Hazus: Earthquake Global Risk Report

Region Name: CalaverasCCCSCE

Earthquake Scenario: calaverascccsceshaw0_m7p26_se

Print Date: November 08, 2024

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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General Description of the Region

Hazus-MH is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 34 county(ies) from the following state(s):

California

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 60,182.10 square miles and contains 3,779 census tracts. There are over 5,658 thousand households in the region which has a total population of 16,410,567 peopleF. The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 5,044 thousand buildings in the region with a total building replacement value (excluding contents) of (millions of dollars). Approximately 90.00 % of the buildings (and % of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 257,906 and 199,969 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 5,044 thousand buildings in the region which have an aggregate total replacement value of (millions of dollars) . Appendix B provides a general distribution of the building value by Total Region and County.

In terms of building construction types found in the region, wood frame construction makes up 87% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 273 hospitals in the region with a total bed capacity of 42,831 beds. There are 5,998 schools, 1,522 fire stations, 534 police stations and 92 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes no hazardous material sites, no military installations and no nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 457,875.00 (millions of dollars). This inventory includes over 11,702.28 miles of highways, 12,148 bridges, 260,324.00 miles of pipes.

Table 1: Transportation System Lifeline Inventory

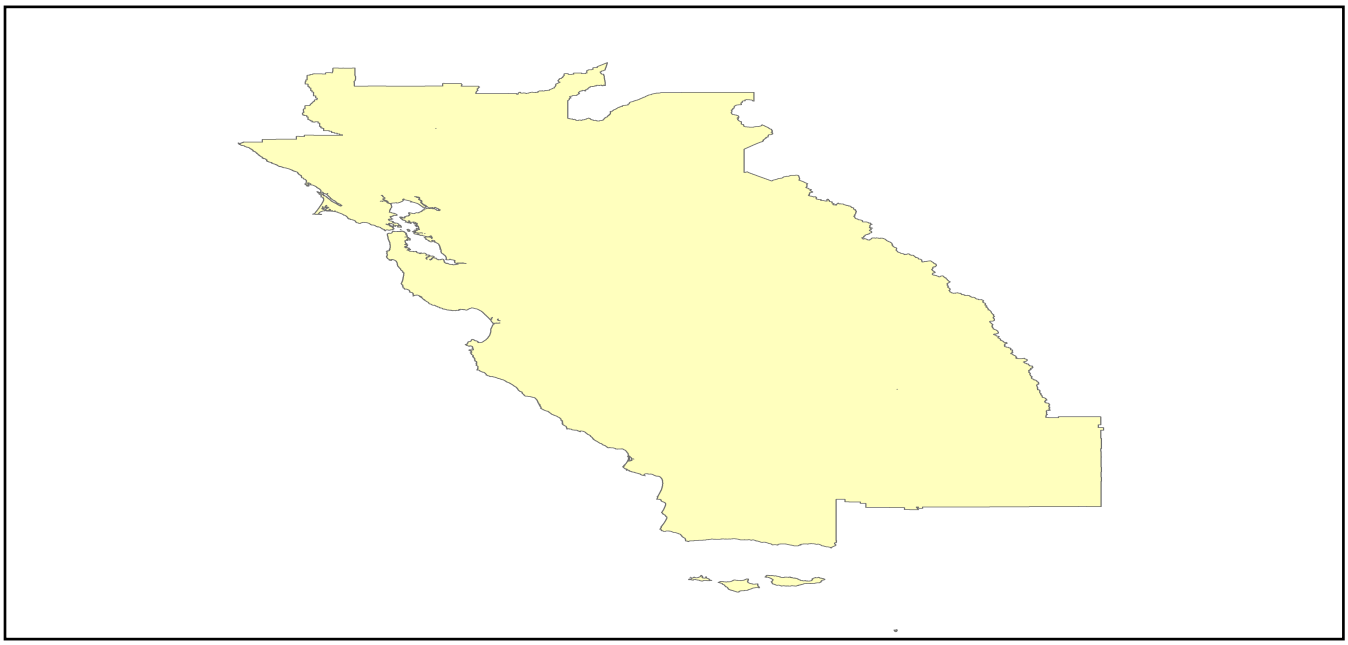
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	12,148	60018.2545
	Segments	7,786	102106.8742
	Tunnels	50	1006.9400
		Subtotal	**163132.0687**
Railways	Bridges	1,808	10287.5200
	Facilities	99	263.6370
	Segments	3,407	68256.7882
	Tunnels	3	1.8495
		Subtotal	**78809.7947**
Light Rail	Bridges	112	15.3529
	Facilities	255	4154.0000
	Segments	15	5403.2756
	Tunnels	0	0.0000
		Subtotal	**9572.6285**
Bus	Facilities	58	129.9869
		Subtotal	**129.9869**
Ferry	Facilities	28	37.2680
		Subtotal	**37.2680**
Port	Facilities	368	1402.7588
		Subtotal	**1402.7588**
Airport	Facilities	126	3001.0193
	Runways	181	1821.4019
		Subtotal	**4822.4212**
		Total	**257,906.90**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	5171.5167
	Facilities	27	1060.9380
	Pipelines	0	0.0000
		Subtotal	**6232.4547**
Waste Water	Distribution Lines	NA	3102.9100
	Facilities	185	31811.0830
	Pipelines	0	0.0000
		Subtotal	**34913.9930**
Natural Gas	Distribution Lines	NA	2068.6067
	Facilities	19	746.9647
	Pipelines	986	18422.3605
		Subtotal	**21237.9319**
Oil Systems	Facilities	34	4.0120
	Pipelines	0	0.0000
		Subtotal	**4.0120**
Electrical Power	Facilities	539	137517.1974
		Subtotal	**137517.1974**
Communication	Facilities	545	64.3100
		Subtotal	**64.3100**
		Total	**199,969.90**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.



