

# **FEMA 356 Life Safety Building Performance Evaluation & PML Analysis**

For

**Atherton Library  
2 Dinkelspiel Station Ln.  
Atherton, California**

September 24, 2009



**Prepared for:**

Town of Atherton  
Office of the City Clerk  
91 Ashfield Road  
Atherton, CA 94027

**Prepared by:**

Crosby Group  
2200 Bridge Parkway Ste. 104  
Redwood City, CA 94065



## Contents

A	Purpose and Scope .....	3
A.1	Purpose of Report .....	3
A.2	Method and Scope of Evaluation.....	3
A.3	PML Analysis.....	3
B	Structural & Component Level of Damage Tables.....	5
B.1	Damage Control & Building Performance Levels .....	5
B.2	Structural Performance Levels & Damage - Vertical Elements .....	5
B.3	Structural Performance Levels & Damage - Horizontal Elements .....	6
B.4	Nonstructural Performance Levels & Damage Architectural Components .....	6
B.5	Nonstructural Performance Levels & Damage Mechanical, Electrical and Plumbing Systems/Components.....	7
B.6	Nonstructural Performance Levels & Damage Contents.....	8
C	Evaluation Summary of Findings .....	9
C.1	General .....	9
C.2	Original Building (1929).....	9
C.3	Addition (1981).....	9

### **Appendix A: Structural Calculations**

### **Appendix B: PML Evaluation Results**



## **A. PURPOSE AND SCOPE**

### **A1. PURPOSE OF REPORT**

The purpose of this evaluation is to determine whether the building's structural systems meet the *Life-Safety Building Performance Level (3-C)* according to the Federal Emergency Management Agency (FEMA 356). Buildings meeting this level may experience extensive damage to structural and nonstructural components, but the structure should remain stable and have significant reserve capacity, while hazardous nonstructural damage is controlled. However, repairs may be required prior to reoccupancy of the building, and these repairs may potentially be deemed economically impractical. The risk to life safety in buildings meeting this target Building Performance Level is low. Additionally, a Probable Maximum Loss analysis will be conducted, to measure the structure's potential earthquake losses.

### **A2. METHOD AND SCOPE OF EVALUATION**

The seismic lateral forces used in this evaluation refer to those calculated in the analysis performed in the ASCE 31-03 Structural Evaluation Report done for the Atherton Library dated February 11, 2009. The calculations provided in Appendix A of this report show why the forces calculated in the February 11 report are still valid and thus should be referred to for the following evaluation.

Due to inherent uncertainties in prediction of ground motion and analytical prediction of building performance, some variation in actual performance should be expected. Compliance with this standard should not be considered a guarantee of performance.

### **A3. PML ANALYSIS**

The probable maximum loss (PML) is the traditional measure of earthquake loss popularized by the insurance and seismic engineering industry in the 1980s. A probabilistic analysis accounts for the full range of possible earthquakes, their location, frequency of occurrence, size, and the propagation of the earthquake motion from the rupture zone to the site of interest. Uncertainty in each of these elements and in the damageability of the building is taken into account. This provides a more complete and "realistic" evaluation of the potential earthquake losses. If the effects of all events are combined, the hazard can be determined, that is, the probability that a ground motion of intensity X will be exceeded. This measures the likelihood that a building will encounter certain levels of ground shaking. The risk to the building then represents a probabilistic measurement of the hazard and the building's response to certain levels of shaking, or damage. Damage can then be translated into financial loss to the owner, casualty to occupants, operational loss to a business (including loss of market share), and other losses.



The PML is historically associated with a 90 percent confidence level on the structural response of the building (i.e., given that this event occurs, the PML would not be exceeded by 9 out of 10 buildings having the same structural features). Because the term "PML" has been in use for a large number of years, many people in the industry have developed benchmarks by which to judge the acceptable limits on PMLs for individual buildings.



**B. STRUCTURAL & COMPONENT LEVEL OF DAMAGE TABLES**

<b>B.1 Damage Control and Building Performance Levels</b>		
<b>Overall Damage</b>	<b>Life Safety Level (3-C) of Damage</b>	<b>Atherton Library Anticipated Damage</b>
General	Some residual strength and stiffness left in all stories. Gravity-load-bearing elements function. No out-of-plane failure of walls or tipping of parapets. Some permanent drift. Damage to partitions. Building may be beyond economical repair.	There is limited residual strength left in the inadequate single sheathed wood plank lateral system. Shear walls will fail under high seismic stress. Unbraced cripple walls may fail causing potential shift in the building. Significant structural damage.
Nonstructural Components	Falling Hazards mitigated but many architectural, mechanical, and electrical systems are damaged.	Unanchored Spanish ceramic tiles on the roof are severe falling hazards and pose a threat to life safety.

