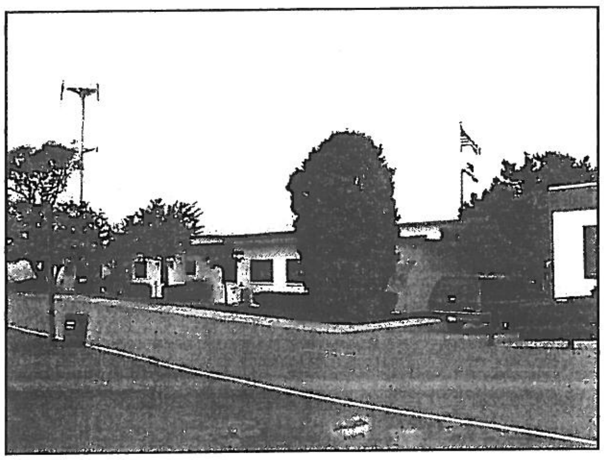
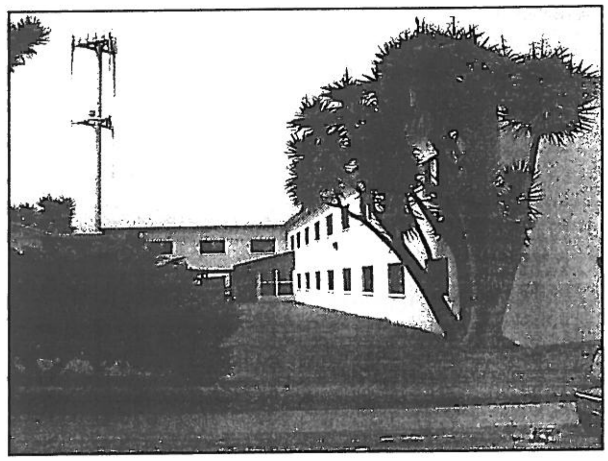
SEISMIC HAZARD EVALUATION

FOR THE

RANCHO PALOS VERDES CIVIC CENTER BUILDINGS

30940 HAWTHORNE BOULEVARD
RANCHO PALOS VERDES
CALIFORNIA 90275





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EXECUTIVE SUMMARY:

This report presents the results for the seismic hazard evaluation of the Administration and the Planning, Building and Code Enforcement buildings that are part of the City of Rancho Palos Verdes Civic Center located at 30940 Hawthorne Boulevard, Rancho Palos Verdes, California. The buildings are a two-story structure and a single-story structure constructed utilizing concrete block masonry construction. The purpose of this report is to identify the seismic hazards for the structures in the event of a major seismic event in the area.

This report summarizes the seismic hazards specific to the location of a building, as well as structural vulnerabilities in a building associated with these seismic hazards. Seismic hazards include the earthquake magnitude expected in an area, the distance to earthquake faults, the stability of the soil as well as other geological parameters for a site. The structural vulnerabilities of a building include the building design characteristics used in achieving the required strength in the building as well as the use and occupancy of the building. The seismic hazards for the site were researched utilizing site-specific data available from the United States Geological Survey and the California Department of Mines and Geology. The structural vulnerabilities were investigated by first conducting field inspections to observe the quality of construction and identify critical structural elements in the building. As-built plans for either building were not available for review.

This report describes the factors involved, researched, investigated, analyzed, and assumed to arrive to our conclusions. The seismic hazard evaluation of the buildings was based on performance-based objectives. A seismic performance objective for a building specifies the acceptable limits of structural and non-structural damage for the building. The most common objective is a Life Safety performance level that is the design objective for the current building codes. Higher performance objectives exist and are selected for buildings that are more essential and are sometimes required to be fully operational after an earthquake. The seismic performance for both subject buildings was measured against defined seismic performance levels to have a better understating of how these buildings will perform during a major earthquake.