Scenario Name	calaverascccsceshaw0_m7p26_se
Type of Earthquake	User-defined
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	7.26
Depth (km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Direct Earthquake Damage

Building Damage

Hazus estimates that about 45,553 buildings will be at least moderately damaged. This is over 1.00 % of the buildings in the region. There are an estimated 708 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage Categories by General Occupancy Type

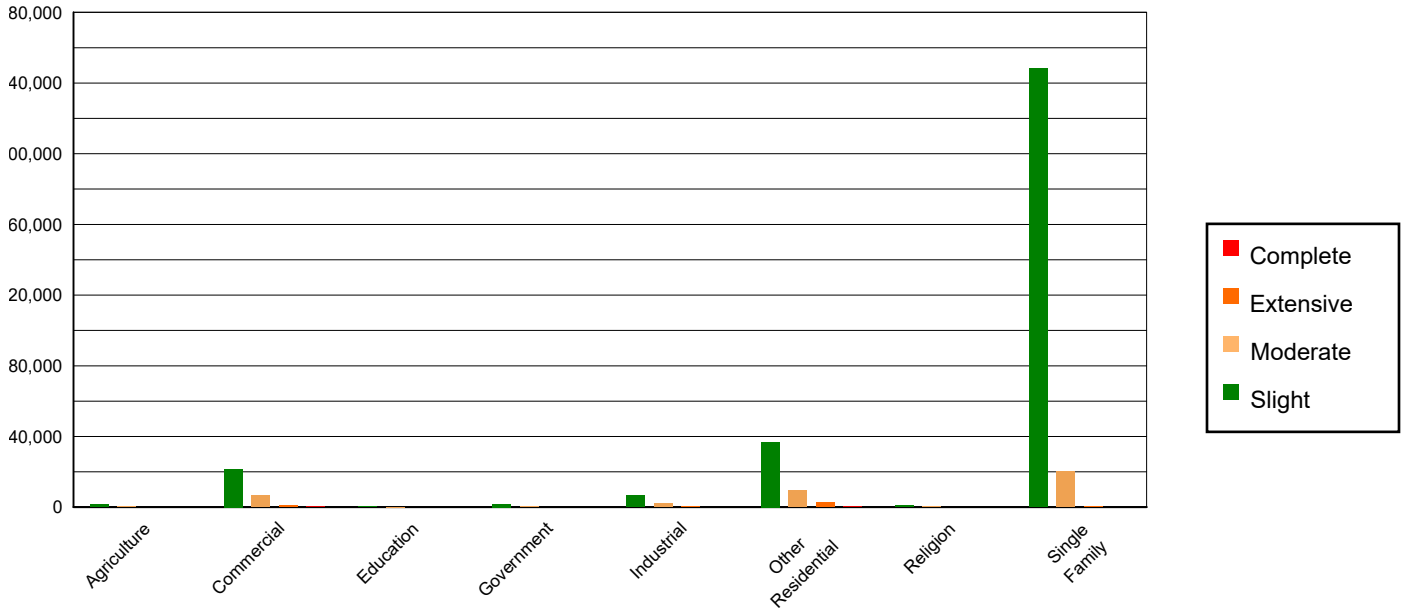


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	34179.18	0.73	1324.17	0.42	465.35	1.16	75.82	1.66	12.48	1.76
Commercial	293042.43	6.26	21643.49	6.81	6762.64	16.79	1062.19	23.31	273.24	38.55
Education	9596.07	0.21	389.38	0.12	83.25	0.21	10.54	0.23	3.76	0.53
Government	20736.08	0.44	1765.14	0.56	396.24	0.98	41.09	0.90	11.46	1.62
Industrial	80372.04	1.72	6682.96	2.10	2335.68	5.80	360.22	7.90	73.09	10.31
Other Residential	604464.62	12.91	36837.55	11.58	9654.67	23.96	2769.66	60.77	300.49	42.39
Religion	18016.69	0.38	1031.56	0.32	346.76	0.86	55.23	1.21	16.77	2.37
Single Family	3620109.95	77.34	248358.26	78.09	20242.26	50.25	182.94	4.01	17.59	2.48
Total	**4,680,517**		**318,033**		**40,287**		**4,558**		**709**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	4076147.91	87.09	274369.29	86.27	21365.94	53.03	148.61	3.26	6.84	0.97
Steel	102641.16	2.19	8630.91	2.71	4253.51	10.56	798.79	17.53	170.82	24.10
Concrete	116064.61	2.48	9188.96	2.89	2766.36	6.87	626.52	13.75	164.40	23.19
Precast	61221.82	1.31	5481.39	1.72	2184.07	5.42	134.62	2.95	8.76	1.24
RM	178372.90	3.81	8350.00	2.63	2656.18	6.59	141.54	3.11	1.71	0.24
URM	37702.94	0.81	6450.48	2.03	1708.77	4.24	387.27	8.50	152.72	21.54
MH	108365.72	2.32	5561.48	1.75	5352.02	13.28	2320.34	50.91	203.65	28.73
Total	**4,680,517**		**318,033**		**40,287**		**4,558**		**709**	

*Note:
RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 42,831 hospital beds available for use. On the day of the earthquake, the model estimates that only 40,330 hospital beds (94.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 98.00% of the beds will be back in service. By 30 days, 100.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	273	2	0	267
Schools	5,998	89	0	5,748
EOCs	92	1	0	89
PoliceStations	534	5	0	517
FireStations	1,522	9	0	1,488

