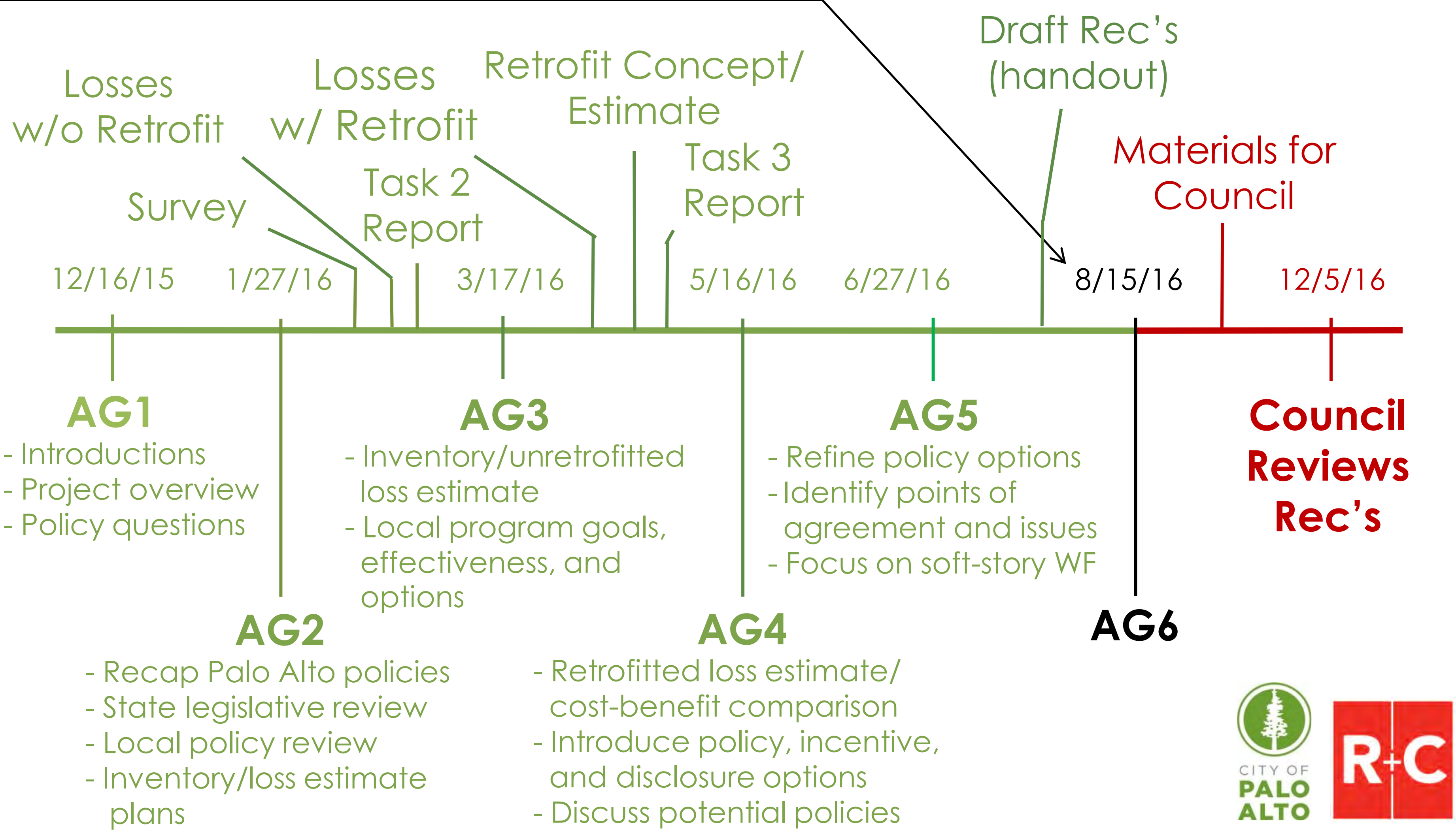
Advisory Group Meeting #6
August 15, 2016

Before Meeting
- AG5 minutes
- Draft status summary report

At Meeting
- Review draft summary report
- Discuss remaining building categories

Purpose of Advisory Group

To review and discuss implications of the project's technical findings and provide input about community concerns, priorities, and preferences.