<b>B.2 Structural Performance Levels &amp; Damage – Vertical Elements</b>			
<b>Elements</b>	<b>Type</b>	<b>Life Safety (S-3) Level of Damage</b>	<b>Atherton Library Anticipated Damage</b>
Wood Stud Walls	Primary	Connections loose. Nails partially withdrawn. Some splitting of members and panels. Veneers dislodged.	Plank and stucco sheathing will potentially fracture and buckle under stress, causing major Life Safety concern.
	Secondary	Sheathing Sheared off. Let-in braces fractured and buckled. Framing split and fractured.	Sheathing will shear, braces and framing will fracture and split.
	Drift	3% transient or permanent.	The 1981 library addition will be within 2% transient drift. The original two story 1929 structure will exceed the 3% transient and have permanent drift.
Foundations	General	Major settlement and tilting.	Settlement is minimal.



**B.3 Structural Performance Levels & Damage – Horizontal Elements**

<b>Element</b>	<b>Life Safety (S-3) Level of Damage</b>	<b>Atherton Library Anticipated Damage</b>
Wood Diaphragms	Some Splitting at connections. Loosening of sheathing. Observable withdrawal of nails and extensive splitting of elements.	Single sheathed wood plank diaphragms are inadequate to transfer loads to and from vertical elements. Diaphragm will experience fracture and splitting.

**B.4 Nonstructural Performance Levels & Damage – Architectural Components**

<b>Component</b>	<b>Life Safety (N-C) Level of Damage</b>	<b>Atherton Library Anticipated Damage</b>
Cladding	Severe distortion in connections. Distributed cracking, bending, crushing, and spalling of cladding elements. Some fracturing of cladding, but panels do not fall.	Exterior plaster will crack and experience spalling but poses little threat to life safety.
Glazing	Extensive cracked glass; little broken glass.	Glazing with shatter with the damaged shear wall. It may pose significant risk due to falling pieces.
Partitions	Distributed damage; some severe cracking, crushing, and racking in some areas.	Severe cracking, crushing and racking may occur.
Ceilings	Extensive damage. Dropped suspended ceiling tiles. Moderate cracking in hard ceilings.	Suspended ceiling tiles in Library will fall. Hard plaster ceilings will crack due to inadequate bracing.
Parapets & Ornamentation	Extensive damage; some falling in unoccupied areas.	Heavy Spanish ceramic roof tiles may slip from roof, falling into unoccupied perimeter of building, as well as above building egress, threatening life safety.
Canopies & Marquees	Moderate damage.	Canopy at East entrance may fail due to inadequate anchorage, creating a falling hazard and blocking means of egress.
Chimneys & Stacks	Extensive damage. No collapse	n/a
Stairs & Fire Escapes	Some racking and cracking of slabs. Usable.	Stairs may crack from weak lateral strength in a seismic



		event.
Doors	Distributed damage. Some racked and jammed doors.	Doors may experience damage.

**B.5 Nonstructural Performance Levels & Damage - Mechanical, Electrical, and Plumbing Systems/Components**

<b>System/Component</b>	<b>Life Safety (N-C) Level of Damage</b>	<b>Atherton Library Anticipated Damage</b>
Elevators	Elevators out of service; counterweights do not dislodge.	n/a
HVAC Equipment	Units shift on supports, rupturing attached ducting, piping, and conduit, but do not fall.	HVAC units may shift, but are not a threat to life-safety.
Manufacturing Equipment	Units slide, but do not overturn; utilities not available; some realignment required to operate.	n/a
Ducts	Ducts break loose of equipment and louvers; some supports damaged, but systems remain suspended.	n/a
Piping	Minor damage at joints, with some leakage. Some supports damaged, but systems remain suspended.	Piping may have damage, but should remain suspended. Not a life safety concern.
Fire Sprinkler Systems	Some sprinkler heads damaged by swaying ceilings. Leaks develop at some couplings.	n/a
Fire Alarm Systems	Ceiling mounted sensors damaged. May not function.	n/a
Emergency Lighting	Some lights fall. Power may be available from emergency generator.	n/a
Electrical Distribution Equipment	Units shift on supports and may not operate. Generators provided for emergency power start; utility service lost.	Units may shift and lose power. Not a life safety concern.
Light Fixtures	Many broken light fixtures. Falling hazards generally avoided in heavier fixtures (> 20 pounds)	Light fixtures may brake and fall, but none over 20 pounds. Not a life safety concern.
Plumbing	Some fixtures broken, lines broken; mains disrupted at source.	Plumbing may have broken fixtures from building movement, but not a life safety concern.



<b>B.6 Nonstructural Performance Levels &amp; Damage – Contents</b>		
<b>Contents</b>	<b>Life Safety (N-C) Level of Damage</b>	<b>Atherton Library Anticipated Damage</b>
Computer Systems	Units shift and may disconnect cables, but do not overturn.	Units may shift. Not a life safety concern.
Desktop Equipment	Some equipment slides off desks	Equipment may slide. Not a life safety concern.
File Cabinets	Cabinets overturn and spill contents.	Cabinets may overturn. Not a life safety concern.
Book Shelves	Books slide off shelves.	Books may slide off shelves, but bookshelves are anchored. Not a life safety concern.
Hazardous Materials	Minor damage; occasional materials spilled; gaseous materials contained.	n/a
Art Objects	Objects damaged by falling, water, dust.	Art objects may be damaged. Not a life safety concern.