Transportation Lifeline Damage

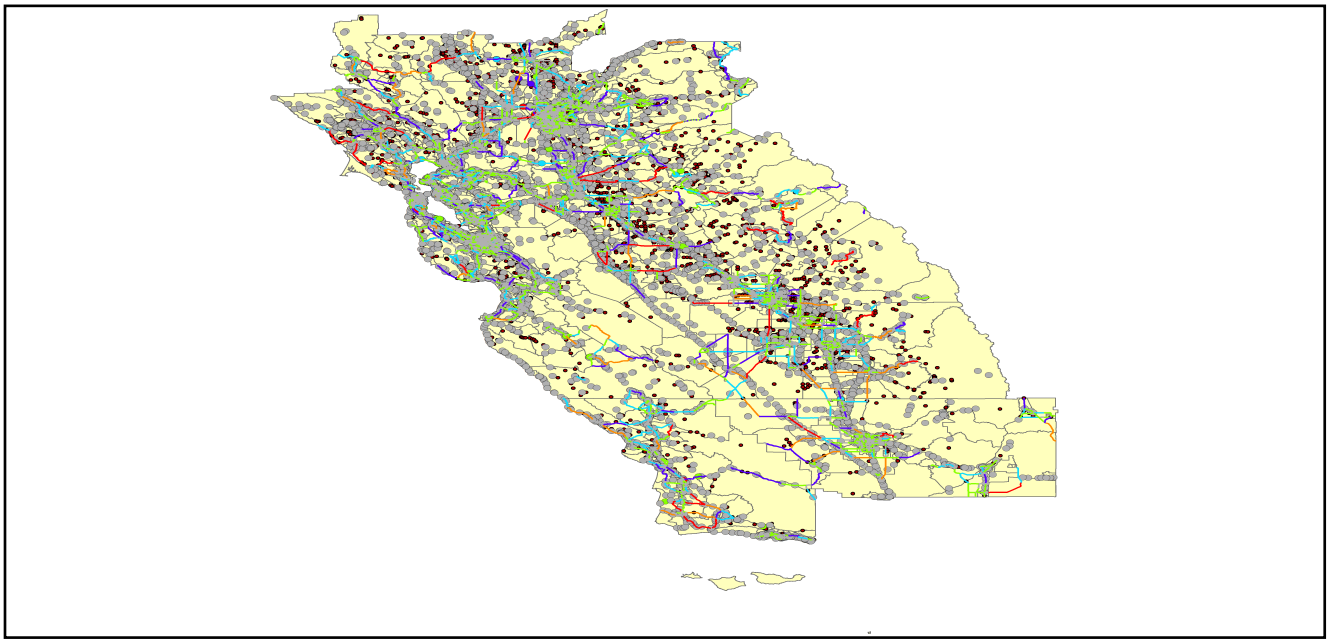


Table 6: Expected Damage to the Transportation Systems

System	Component		Number of Locations			
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	7,786	0	0	7,786	7,786
	Bridges	12,148	5	0	12,144	12,146
	Tunnels	50	0	0	50	50
Railways	Segments	3,407	0	0	3,407	3,407
	Bridges	1,808	0	0	1,808	1,808
	Tunnels	3	0	0	3	3
	Facilities	99	0	0	99	99
Light Rail	Segments	15	0	0	15	15
	Bridges	112	0	0	112	112
	Tunnels	0	0	0	0	0
	Facilities	255	0	0	255	255
Bus	Facilities	58	0	0	58	58
Ferry	Facilities	28	0	0	28	28
Port	Facilities	368	0	0	368	368
Airport	Facilities	126	2	0	126	126
	Runways	181	0	0	181	181

Table 6 provides damage estimates for the transportation system.

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	27	0	0	25	27
Waste Water	185	1	0	178	185
Natural Gas	19	0	0	19	19
Oil Systems	34	0	0	34	34
Electrical Power	539	23	0	520	538
Communication	545	17	0	536	545

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	160,672	5573	1393
Waste Water	96,403	2800	700
Natural Gas	3,250	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	5,658,917	161,579	135,654	93,104	0	0
Electric Power		177,775	109,176	42,195	3,355	244