This report states that the analysis for the subject buildings indicates that the buildings will perform satisfactorily under current 1997 Uniform Building Code criteria. The buildings are expected to exceed a Life Safety performance level. The risk to life safety in these buildings is low although the buildings may still experience extensive damage to structural and non-structural elements. The analysis of the two-story building indicates that the Design Basis Earthquake may result in minor structural damage to the roof connections. The non-structural damage for both buildings may be considerable, but the overall risk of life-threatening injuries as a result of damage is low. The non-structural damage may include overturned bookcases and filing cabinets, damaged ceilings, cracked walls and window breakage. The expected damage for these buildings is reported as a Probable Maximum Loss (PML) of 7% for the two-story building and 8% for the one-story building.

This report concludes that the current condition of the buildings does not present a major life-safety hazard to its occupants. The PML for the buildings is average compared to some of the similar structures we have reviewed recently. The buildings meet the current life-safety requirements enforced by the City thus, seismic hazard reduction work is not recommended to meet a Life Safety performance level. Recommendations are provided in this report shall there be a need to enhance the seismic performance of the building. Retrofitting guidelines and retrofit work cost estimates are described in this report in order to upgrade these buildings to an Immediate Occupancy performance level. Retrofitting is also recommended shall there be a need to further reduce the expected losses after a major earthquake.

INTRODUCTION:

The Administration and Planning, Building and Code Enforcement buildings were formerly occupied by the United States Armed Forces. The subject buildings built circa 1940 were most likely designed per the U.S. Corp of Engineers' Standards. These standards as well as other building codes of this period contained criteria for seismic design that is now considered rudimentary.

Seismic design was first introduced in the late 1930's after the 1933 Long Beach Earthquake caused devastating damage in many of the South Bay communities of Los Angeles County. Recent major earthquakes in California and elsewhere have raised a considerable concern in regard to the earthquake preparedness of municipal governmental buildings. The current Uniform Building Code requires essential facilities such as police and fire stations and communication centers to be designed for a higher seismic performance than conventional office buildings. Administration facilities for the municipalities may be considered essential facilities where they handle communication systems or house equipment for emergency response, including shelter centers. As a result of earthquake preparedness in recent years, it is also becoming more frequent for city officials to set seismic performance objectives for their buildings that are higher than minimum life safety objectives. These objectives could range from Immediate Occupancy objectives to Fully Operational objectives, which are described later in this report.

The subject buildings are used primarily as administration offices but they also house communication equipment and computer network equipment that is used by the many different departments that run the City. Public Works and Planning Building and Safety Departments can prove to be very important after a major earthquake. Citizens may request that the City repair damaged streets and broken water or sewer lines or the City may be requested to perform building inspections to evaluate the damage to residences and commercial buildings. The damage repair for the residences and commercial properties in the City normally require a building permit from the City. Although the above scenarios as represented are not classified as life safety emergency services, these may be significant for the City to consider a higher performance objective. In our analysis results we will describe how these buildings measure to defined seismic objective levels. This report will give you an indication of how these buildings can function in the event of a major earthquake and whether it meets the intent of the City.

DESCRIPTION OF BUILDINGS:

The Administration building is a two-story structure constructed with reinforced concrete masonry unit (CMU) block walls, wood framed floor and wood framed roof. The building has an L-shaped footprint and it is physically divided into two buildings by a construction joint that can be observed form the main stairs. It may be worth noting that the construction joint occurs only in the masonry and it is not continuous through the stair or floor framing. The east wing has a rectangular shape of approximately 142 feet by 33 feet and the south wing has a rectangular shape of 85 feet by 38 feet. The exterior of the building consists of 12" thick CMU bearing walls at the first floor and 8" thick CMU bearing walls at the second floor. Most of the interior partition walls are wood framed with gypsum plaster finish, but there are some interior 8", 6", and 4" thick CMU walls that extend from the ground floor to the roof. Our investigation verified that the CMU walls are only partially grouted. The grouted cell that was observed contained ½ inch diameter steel reinforcement. The wood framed construction for the floors consists of ¾" thick plywood over 2x wood joists that are supported by wood beams or wood ledgers anchored to the CMU walls with 5/8" diameter bolts. The wood joist connections are accomplished by utilizing steel joist hangers similar to current construction practices. The foundations most likely consist of conventional continuous footings for the CMU and wood framed bearing walls and spread footing pads for the interior wood posts found in the east wing. The lateral force resisting system for the building consists of the perimeter and interior CMU walls and wood framed diaphragms for the floor and roof. The quality of construction and the construction practices observed were found to be adequate.