## **C. EVALUATION SUMMARY OF FINDINGS**

### **C.1 GENERAL**

Due to the high level of seismicity and dated construction, the Atherton Library building does not meet the Target Building Performance Level 3-C according to FEMA 356 and therefore poses threat to the life safety of its occupants. The FEMA 356 defined Building Performance Level 3-C considers buildings that meet its criteria to have no major structural deficiencies, however the inadequate lateral system of the Atherton Library risks instability and very little, if any reserve capacity. Following a seismic event, the building may become “beyond economical repair”. This evaluation exposes the significant level of threat to life safety that the Atherton Library possesses in the event of an earthquake, reinforcing the need for the structure to be rehabilitated.

The PML analysis obtained a level of 38 for the Atherton Library.

### **C2. ORIGINAL BUILDING (1929)**

The main area of concern is the lateral system in the original library structure. The wood plank sheathing does not provide enough strength for the high seismic forces that the structure is susceptible to experience. This weakness will cause the shear walls to crack, split and fracture. Also, the East Entrance of the Atherton Library building shares a wall with the adjacent the Council Chambers structure, without any visible expansion joint, which means when the two buildings move independently in an earthquake there is the potential of fracture at that shared wall. The wall at the Library’s east entrance may then shear and lose its lateral capacity. Additionally, the Spanish ceramic tiles on the roof of the structure are not anchored appropriately. Under the intensity of even an average seismic event, they will become significant falling hazards along the perimeter of the building, including the building’s entrance and exit, creating a life threatening situation. This poses a danger to individuals surrounding or evacuating the building.

### **C3. ADDITION (1981)**

While the newer 1981 one story addition to the Library is in general compliance with the FEMA 356 life safety criteria, there is still one explicit deficiency. Similar to the original 1929 structure, the Spanish ceramic tiles continue throughout the perimeter of the building’s roof. These heavy tiles are severe falling hazards, especially where located above the building’s exit, threatening those individuals evacuating the building.



# **APPENDIX A: STRUCTURAL CALCULATIONS**



Project:	Job No:	
Description: BSE-1 RESPONSE ACCL.	Date: 9/2009	Sht:
	By: JKR	

$S_{xs}$ ,  $S_{xi}$  IS SMALLER OF...

- 1] 10%/50 YR SPECTRAL RESPONSE ACCL. CONTOUR MAPS  $\frac{1}{3}$   
MODIFIED FOR SITE CLASS W/ SEC 1.6.1.4
- 2]  $\frac{2}{3}$  OF VALUES FOR BSE-2 EARTHQUAKE HAZ. LVL  
( $S_{xs}$  +  $S_{xi}$  VALUES FROM MCE SPECTRAL RESPONSE  
ACCL. CONTOUR MAPS), 2%/50YR

1]  $S_{xs} = 1.305g$   
 $S_{xi} = 0.804g$   
(SEE ATTACHED OUTPUT)

2]  $S_{xs} = 1.159g$   
 $S_{xi} = 0.789g$   
(SEE ATTACHED OUTPUT) ← SMALLEST VALUES GOVERN

SEE LATERAL CALCS FROM  
TIER 1 / TIER 2 ANALYSIS  
REPORT FOR ATHERTON  
LIBRARY + CHAMBERS  
(SAME SPECTRAL RESPONSE ACCL)

## 10% / 50 YR Spectral Response Accelerations

Conterminous 48 States

2002 Data

Uniform Hazard Spectrum (UHS) for 10 % PE in 50 years

Latitude = 37.4629

Longitude = -122.1957

B/C Boundary

Data are based on a 0.05 deg grid spacing

Period (sec)	S <sub>a</sub> (g)	S <sub>d</sub> (inches)
0.000	0.542	0.000
0.100	0.976	0.095
<b>0.200</b>	<b>1.208</b>	0.472
0.300	1.138	1.001
0.500	0.890	2.173
<b>1.000</b>	<b>0.536</b>	5.232
2.000	0.272	10.625

S<sub>s</sub> = 1.208

S<sub>1</sub> = 0.536

Site Class D

F<sub>a</sub> = 1.08

F<sub>v</sub> = 1.5

S<sub>Xs</sub> = S<sub>MS</sub> = S<sub>s</sub> x F<sub>a</sub> = 1.305

S<sub>X1</sub> = S<sub>M1</sub> = S<sub>1</sub> x F<sub>v</sub> = .804

## BSE-2 Values

Conterminous 48 States  
2003 NEHRP Seismic Design Provisions  
Latitude = 37.4629  
Longitude = -122.1957  
Spectral Response Accelerations Ss and S1  
Ss and S1 = Mapped Spectral Acceleration Values  
Site Class B - Fa = 1.0 ,Fv = 1.0  
Data are based on a 0.01 deg grid spacing

Period	Sa
(sec)	(g)
0.2	1.738 (Ss, Site Class B)
1.0	0.789 (S1, Site Class B)