Induced Earthquake Damage

Fire Following Earthquake

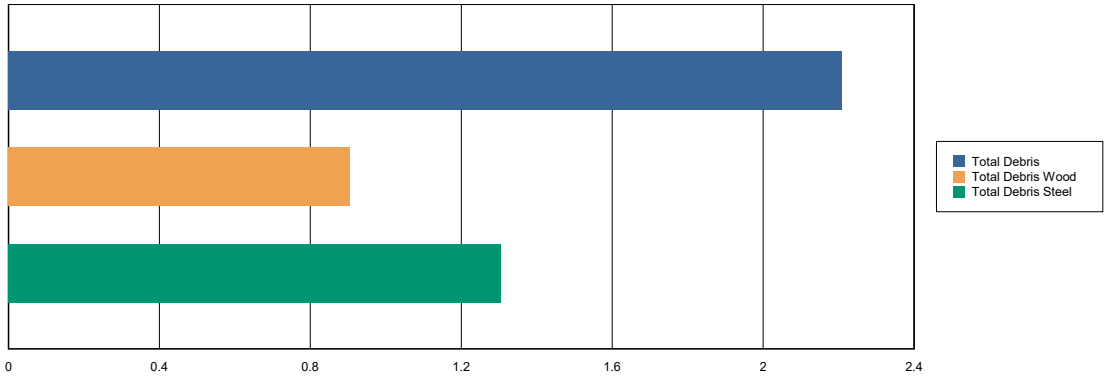
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 66 ignitions that will burn about 2.11 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 20,011 people and burn about 2,896 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 2,210,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 41.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 88,400 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



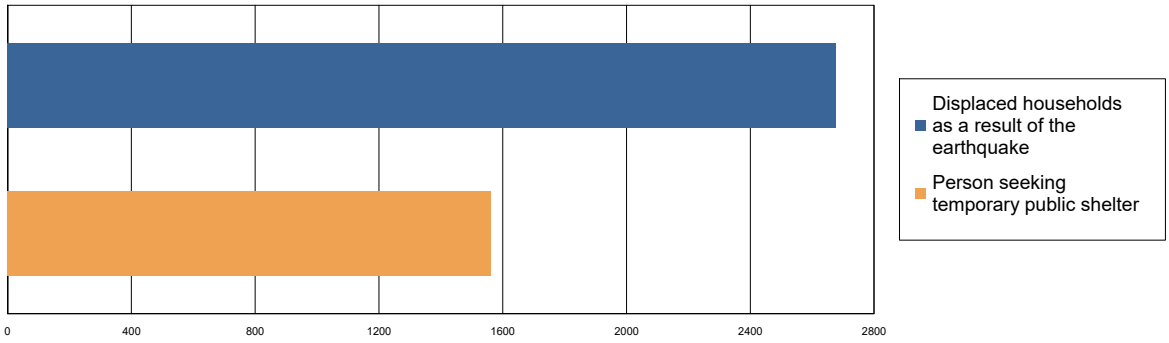
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.91	1.30	2.21	88,400 (@25 tons/truck)

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 2,678 households to be displaced due to the earthquake. Of these, 1,562 people (out of a total population of 16,410,567) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter



Displaced households as a result of the earthquake	Persons seeking temporary public shelter
2,678	1,562

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	17.52	2.87	0.33	0.65
	Commuting	0.22	0.29	0.49	0.10
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.78	0.08	0.00	0.01
	Industrial	25.89	3.80	0.38	0.75
	Other-Residential	615.42	90.04	9.44	18.32
	Single Family	579.95	23.90	0.45	0.87
	Total	**1,240**	**121**	**11**	**21**
2 PM	Commercial	1191.39	198.03	23.17	45.02
	Commuting	1.99	2.59	4.45	0.86
	Educational	320.14	55.20	7.04	13.76
	Hotels	0.15	0.01	0.00	0.00
	Industrial	189.53	27.97	2.85	5.51
	Other-Residential	189.71	29.53	3.36	6.28
	Single Family	155.41	6.80	0.17	0.30
	Total	**2,048**	**320**	**41**	**72**
5 PM	Commercial	853.69	143.37	16.95	32.39
	Commuting	40.33	52.28	90.07	17.35
	Educational	42.37	6.54	0.79	1.53
	Hotels	0.23	0.02	0.00	0.00
	Industrial	118.46	17.48	1.78	3.44
	Other-Residential	231.31	34.96	3.84	7.17
	Single Family	211.43	9.20	0.21	0.37
	Total	**1,498**	**264**	**114**	**62**