The Planning, Building and Code Enforcement building is a single-story structure constructed with reinforced CMU block walls and a wood framed roof. The original shape of the building had a rectangular footprint with approximate dimensions of 125 feet by 33 feet. An addition, north of building, was constructed circa 1984 to incorporate handicapped restrooms and a conference room. The addition added an area of approximately 532 square feet and is located in the center of the north elevation. The exterior of the building consists of 8" thick CMU bearing walls. Most of the interior partition walls are wood framed with gypsum plaster finish, but there are some interior 8" and 4" thick CMU walls that extend from the ground floor to the roof. The original portion of the building has an interior bearing line in the longitudinal direction that is a combination of wood framed bearing walls, wood posts, and masonry pilasters integral with the transverse CMU walls. The wood post connections consist of a bolted steel saddle at the beam and a bolted and anchored steel base plate at the footing. The foundations most likely consist of conventional continuous footings for the CMU and wood framed bearing walls and spread footing pads for the interior wood posts. The lateral force resisting system for the building consists of the perimeter and interior CMU walls and wood framed diaphragms for the floor and roof. The quality of construction and the construction practices observed were found to be adequate.

SEISMIC PERFORMANCE OBJECTIVES:

Seismic performance objectives are described by designating the maximum allowable damage state for an identified earthquake or ground motion. A seismic performance objective for a building specifies the desired limits of structural and non-structural damage for the building. While the majority of buildings are expected to meet or exceed the assigned performance-level when exposed to the ground motion implied by the selected hazard level, such performance should not be considered a guarantee. The following performance levels are the most common benchmark levels used by structural engineers.

OPERATIONAL LEVEL (1-A)

Buildings meeting this performance level are expected to sustain minimal or no damage to their structural and non-structural components. The building is suitable for its normal occupancy and use, although possibly in a slightly impaired mode, with power, water and other required utilities provided by emergency sources, and possibly with some nonessential systems not functioning. Buildings meeting this performance level pose an extremely low risk to life safety.

The basic vertical-force and lateral-force resisting systems of the building retain nearly all of their pre-earthquake strength and stiffness. Although some minor structural repairs may be appropriate, these would generally not be required prior to re-occupancy. Most nonstructural systems required for normal use of the building - including lighting, plumbing, HVAC and computer systems - are functional, although minor cleanup and repair of some items may be required.

Under very low levels of earthquake ground motion, most buildings should be able to exceed this performance level. Typically, however, it will not be economically practical to design for this performance under severe levels of ground shaking, except for buildings that house essential facilities.

IMMEDIATE OCCUPANCY LEVEL (1-B)

Buildings meeting this performance level are expected to sustain minimal or no damage to their structural elements and only minor damage to their nonstructural components. While it would be safe to reoccupy a building meeting this performance level immediately following a major earthquake, nonstructural systems may not function due to either a lack of electrical power or internal damage to equipment. Therefore, although immediate re-occupancy of the building is possible, it may be necessary to perform some cleanup and repair, and await restoration of utility service, before the building could function in a normal mode. The risk to life safety at this performance level is very low.

This level provides most of the protection obtained under Operational Level, without the cost of providing standby utilities and performing rigorous seismic qualification of equipment performance. Basic access and life safety systems, including doors, stairways, elevators, emergency lighting and fire alarms remain operational provided that power is available. There could be minor window breakage and damage to other nonstructural components. Presuming that the building is structurally safe, it is expected that occupants could safely remain in the building, although normal use may be impaired and some cleanup and inspection may be required.

Many owners may wish to achieve this level of performance when the building is subject to moderate levels of earthquake ground motion. In addition, some owners may desire such performance for very important buildings, under severe levels of earthquake ground shaking.