Conterminous 48 States  
2003 NEHRP Seismic Design Provisions  
Latitude = 37.4629  
Longitude = -122.1957  
Spectral Response Accelerations SMs and SM1  
SMs = Fa x Ss and SM1 = Fv x S1  
Site Class D - Fa = 1.0 ,Fv = 1.5

Period	Sa
(sec)	(g)
0.2	1.738 (SMs, Site Class D)
1.0	1.183 (SM1, Site Class D)

Conterminous 48 States  
2003 NEHRP Seismic Design Provisions  
Latitude = 37.4629  
Longitude = -122.1957  
Design Spectral Response Accelerations SDs and SD1  
SDs = 2/3 x SMs and SD1 = 2/3 x SM1  
Site Class D - Fa = 1.0 ,Fv = 1.5

Period	Sa
(sec)	(g)
0.2	<b>1.159</b> (SDs, Site Class D)
1.0	<b>0.789</b> (SD1, Site Class D)

$S_{XS} = S_{DS} = 1.159$   
 $S_{X1} = S_{D1} = 0.789$



# **APPENDIX B:**

# **PML EVALUATION RESULTS**

# ATHERTON LIBRARY PML - Seismic Risk Analysis

**Company Name:** Crosby Group  
**Building Name:** Atherton Library  
**Street Address:** 2 Dinkelspiel Station Lane  
Atherton, CA, USA 94027

**Date:** September 15, 2009  
**Job Number:**  
**Engineer:** Dan Petruc-Naum  
**PE Number/State:** C 51766 California

## INFORMATION SOURCES

**Site Visit:** Dan Petruc-Naum  
**Interviewed:**

**Date:** 1-7-2009  
**Docs Reviewed:** 7/15/1981 Addition and  
Alterations to Atherton Branch  
drawings

## BUILDING DESCRIPTION

**Building Classification:** W1 - Wood Light Frame  
**Occupancy:** Office  
**Latitude/Longitude:** 37.4629 -122.1957  
**Region:** USA: California  
**Region Version:** 3.00  
**Evaluation Lifetime (yrs):** 30  
**Uniform Building Code Design Edition:** ? (pre-1973)  
**Year Constructed:** 1929  
**Year Retrofitted:**  
**Building Height (stories):** 2  
**Fundamental Period (s):** 0.590000  
**Area (sf):** 4,700  
**Replacement Cost (\$):**  
**Plan Dimensions:** Approximately 46' x 95'  
**Exterior North-South Walls:** Wood planks  
**Exterior East-West Walls:** Wood planks  
**Roof Deck/Framing:** Planks over wood joists in Original 1929 Buildng, Plywood Diaphragm with wood joists  
in 1981 Addition  
**Intermediate Floors/Framing:** Planks over wood joists  
**Ground Floors:** Planks over wood joists  
**Columns:** HSS tube steel  
**Foundation:** Concrete continuous and spread footings  
**Basement Levels:** n/a  
**Parking Structure:** n/a

## LATERAL FORCE RESISTING SYSTEM

**Floors/Roof:** Wood Plank Sheathing  
**Walls/Braces:** Wood Plank Sheathing

## BUSINESS INTERRUPTION

**Max. Loss With No BI:**  
**Min. Loss At Abandonment:**  
**BI Months At Abandonment:**  
**BI Revenue Loss Rate(\$/Month):**

# ATHERTON LIBRARY PML - Seismic Risk Analysis

---

**Company Name:** Crosby Group  
**Building Name:** Atherton Library  
**Street Address:** 2 Dinkelspiel Station Lane  
Atherton, CA, USA 94027

**Date:** September 15, 2009  
**Job Number:**  
**Engineer:** Dan Petruc-Naum  
**PE Number/State:** C 51766 California

---

## GEOTECHNICAL DESCRIPTION

**Provider:**  
**Date:**  
**UBC Soil Class:** Unknown [Assuming - D]  
**Liquefaction Resilience:** Low  
**Liquefaction Susceptibility:** Moderate  
**Depth to Water Table (ft):** Unknown [Assuming - 20]  
**Landslide Susceptibility:** Very Low

**Topography:**  
**Soil Conditions:**

---

## COMMENTS

**Comments:**

# ATHERTON LIBRARY PML

**Company Name:** Crosby Group  
**Building Name:** Atherton Library  
**Street Address:** 2 Dinkelspiel Station Lane  
 Atherton, CA, USA 94027