Economic Loss

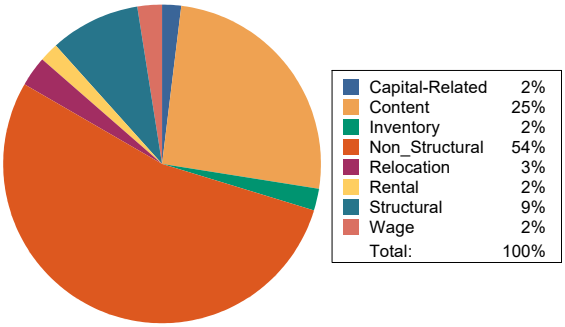
The total economic loss estimated for the earthquake is 28,323.48 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 23,876.18 (millions of dollars); 9 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 48 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

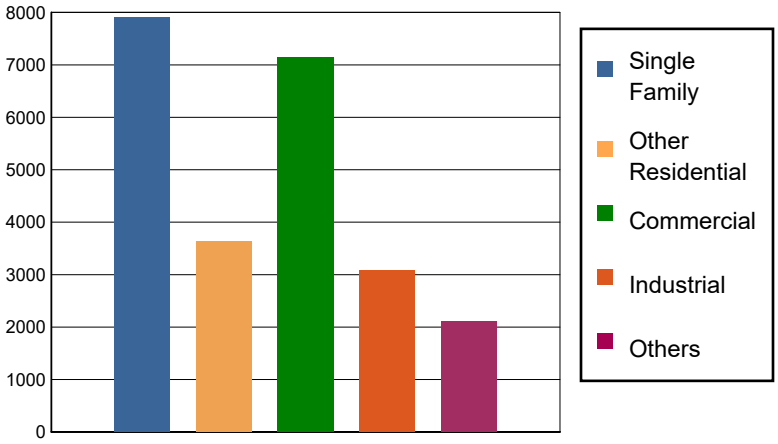


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	38.7836	456.3699	25.0398	49.4582	569.6515
	Capital-Related	0.0000	16.4898	441.3198	15.2222	9.9249	482.9567
	Rental	50.6906	141.2421	241.9494	15.4241	22.4625	471.7687
	Relocation	141.8428	86.3244	303.3480	66.3619	119.7662	717.6433
	Subtotal	**192.5334**	**282.8399**	**1442.9871**	**122.0480**	**201.6118**	**2242.0202**
Capital Stock Losses							
	Structural	755.1657	351.6636	655.9064	255.0826	219.0642	2,236.8825
	Non_Structural	5012.3606	2332.3910	2947.4229	1481.4904	1023.0750	12,796.7399
	Content	1946.8405	668.0113	1776.1419	1073.8588	602.9950	6,067.8475
	Inventory	0.0000	0.0000	320.0843	153.8973	58.7064	532.6880
	Subtotal	**7714.3668**	**3352.0659**	**5699.5555**	**2964.3291**	**1903.8406**	**21634.1579**
	Total	**7906.90**	**3634.91**	**7142.54**	**3086.38**	**2105.45**	**23876.18**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	102106.8742	0.0000	0.00
	Bridges	60018.2545	235.0112	0.39
	Tunnels	1006.9400	0.2089	0.02
	Subtotal	**163132.0687**	**235.2201**	
Railways	Segments	68256.7882	0.0000	0.00
	Bridges	10287.5200	18.0124	0.18
	Tunnels	1.8495	0.0001	0.01
	Facilities	263.6370	10.3435	3.92
	Subtotal	**78809.7947**	**28.3560**	
Light Rail	Segments	5403.2756	0.0000	0.00
	Bridges	15.3529	0.0355	0.23
	Tunnels	0.0000	0.0000	0.00
	Facilities	4154.0000	254.9636	6.14
	Subtotal	**9572.6285**	**254.9991**	
Bus	Facilities	129.9869	4.1651	3.20
	Subtotal	**129.9869**	**4.1651**	
Ferry	Facilities	37.2680	1.1601	3.11
	Subtotal	**37.2680**	**1.1601**	
Port	Facilities	1402.7588	56.9269	4.06
	Subtotal	**1402.7588**	**56.9269**	
Airport	Facilities	3001.0193	209.5945	6.98
	Runways	1821.4019	0.0000	0.00
	Subtotal	**4822.4212**	**209.5945**	
	Total	**257,906.93**	**790.42**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	1060.9380	16.7493	1.58
	Distribution Lines	5171.5167	25.0797	0.48
	Subtotal	**6232.4547**	**41.8290**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	31811.0830	383.0811	1.20
	Distribution Lines	3102.9100	12.5982	0.41
	Subtotal	**34913.9930**	**395.6793**	
Natural Gas	Pipelines	18422.3605	0.0000	0.00
	Facilities	746.9647	0.1909	0.03
	Distribution Lines	2068.6067	4.3160	0.21
	Subtotal	**21237.9319**	**4.5069**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	4.0120	0.0162	0.40
	Subtotal	**4.0120**	**0.0162**	
Electrical Power	Facilities	137517.1974	3212.5241	2.34
	Subtotal	**137517.1974**	**3212.5241**	
Communication	Facilities	64.3100	2.3246	3.61
	Subtotal	**64.3100**	**2.3246**	
	Total	**199,969.90**	**3,656.88**	