LIFE SAFETY LEVEL (3-C)

Buildings meeting this level may experience extensive damage to structural and nonstructural components. Repairs may be required before re-occupancy of the building occurs, and repair may be deemed economically impractical. The risk to life safety in buildings meeting this performance level is low.

At this performance level significant damage to the structure may occur, but some margin against partial or total collapse remains. Some structural elements and components are severely damaged, but this has not resulted in large falling debris hazards, either within or outside the building. Egress routes within the building are not extensively blocked, but may be impaired by lightweight debris. Plumbing and fire sprinkler systems may have been damaged, resulting in local flooding and loss of function. Injuries may occur during the earthquake; however, it is expected that the overall risk of life-threatening injury as a result of structural damage is low. It should be possible to repair the structure; however, for economic reasons this may not be practical. While the damage of the collapse is not imminent collapse risk, it would be prudent to implement structural repairs or install temporary bracing prior to re-occupancy.

This performance level entails somewhat more damage than anticipated for new buildings that have been properly designed and constructed for seismic resistance when subjected to their design earthquakes. Many building owners will desire to meet this performance level for a severe level of ground shaking.

COLLAPSE PREVENTION LEVEL (5-E)

Buildings meeting this level are on the verge of experiencing partial or total collapse. Substantial damage to the structure has occurred, potentially including significant degradation in stiffness and strength of the lateral force resisting system, large permanent lateral deformation of the structure, and - to a more limited extent - degradation in vertical load carrying capacity. However, all significant components of the gravity load resisting system must continue to carry their gravity load demands. Significant risk of injury due to falling hazards from structural debris may exist. However, because the building itself does not collapse, gross loss of life should be avoided. The structure may not be technically practical to repair and is not safe for re-occupancy, as aftershock activity could induce collapse. Many buildings meeting this level will be complete economic losses.

This level has sometimes been selected as the basis for mandatory seismic rehabilitation ordinances enacted by municipalities, as it results in mitigation of the most severe life-safety hazards at relatively low cost. The vulnerabilities of nonstructural components are not considered at this performance level.

SEISMIC HAZARDS AT SITE:

The likely source of future ground motion and the anticipated seismic activity for the building is governed primarily by the following known faults in the area. The table below lists the distance from the site to the faults and other characteristics in regard to these faults.

TABLE - FAULTS NEAR THE BUILDING SITE

Fault Zones	Distance (kilometers)	Slip Rate (mm/yr.)	Richter Magnitude (maximum)
Newport-Inglewood Fault	20	1	6.9
Palos Verdes Fault	9	3	7.1
Santa Monica Fault	44	1	6.6

Seismic hazard levels are usually specified in terms of a peak ground acceleration magnitude associated with a probability that this magnitude could be exceeded for a determined period (probability of exceedence). Most current building codes require structures to be designed for a ground motion magnitude associated with a 10% probability of exceedence in 50 years (475-year return period). This is commonly referred as the Design Basis Earthquake (DBE) or the Basic Safety Earthquake 1 (BSE-1). Based on published USGS data, the peak ground acceleration (PGA) is approximately 0.44g for the site specific DBE. At this level of ground motion, the Modified Mercalli Intensity (MMI) is expected to be approximately VII to VIII. Refer to the appendix for a full description of this MMI scale.

A ground motion associated with a 2% probability of exceedence in 50 years (2,500-year return period) is commonly referred as the Maximum Credible Earthquake or Basic Safety Earthquake 2 (BSE-2). This type of seismic hazard is usually not used for design or analysis since the probability of this event actually occurring is very low. Nuclear buildings and emergency preparedness center such as 911 emergency facilities are among the few types of buildings that consider this type of hazard for design or analysis.