**Date:** September 15, 2009  
**Job Number:**  
**Engineer:** Dan Petruc-Naum  
**PE Number/State:** C 51766 California

## MODIFIED FEMA-310 WORKSHEET

### W1 Wood Light Frame

Category	Range	Typical	Modifier
<b>GENERAL BUILDING FEATURES</b>			
Complete load path	T, F	F	<u>F</u>
No vertical discontinuities	T, F	T	<u>T</u>
No overdriven fasteners	N/A, T, F	T	<u>T</u>
Cripple walls braced	N/A, T, F	F	<u>?</u>
Wood sills bolted	N/A, T, F	F	<u>T</u>
<b>LATERAL FORCE RESISTING SYSTEM</b>			
Redundancy	T, F, 0-5	2	<u>T</u>
Shear stress check in shear walls	T, F, 0-10	8	<u>F</u>
No stucco shear walls	T, F, 0-10	5	<u>F</u>
No gypsum wallboard or plaster shear walls	T, F, 0-10	5	<u>T</u>
No narrow wood shear walls	T, F, 0-10	5	<u>T</u>
Walls connected through floors	T, F, 0-5	2	<u>T</u>
Adequate hillside shear wall aspect ratios	N/A, T, F, 0-10	5	<u>N/A</u>
Openings properly detailed	N/A, T, F, 0-5	2	<u>T</u>
Properly constructed hold-downs	N/A, T, F, 0-10	5	<u>N/A</u>
<b>CONNECTIONS</b>			
Adequate wood sill bolt spacing	N/A, T, F, 0-10	0	<u>N/A</u>
Adequate girder to column/wall connection	N/A, T, F, 0-10	0	<u>N/A</u>
Wood posts positively connected to foundation	N/A, T, F, 0-10	0	<u>N/A</u>
<b>FLOOR DIAPHRAGMS</b>			
Reinforcing at re-entrant corner	N/A, T, F, 0-10	0	<u>F</u>
Adequate reinforcing at openings	N/A, T, F, 0-5	0	<u>N/A</u>
Diaphragm continuity	T, F, 0-10	5	<u>T</u>
Adequate straight sheathing aspect ratios	N/A, T, F, 0-5	2	<u>T</u>
Large spans adequately sheathed	N/A, T, F, 0-5	2	<u>T</u>
Unblocked diaphragms meet requirements	T, F, 0-5	2	<u>T</u>
Chord continuity	T, F, 0-10	5	<u>F</u>
Other diaphragms meet requirements	N/A, T, F, 0-5	2	<u>T</u>

# ATHERTON LIBRARY PML

**Company Name:** Crosby Group  
**Building Name:** Atherton Library  
**Street Address:** 2 Dinkelspiel Station Lane  
 Atherton, CA, USA 94027

**Date:** September 15, 2009  
**Job Number:**  
**Engineer:** Dan Petruc-Naum  
**PE Number/State:** C 51766 California

## MODIFIED FEMA-310 WORKSHEET

Category	Range	Typical	Modifier
<b>ROOF DIAPHRAGM</b>			
Reinforcing at re-entrant corner	N/A, T, F, 0-10	0	F
Adequate reinforcing at openings	N/A, T, F, 0-5	0	N/A
Diaphragm continuity	T, F, 0-10	5	T
Adequate straight sheathing aspect ratios	N/A, T, F, 0-5	2	T
Large spans adequately sheathed	N/A, T, F, 0-5	2	T
Unblocked diaphragms meet requirements	T, F, 0-5	2	T
Chord continuity	T, F, 0-10	5	F
Other diaphragms meet requirements	N/A, T, F, 0-5	2	T
<b>UNUSUAL CONDITIONS</b>			
Little deterioration of wood	T, F, 0-5	2	T
Adequate overturning resistance	T, F, 0-5	2	T
Little foundation damage	T, F, 0-5	2	T
Little foundation deterioration	T, F, 0-5	2	T
Ties between foundation elements	N/A, T, F, 0-5	2	N/A
Insignificant sloping at site	N/A, T, F, 0-5	0	T
<b>SITE DEPENDENT HAZARDS - ACTIVE FAULTS</b>			
Surface fault rupture	N/A, 0-50	0	0
<b>NONSTRUCTURAL EXTERIOR 'WALLS'</b>			
Cladding, glazing, veneer	N/A, T, F, 0-10	5	F
Chimneys	N/A, T, F, 0-5	5	N/A
<b>NONSTRUCTURAL INTERIOR 'WALLS'</b>			
Partitions (HC tile)	N/A, T, F, 0-10	0	N/A
Partitions (pre-cast panels..)	N/A, T, F, 0-10	5	N/A
<b>EXTERIOR ORNAMENTATION</b>			
Parapets, cornices, and appendages	N/A, T, F, 0-10	0	F
<b>INTERIOR ORNAMENTATION</b>			
Building contents and furnishings	T, F, 0-10	5	T
Ceiling systems	T, F, 0-5	5	F
Light fixtures	T, F, 0-5	5	T

# ATHERTON LIBRARY PML

**Company Name:** Crosby Group  
**Building Name:** Atherton Library  
**Street Address:** 2 Dinkelspiel Station Lane  
 Atherton, CA, USA 94027