CITY OF PALO ALTO

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Project and Advisory Group Process Status

- Review of minutes from 6/27/16 AG5 meeting

- Seismic Risk Management Program Website: http://www.cityofpaloalto.org/gov/depts/ds/srmag.asp
  - Added content includes presentation slides from last meeting

Agenda and Meeting Goals

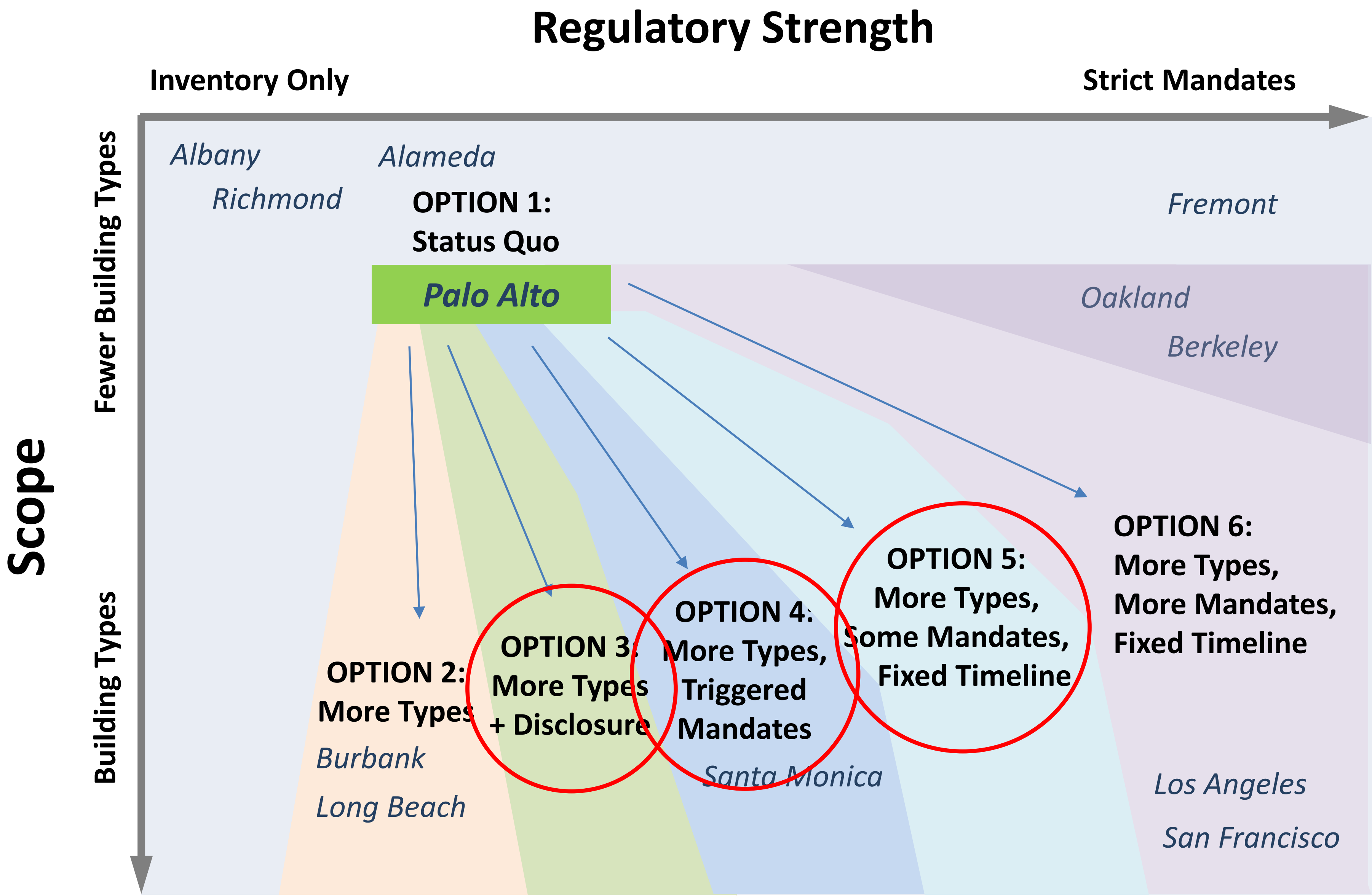
- Discussion of draft status summary report handout
- Discuss policy options for:
  - Tilt-up buildings
  - Soft-story concrete and other older nonductile concrete buildings
  - Older steel moment frames
- Conclusions and wrap-up

Guiding Principles

- **Palo Alto faces significant losses.**
- **Potential benefits from retrofitting are also significant.**
- **Addressing known potentially hazardous building types that are present in large numbers maximizes risk reduction.**

- A range of policy approaches can be combined into a program package.
- A range of disclosure measures and incentives can help stimulate and ease the process.