Other geological hazards that were considered for this study include ground fault rupture, landsliding and liquefaction. Ground fault rupture is the direct sign of the movement along a fault that could leave permanent deformation at the ground surface. Landsliding is the downhill movement of masses of earth under the force of gravity. Landslides are most common on hills with a slope of more than 15 degrees. Earthquake movement can trigger landslides in areas that are prone to landslides. Liquefaction is the sudden loss of bearing strength that can occur when saturated, cohesion-less soils (sands and silts) are strongly and repetitively vibrated. Based on our research and data from the California Department of Mines and Geology (CDMG), the site is not expected to experience these geological hazards. For the purpose of this analysis, it was assumed that the soils are stable throughout the site.

SEISMIC PERFORMANCE:

As-built information for the buildings was collected as required for the level of structural detail needed to analyze the buildings. Without original as-built structural plans, BQE engineers were presented with the challenge of analyzing the structure with information gathered from structural observations and field measurements. Mr. Lionel Garcia, P.E. and Mr. David Breiholz, P.E. conducted field inspections to identify and evaluate the condition of the buildings. Critical lateral force resisting elements were identified. Although the buildings were originally designed and built approximately 50 to 60 years ago, before seismic design criteria was well established, the buildings have performed fairly well throughout their history. The structures have inherent strengths and structural attributes by design and/or from construction practices and workmanship of that period. After conducting the structural assessment of the buildings, BQE considers that the current condition of the building does not present a major life safety hazard to its occupants.

The expected performance of the buildings during an earthquake was investigated by performing simplified structural calculations based on the limited information collected from our site investigations. The seismic calculations were based on the 1997 Uniform Building Code (UBC) and soil conditions representative of the site. The 1997 UBC prescribes that a building, categorized as an essential facility, be designed for a lateral force equal to 21% of its mass for allowable stress design. The structural elements investigated included the roof diaphragms and the in-plane and out-of-plane forces in the steel reinforced brick walls.

Upon review of our analysis, it was enlightening to discover that both structures performed better than anticipated. The investigation revealed that the CMU bearing walls appear to be properly designed and distributed throughout the buildings to resists seismic forces acting on the buildings. These walls are expected to perform well for in-plane forces as well as for out-of-plane forces. Although not exposed for observation, the foundations of the buildings should be able to provide the rigidity that is needed at the base thus no settlements are expected. The roof diaphragm connections for the two-story building could be slightly overstressed at some of the transverse CMU walls located in the east wing of the building. Although this connection was not verified during inspections since it was not exposed for observation, the construction practices used in that period indicate that the a deficiency may be present from cross-grain bending in the ledger, poor nailing between the plywood sheathing and the wood ledger as well as poor bolting/anchoring of the wood ledgers to the CMU walls. There is only a moderate margin of surplus capacity in these connections and thus these connections may sustain some damage. These damages are not anticipated to affect the integrity of the vertical-load carrying system. The analysis shows that most structural elements are expected to remain in the material's elastic range and thus the overall strength and ductility of the structural elements is adequate.

The non-structural damage for both buildings may be considerable in the event of a major earthquake. The non-structural damage may include overturned bookcases and filing cabinets, damaged ceilings, cracked partition walls and window breakage. The utilities including electricity, water and telephone lines are expected to be temporarily out of service. These may cause inconveniences to the occupants but it should not affect the functionality of the building for an extended period of time. Repair and clean-up crews may be needed before resuming normal activities.

The analysis indicates that the buildings will perform well under the current 1997 Uniform Building Code. The buildings are expected to exceed a Life Safety performance level. The risk to life safety in these buildings is low although the buildings may still experience extensive damage to structural and non-structural performance. The analysis of the two-story building indicates that the Design Basis Earthquake will result in minor structural damage to the roof connections. The non-structural damage for both buildings may be considerable, but the overall risk of life-threatening injuries as a result of damage is low. The current condition of the buildings does not present a major life-safety hazard to its occupants.