**Date:** September 15, 2009  
**Job Number:**  
**Engineer:** Dan Petruc-Naum  
**PE Number/State:** C 51766 California

## MODIFIED FEMA-310 WORKSHEET

Category	Range	Typical	Modifier
<b>MECHANICAL AND ELECTRICAL SYSTEMS</b>			
Mechanical and electrical equipment	T, F, 0-10	5	<u>T</u>
Piping and sprinklers	T, F, 0-5	2	<u>T</u>
Ducts	T, F, 0-5	2	<u>T</u>
Elevators	N/A, T, F, 0-5	2	<u>N/A</u>
<b>HAZARDOUS EXPOSURES - POUNDING</b>			
No adjacent buildings	N/A, T, F, 0-5	0	<u>F</u>
<b>HAZARDOUS EXPOSURES - MATERIALS</b>			
No hazardous materials	N/A, T, F, 0-10	0	<u>T</u>
<b>OCCUPANCY (TYPE: OFFICE)</b>			
Interior Construction	-5-5	0	<u>?</u>
<b>SITE DEPENDENT CHARACTERISTICS</b>			
UBC Soil Class	A - E	D	<u>Unknown</u>
Liquefaction Resilience	Low - High	Low	<u>Low</u>
Liquefaction Susceptibility	V. Low-V. High	Moderate	<u>Moderate</u>
Depth to Water Table (ft)	0-1000+	20	<u>Unknown</u>
Landslide Susceptibility	V. Low-V. High	Very Low	<u>Very Low</u>

# ATHERTON LIBRARY PML

**Company Name:** Crosby Group  
**Building Name:** Atherton Library  
**Street Address:** 2 Dinkelspiel Station Lane  
 Atherton, CA, USA 94027

**Date:** September 15, 2009  
**Job Number:**  
**Engineer:** Dan Petruc-Naum  
**PE Number/State:** C 51766 California

## VULNERABILITY SUMMARY

### Component Modifier Summary

**Base Class 90% Fractile Loss at MMI=IX (% of Value):** 37

#### Modifiers to Base Class Loss

Item	Group Modifier (% of Loss)	Sigma (% of Loss)
1. Occupancy type:	0	1.7
2. Connections:	0	0.0
3. Walls:		
A. Exterior	10	7.7
B. Interior	0	0.0
4. Diaphragms:		
A. Floor(s)	1	3.1
B. Roof	1	3.1
5. Ornamentation:		
A. Exterior	10	7.7
B. Interior	-3	2.4
6. Mechanical/electrical systems:	-8	2.5
7. Unusual conditions:	-8	3.3
8. Hazardous exposures:		
A. Tank and overhanging walls	0	2.6
B. Pounding and adjacent buildings	5	1.9
9. Site dependent hazards:		
A. Proximity of active fault	0	19.1
<b>Total</b>	<b>8</b>	<b>23.2</b>

**Modified Base Class 90% Fractile Loss at MMI=IX (% of Value):** 40

### Loss vs MMI

MMI	Loss to Facilities (% of Value)	
	90% Frac. Loss	Mean
V	0	0
VI	1	1
VII	14	7
VIII	27	14
IX	40	21
X	47	24
XI	53	27
XII	60	31

# ATHERTON LIBRARY PML

**Company Name:** Crosby Group  
**Building Name:** Atherton Library  
**Street Address:** 2 Dinkelspiel Station Lane  
 Atherton, CA, USA 94027

**Date:** September 15, 2009  
**Job Number:**  
**Engineer:** Dan Petruc-Naum  
**PE Number/State:** C 51766 California

## RISK SUMMARY

### Expected Loss Table

Probability of Exceedence	MMI	Loss to Facilities (% of Value)			BI (months)
		PL	SUL	SEL	
50.0% in 30 years 43 year return period	VI-VII	3	11	6	N/A
10.0% in 30 years 285 year return period	VIII	17	31	16	N/A
2.0% in 30 years 1485 year return period	IX	71	70	70	N/A
10.0% in 50 years 475 year return period	VIII-IX	25	PML 38	19	N/A
2.0% in 50 years 2475 year return period	IX	82	82	82	N/A

### Event and Fault Table

Close and Significant Seismic Sources	Maximum Magnitude	Closest Distance (km)	Max. MMI	Max. SUL *	Max. SEL *	Maximum Business Interruption (months)	Percent Contribution **
California Gridded***	7.0	5.0	VIII-IX	36	18	N/A	6
Monte Vista-Shannon	6.5	5.3	VIII	27	14	N/A	4
N. San Andreas;SAP	7.2	7.7	VIII	30	15	N/A	3
N. San Andreas;SAO+SAN+SAP	8.0	7.7	VIII-IX	35	18	N/A	1
N. San Andreas;SAN+SAP	7.7	7.7	VIII-IX	33	17	N/A	<1
N. San Andreas;SAO+SAN+SAP+SAS	8.1	7.7	VIII-IX	36	18	N/A	32
N. San Andreas	8.0	7.7	VIII-IX	35	18	N/A	11
N. San Andreas;SAN+SAP+SAS	7.9	7.7	VIII-IX	34	18	N/A	<1
N. San Andreas;SAP+SAS	7.5	7.7	VIII-IX	32	16	N/A	26
Hayward-Rodgers Creek	7.3	22.9	VII-VIII	20	10	N/A	<1
Hayward-Rodgers Creek;RC+HN+HS	7.3	22.9	VII-VIII	21	11	N/A	<1
Hayward-Rodgers Creek;HS	6.8	23.0	VII	14	7	N/A	2
Hayward-Rodgers Creek;HN+HS	7.0	23.0	VII	17	9	N/A	2
San Gregorio Connected	7.5	23.0	VII-VIII	22	11	N/A	6
Extensional Gridded	7.0	25.8	VII	16	8	N/A	<1
Calaveras;CN	6.9	31.6	VII	12	6	N/A	<1

\* Losses to individual events are from shaking only.