Possible Directions for Palo Alto



Disclosure Measures Vary in Strategy, Ease of Implementation, and Effectiveness

Easier to Implement

More Difficult to Implement

DISCLOSURE MEASURES
Make the list more prominent on city website
Include compliance status on the city website
Record notice on title
Require tenant notification
Community events (e.g., forums, retrofit fairs)
Distribute educational materials
Require signage until retrofit is completed
Require signage in perpetuity
Encouraging or requiring use of building rating systems

Bundle 1—Basic Transparency

- Building owner-focused
- Some upfront and ongoing IT costs
- Promotes information access

Bundle 2—Community Awareness

- Tenant- and citizen- focused
- Some upfront and ongoing enforcement costs
- Empowers informed decisions

Bundle 3—Signage

- Onsite-focused
- Some ongoing enforcement costs
- May draw public attention
- Owners fear more stigma than may actually occur

R+C

Incentive Options for Palo Alto

Easier to Implement → More Difficult to Implement

FINANCIAL INCENTIVES	POLICY INCENTIVES
Waivers or reductions of building department fees **Type 1: Basic Help**	Exemption from future retrofit requirements Expedited permits, inspections, and reviews
Property-Assessed Financing Loan (PACE*) Other subsidized or special term loans	Exemptions or relief from standards or non-conforming conditions Technical assistance for owners on navigating financing, compliance, and project management issues Zoning relief (e.g., setbacks, parking) Density or intensity bonuses (e.g., FAR) Transfer of Development Rights (TDR) **Type 2: Project Facilitation**
Real estate transfer tax rebates Special district or historic designation tax reductions Tax credits Grants General obligation or special purpose bonds **Type 3: Deeper Financial Assistance**	

* PACE = Property Assessed Clean Energy

Policy Option 5: Increase Scope, with Some Categories Voluntary and a Few Categories Mandatory with Fixed Deadlines(p. 8 in Handout)

Category	Approx. Number	Building Type	Date of Construction	Occupants	Voluntary, Triggered, or Mandatory[1]	Deadlines for Report/ Construction (years)[2]	Disclosure	Incentives
Current Program (Potential Revision in *Italics*)								
I	10	URM	NA	Over 6 (and over 1,900 sf)	*Mandatory*	Report: Expired Const: 2-4	*Website listing and tenant notification*	*Waiver on fee, expedited permit review, FAR bonus/ transfer of development rights (TDR)*
II	4	Any	Before 1/1/35	Over 100	Voluntary	Report: Expired Const: Not Req.		
III	9	Any	Before 8/1/76	Over 300	Voluntary	Report: Expired Const: Not Req.		
Expanded Program *(Note: Category IV has been discussed; Categories V-VIII to be discussed at AG6 meeting)*								
IV	294	Soft story woodframe	Before 1977	Any	*Mandatory*	Report: 2-4 Const: 4-6	Same as above	Same as above
V	99	Tilt-up	Before 1998	Any	Voluntary	Report: 4-6 Const: Not Req.	Ditto	Ditto
VI	37	Soft story concrete	Before 1977	Any	Voluntary	Report:6- 8 Const: Not Req.	Ditto	Ditto
VII	35	Steel moment frame	Before 1998	Any	Voluntary	Report: 6-8 Const: Not Req.	Ditto	Ditto
VIII	TBD	Other older nonductile concrete	Before 1977	Any	Voluntary	Report: 20 Const: Not Req.	Ditto	Ditto

[1]Voluntary: Evaluation report is required; retrofit is voluntary.
Triggered: Evaluation report is required; retrofit is triggered when the building is sold or undergoes substantial renovation.
Mandatory: Evaluation report is required, and retrofit is required per a fixed timeline.

[2]Deadlines provide a potential range. Timelines would vary depending on tiers or priority groupings of different subcategories.

Still Needing Discussion

- Policies for remaining building categories
- Should FAR bonuses and parking exemptions be permitted for:
  - Retrofitted buildings?
  - Other buildings through TDR?
- Include PACE loans in incentives?
- Appropriate timelines
- Other issues

Comparison of Selected Categories

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	All buildings	2,632	13,422	47,346	2,421	1,066	23	25	1

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Meeting Wrap-Up and Follow-Ups

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