PROBABLE MAXIMUM LOSS (PML):

A Probable Maximum Loss (PML) of a building is defined as the best estimate of direct earthquake economic loss for a building exposed to a defined seismic hazard. The PML estimate in this report refers to the probable cost of repair or replacement of the structural and nonstructural building components and building systems, expressed as a percentage of the replacement value of the structure. Several PML levels of implementation could be acceptable, depending upon the intended use of the PML and the degree of certainty required. The level of confidence that can be provided for these estimates depends on the information available regarding the structures and hazards as well as the level of investigation performed to prepare the earthquake loss assessment. The Structural Engineers Association of California (SEAOC), Earthquake Damage Assessment Subcommittee has categorized PML studies into the following levels:

> Level 1 is the simplest level of analysis that requires the minimum amount of site-specific data and evaluation of the structures to prepare an earthquake loss assessment. Site earthquake hazards are evaluated based on published regional geological and seismic hazard maps. Building vulnerability is based on the likely hazards identified on standardized damageability data for model buildings of similar construction.
>
> Level 2 is the best estimate, which can be obtained using available site and building data in combination with standardized damageability data for model building types. Modification factors are applied to the standardized losses to account for the strengths and weaknesses of the building. The original structural and architectural drawings as well as original geotechnical reports should be available for the estimate. A licensed engineer performs a building inspection to observe the condition of the building and to compare the as-built condition to the design documents. Earthquake ground motions are characterized in parameters in terms of peak ground acceleration modified Mercalli intensity, UBC soil type and others.
>
> Level 3 incorporates the results of detailed engineering studies, including analysis of structural systems and components. Calculations, including computer analysis, are made to compare earthquake involved stresses and deformation of key structural elements. Ground motion may be represented by site-specific response spectra or time histories in addition to other ground motion parameters.

The PML study performed for the property may be considered a Level 2 study as defined by the Structural Engineers Association of California. Architectural and structural drawings were not available for review; however, field inspections by a licensed engineer were performed to obtain more information in regard to the type and quality of construction used in these buildings. Modification factors to the standardized damageability data were applied based on these observations. Good engineering judgment and knowledge of construction was pertinent to this study. The PML procedures underlying this report are based on methods developed by reputable researcher, Karl Steinbrugge and new data and improvements incorporated into this procedure.

The seismic risk for the buildings is provided in the table below. These numbers are the percentage of total building replacement value and they represent the probable range of costs to restore the structures to the pre-earthquake condition. The person using this report is reminded that the PML estimates exclude losses due to building contents, fire or water damage and related business interruption/loss of rents. These estimates are consistent with conventional reporting procedures by the profession. The expected maximum percentage loss will not be exceeded for 9 out of 10 buildings of similar construction for the associated hazard level (90% confidence level).

TABLE - PML FOR BUILDING (REPAIR COST AS A % OF BUILDING REPLACEMENT VALUE)

BUILDING TYPE	PML Design Basis Earthquake
Two-story building	7
Single-story building	8

The Design Basis Earthquake corresponds to an event that has a 10% chance of being exceeded once in 50 years (475-year return period) as recommended in the Uniform Building Code. When a holding period is reported, the estimate losses are calculated by mathematically combining the probability of having different size earthquakes and the associated possible ground motions during that holding period indicated. The PML reported for the holding period is also associated with 10% chance of being exceeded once during the holding period. When a specific event is indicated, the estimated losses apply to damages that may occur for that specific earthquake event only.

RECOMMENDATIONS:

The Administration and Planning, Building and Code Enforcement buildings meet the current life-safety requirements enforced by the City, thus seismic hazard reduction work is not recommended to meet a Life Safety performance level. However, recommendations are provided in this report shall there be a need to enhance the seismic performance of the buildings to Immediate Occupancy performance level. The seismic hazard reduction objectives should be fully discussed to arrive at the optimum seismic performance desired in a cost effective manner.

The seismic hazard reduction work required to meet Immediate Occupancy requirements may include structural retrofit work for the two-story building and non-structural retrofit work for both buildings. A structural retrofit work for the two-story building should address the vulnerable roof-to-wall connections. This work may consist of installing new anchor bolts, continuity ties and drag elements as well as re-nailing the plywood sheathing for the roof diaphragm. The non-structural retrofit should address both furniture and utility (life line) components for both buildings. The furniture that is most susceptible to damage should be anchored to the walls and floors of the building. These items include tall bookcases and filing cabinets that are likely to overturn during an earthquake. Electrical and telephone panels should also be properly anchored to the walls and floors if currently not properly anchored.