\*\* Percent contributions are for the probabilistic 475 year return period risk.

\*\*\* Event causing highest loss (from shaking only)

**Average Annual Loss (% of Repl. Cost): 0.328854**  
**Return Period of Major Liquefaction/Landslide: 887 Years**

**Business Interruption Average Annual Loss (\$): 0**

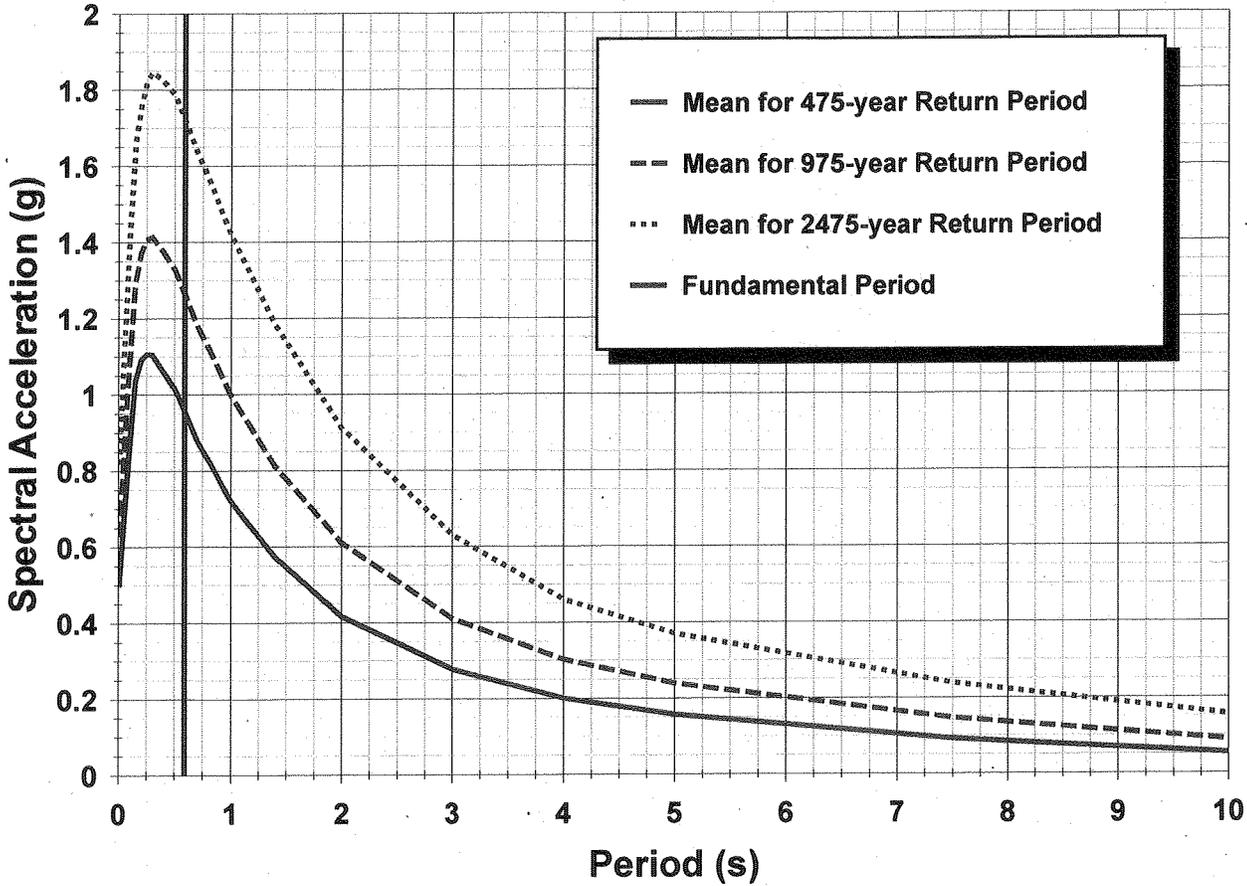
# ATHERTON LIBRARY PML

**Company Name:** Crosby Group  
**Building Name:** Atherton Library  
**Street Address:** 2 Dinkelspiel Station Lane  
 Atherton, CA, USA 94027