Appendix A: County Listing for the Region

Alameda,CA

Amador,CA

Calaveras,CA

Colusa,CA

Contra Costa,CA

El Dorado,CA

Fresno,CA

Kern,CA

Kings,CA

Lake,CA

Madera,CA

Marin,CA

Mariposa,CA

Merced,CA

Monterey,CA

Napa,CA

Placer,CA

Sacramento,CA

San Benito,CA

San Francisco,CA

San Joaquin,CA

San Luis Obispo,CA

San Mateo,CA

Santa Barbara,CA

Santa Clara,CA

Santa Cruz,CA

Solano,CA

Sonoma,CA

Stanislaus,CA

Sutter,CA

Tulare,CA

Tuolumne,CA

Yolo,CA

Yuba,CA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
California					
	Alameda	1,682,353	209,951	122,639	332,590
	Amador	40,474	5,608	2,517	8,125
	Calaveras	45,292	8,305	4,893	13,199
	Colusa	21,839	2,244	2,024	4,268
	Contra Costa	1,165,927	158,118	60,339	218,458
	El Dorado	191,185	34,907	9,704	44,611
	Fresno	1,008,654	98,532	61,772	160,304
	Kern	909,235	87,567	59,168	146,736
	Kings	152,486	13,719	7,861	21,581
	Lake	68,163	9,699	4,530	14,229
	Madera	156,255	18,025	9,641	27,667
	Marin	262,321	47,738	15,030	62,769
	Mariposa	17,131	3,299	1,141	4,441
	Merced	281,202	25,194	26,098	51,292
	Monterey	439,035	47,655	28,750	76,405
	Napa	138,019	20,517	13,045	33,563
	Placer	404,739	69,985	24,193	94,179
	Sacramento	1,585,055	179,811	83,911	263,723
	San Benito	64,209	9,440	3,799	13,239
	San Francisco	873,965	108,848	46,020	154,869
	San Joaquin	779,233	82,706	56,882	139,589
	San Luis Obispo	282,424	41,720	20,896	62,616
	San Mateo	764,442	110,372	44,995	155,368
	Santa Barbara	448,229	49,971	28,481	78,452
	Santa Clara	1,936,259	261,111	120,471	381,582
	Santa Cruz	270,861	36,147	18,805	54,952
	Solano	453,491	55,802	26,393	82,195
	Sonoma	488,863	68,827	35,781	104,609
	Stanislaus	552,878	62,937	37,511	100,449
	Sutter	99,633	10,618	6,448	17,066
	Tulare	473,117	43,262	31,210	74,472
	Tuolumne	55,620	8,964	3,507	12,471
	Yolo	216,403	24,130	18,343	42,473
	Yuba	81,575	8,161	4,677	12,839
Total Region		**16,410,567**	**2,023,890**	**1,041,475**	**3,065,381**