COST OF STRENGTHENING

Without the benefit of completed working drawings for the seismic retrofit, the cost of strengthening as recommended in this report was based on experience with similar seismic retrofits, our in-house database and Means cost estimate standards. The following is a projection of the retrofit cost for the new structural elements only.

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	ITEM DESCRIPTION	UNITS	RATE	AMOUNT
1	Structural Retrofit (and related architectural finishes)	LS	$ 30,000	$ 30,000
2	Non-structural Retrofit	LS	$ 15,000	$ 15,000
3	Miscellaneous Repairs and Strengthening	LS	$ 5,000	$ 5,000
			SUBTOTAL	**$50,000**
4	Permit and Plan Check Fees (1.5%)	LS	$500	$ 500
5	Consulting	LS	$10,000	$10,000
6	Contingency (15%)			$ 7,500
			TOTAL	**$ 68,00**

CONCLUSIONS:

The analysis indicates that the buildings, as non-essential facilities, will perform adequately under 1997 Uniform Building Code base shear requirements. The buildings are expected to exceed a Life Safety performance level. The risk to life safety in these buildings is low although the buildings may still experience extensive damage to structural and non-structural elements. The current condition of the buildings does not present a major life-safety hazard to its occupants. The expected damage for these buildings is reported as a Probable Maximum Loss (PML) of 7% for the two-story building and 8% for the one-story building. The PML for the buildings is average compared to similar structures we have reviewed recently. For the necessary consideration that the two buildings should comply and perform as essential facilities, there is a need to enhance the seismic performance of both buildings.

The scope of this inspection and report did not include a seismic hazard evaluation for the exterior mechanical equipment and antennas supported at grade level at the west end of the Administration Building nor the mobile/modular building that is adjacent to the east of the Planning, Building and Code

Enforcement Building. The mobile building should be investigated to verify that proper seismic anchorage to the ground is present.

DISCLAIMER:

Our findings, interpretations, analysis and recommendations are based solely on visual observation and are limited to the stated areas of concern. Other conditions affecting this or other adjacent properties that were not inspected, accessible or anticipated are beyond the scope of this report. Our office conducted no subsurface or destructive investigations. For additional specific geotechnical information, a soils engineer and/or geologist should be consulted. The earthquake loss estimation in general is more an art than science. We have sufficient knowledge to describe the scope of earthquake damage, as has been done in this report, but we do not have sufficient observational data to call it an accurate science. Services performed by this firm, at subject site, were conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other warranties are expressed or implied.

REFERENCES:

1. **"1997 Uniform Building Code"**; International Conference of Building Officials; 1997; Whittier, California.

2. **"NEHRP Guidelines for the Seismic Rehabilitation of Buildings (FEMA-273)"**; Federal Emergency Management Agency; 1997; Washington D.C.

3. **"Reinforcing Existing Buildings To Resist Earthquake Forces"**; James Lefter, James Coville; Proceedings of U.S. National Conference on Earthquake Engineering; 1975; Ann Arbor, Michigan.

4. **"Repair and Retrofit of Structures for Earthquake Resistance"**; Shizuoka Perfecture; US/Japan Cooperative Earthquake Engineering Research Program; May 1982.

5. **"Reviewing Earthquake Hazardous Buildings and Hazardous Abatement Techniques"**; URS/John A. Blume and Associates, Engineers, San Francisco, California; Prepared for the City of Long Beach, California; October 1989.

6. **"Earthquakes, Volcanoes, and Tsunamis; An Anatomy of Hazards"**; Karl V. Steinbrugge; Skandia America Group; 1982.

7. **"USGS - National Seismic Hazard Mapping Project"**; United States Geological Survey; Current Database.

8. **"California Fault Parameters and Seismic Hazard Zone Maps"**; California Department of Conservation, Division of Mines and Geology; Current Database.