**Date:** September 15, 2009  
**Job Number:**  
**Engineer:** Dan Petruc-Naum  
**PE Number/State:** C 51766 California

## SPECTRAL RESPONSE SUMMARY

### Uniform Hazard Spectra



**Spectral Response Values**

Period (s)	10% in 50 yrs (g)	5% in 50 yrs (g)	2% in 50 yrs (g)
(0.59)	0.95	1.26	1.71
PGA	0.50	0.63	0.82
0.1	0.86	1.08	1.41
0.15	1.04	1.29	1.66
0.2	1.09	1.37	1.76
0.25	1.11	1.41	1.82
0.3	1.10	1.41	1.85
0.4	1.06	1.37	1.82
0.5	1.02	1.33	1.79
0.7	0.88	1.18	1.64
1.	0.72	1.00	1.42
1.4	0.57	0.81	1.18
2.	0.42	0.61	0.91
3.	0.28	0.41	0.63
4.	Report generated by ST-RISK Version 4.41		0.46
5.	0.16	0.24	0.37
7.5	0.09	0.15	0.24

## ATHERTON LIBRARY PML

---

**Company Name:** Crosby Group  
**Building Name:** Atherton Library  
**Street Address:** 2 Dinkelspiel Station Lane  
Atherton, CA, USA 94027

**Date:** September 15, 2009  
**Job Number:**  
**Engineer:** Dan Petruc-Naum  
**PE Number/State:** C 51766 California

---

### DISCLAIMERS and OTHER INFORMATION

#### RESULTS DISCLAIMER

This report, and the analyses, estimates and conclusions are based on scientific data, mathematical and empirical models, and experience of engineers, geologist and geotechnical specialist, using the input specified by the software licensee. Actual losses experienced during any earthquake may differ substantially from these estimates. Neither Risk Engineering, Inc., Degenkolb Engineers, nor any third party supplier of information to this software can be held liable for any inaccuracies in the results obtained by ST-RISK.

#### SPRINKLER DAMAGE

Substantial building facilities loss has occurred in recent large earthquakes due to fire sprinkler damage. The figures presented herein may not adequately account for these potential losses. If the modifier for sprinklers in the Mechanical and Electrical Systems section of the Modified FEMA-310 Worksheet was 3 or higher, or '?', a more detailed evaluation of potential sprinkler damage should be made and additional loss anticipated.

#### THIRD PARTY DATA

Much of the data in this report is derived from data provided by the California Geological Survey (CGS), the US Geological Survey (USGS), the Geological Survey of Canada (GSC), as well as other parties. Most of the original data received was modified to make compatible with ST-RISK. None of these parties can be held liable for any inaccuracies inherent in the data or inherent in the modifications.

# ATHERTON LIBRARY PML

**Company Name:** Crosby Group  
**Building Name:** Atherton Library  
**Street Address:** 2 Dinkelspiel Station Lane  
Atherton, CA, USA 94027

**Date:** September 15, 2009  
**Job Number:**  
**Engineer:** Dan Petruc-Naum  
**PE Number/State:** C 51766 California

## GLOSSARY

<b>MMI</b>	Modified Mercalli Intensity - A measure of ground motion intensity based on human perception of motion and observed structural damage.
<b>PML</b>	Probable Maximum Loss - The percentage monetary loss (damage/replacement cost x 100) that has a 10 percent chance of being exceeded for a 475-year ground motion.
<b>PL</b>	Probable Loss - For a given time interval, or return period, this is the amount of loss that a property is expected to meet or exceed on an average basis. This combines the probability distribution of hazard with the full damage distribution, representing the best overall assessment of risk.
<b>SUL</b>	Scenario Upper Loss - The percentage monetary loss (damage/replacement cost x 100) that has a 10 percent chance of being exceeded given any defined ground shaking intensity. Equal to PML for 475-year ground shaking.
<b>SEL</b>	Scenario Expected Loss - The expected, or mean, percentage monetary loss (damage/replacement cost x 100) that is predicted given any defined ground shaking intensity.
<b>Mean Loss</b>	The expected, or average, percentage monetary loss (damage/replacement cost x 100) that is predicted for a given ground shaking level.
<b>Sigma</b>	The range of building assessment variation covered by one standard deviation. This represents the uncertainty of characterizing the building properly. This does not include uncertainty in the expected ground motion intensities nor range of expected damage. It is implied that the distribution of uncertainty is truncated at 100% and 0% of building value.
<b>BI</b>	Business Interruption / Loss-of-Use - The number of months that the facility is out of operation.
<b>Base Class Loss</b>	The percentage monetary loss for 90% fractile (damage/replacement cost x 100) assigned to a building class that accounts for type of construction and important construction deficiencies.
<b>Modified Base Class Loss</b>	The percentage monetary loss for 90% fractile assigned to a building class that accounts for the Base Class Loss and location and minor construction deficiencies.
<b>Probability of Exceedence</b>	The probability that the ground shaking level or damage level will be exceeded.
<b>Event Causing Highest Loss</b>	The highest level of intensity due only to shaking that is experienced when considering all earthquakes given a median predicted shaking level.
<b>Maximum Considered Earthquake (MCE)</b>	Loss associated with a 2% in 50 year probability of exceedence.
<b>Uniform Building Code (UBC)</b>	Loss associated with a 10% in 50 year probability of exceedence as defined by new building design provisions found in the Uniform Building Code.
<b>% Contribution</b>	Percent contribution of fault or fault segment to the 475-year return period risk.