9. **"FEMA 178 - NEHRP Handbook for the Seismic Evaluation of Existing Buildings"**; Building Seismic Safety Council; 1992; Washington D.C.

10. **"Earthquake Spectra: Loss Estimation"**; Professional Journal Volume 13, Number 4; Earthquake Engineering Research Institute; 1997; Oakland, California.

11. **"Probable Maximum Loss (PML), A Rational Approach, Progress Report"**; Earthquake Damage Assessment Subcommittee, Structural Engineers Association of California (SEAOC); 1997; Whittier, California

APPENDIX:

PHOTOGRAPHS OF BUILDING

PRELIMINARY DRAWINGS

EARTHQUAKE INFORMATION

COST OF STRENGTHENING BY BUILDING

Without the benefit of completed working drawings for the seismic retrofit, the cost of strengthening as recommended in this report was based on experience with similar seismic retrofits, our in-house database and Means cost estimate standards. The following is a projection of the retrofit cost for the new structural elements only.

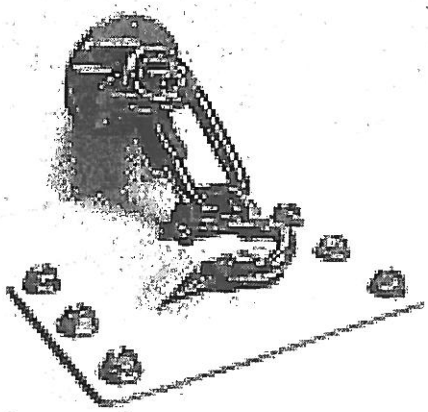
ADMINISTRATION BUILDING

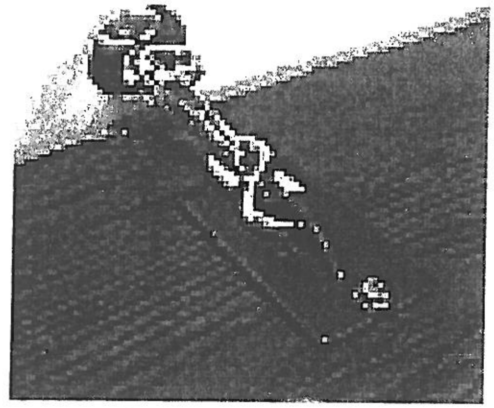
	ITEM DESCRIPTION	UNITS	RATE	AMOUNT
1	Structural Retrofit (and related architectural finishes)	LS	$ 30,000	$ 30,000
2	Non-structural Retrofit	LS	$ 9,000	$ 9,000
3	Miscellaneous Repairs and Strengthening	LS	$ 4,000	$ 4,000
			SUBTOTAL	**$ 43,000**
4	Permit and Plan Check Fees (1.5%)	LS	$500	$ 500
5	Consulting	LS	$ 9,000	$ 9,000
6	Contingency (15%)			$ 6,500
			TOTAL	**$ 59,000**

PLANNING, BUILDING AND CODE ENFORCEMENT BUILDING

	ITEM DESCRIPTION	UNITS	RATE	AMOUNT
1	Non-structural Retrofit	LS	$ 6,000	$ 6,000
2	Miscellaneous Repairs and Strengthening	LS	$ 1,000	$ 1,000
			SUBTOTAL	**$ 7,000**
3	Consulting	LS	$ 1,000	$ 1,000
4	Contingency (15%)			$ 1,000
			TOTAL	**$ 9,000**

RECOMMENDED NON-STRUCTURAL RETROFIT





The above pictures show the top of filing cabinets and/or bookcases anchored to adjacent walls. This type of anchorage can also be applied to other tall furniture in the building. Tall furniture is likely to overturn during a major earthquake. Desktop computers may move during a major earthquake but these are not likely to fall down from desks. Computer anchorage shown on the pictures below is only recommended for critical computer equipment such as computer servers. The suspended ceiling system in the building is not expected to suffer extensive damage. The partition walls for the offices divide the ceiling into numerous sections that are actually confined by the walls. The picture to the left shows extensive damage from overturn filing cabinets and bookcases.